Annexure - II

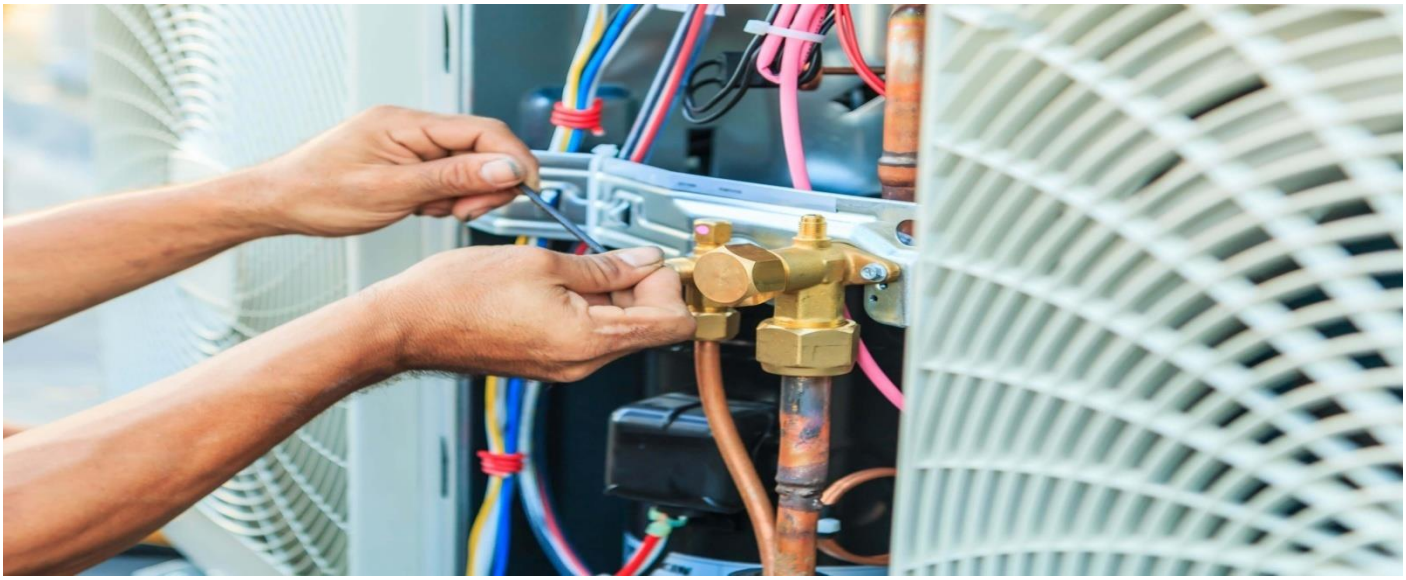
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

REFRIGERATION AND AIR CONDITIONING TECHNICIAN

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)



NSQF LEVEL- 4

SECTOR – CAPITAL GOODS & MANUFACTURING

Directorate General of Training

REFRIGERATION AND AIR CONDITIONING TECHNICIAN

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During two-year duration of "Refrigeration and Air Conditioning Technician" trade a candidate is trained on professional skill, professional knowledge and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work, extracurricular activities and on job training to build up confidence. The broad components under Professional Skill subject are as below: -

FIRST YEAR: The trainee learns about personal safety and machinery safety, manipulating tools, instruments and equipment in refrigeration workshop. The trainee is able to perform fitting and sheet metal works related to repair refrigeration and air conditioning equipment. The trainee is able to work in electrical area to measure current, voltage, resistance and able to connect star and delta connections. The trainee is able to check and rectify the electrical defects in refrigerators. He will be able to identify the electronic components in refrigerator and rectify the defects. The trainee is able to operate gas welding machines for brazing in refrigeration systems. The trainee shall be able to repair, maintenance, Install, servicing, trouble shooting, fault detection, leak testing and gas charging, diagnosis & remedial measures in Refrigerator (Direct cool), Frost free refrigerator and Inverter technology Refrigerator.

The trainee shall be able to identify different compressor, dismantling and assembling compressors. The trainee shall be able to start the motor through DOL, Star Delta starter and changing DOR. The trainee shall be able to service condensers. The trainee shall be able to fix refrigerant controls and service evaporator. The trainee shall be able to Recover and Recharge of Refrigerant used in systems, transfer & handling of gas cylinders. The trainee shall be able to Retrofit CFC/HFC machine with ozone friendly refrigerant. The trainee shall be able to fix thermal insulation. The trainee shall be able to install window AC, test Electrical, electronic components, Fault diagnosis & remedial measures in window A.C. The trainee shall be able to Install, servicing, trouble shooting, fault detection, leak testing and gas charging in Split A.C (wall mounted),Split A.C (floor, ceiling /cassette mounted Split A.C),Split A.C (ducted), multi Split A.C and Inverter Split A.C. The trainee shall be able to Installation, servicing, trouble shooting, fault detection, leak testing and gas charging in Car Air Conditioner.

SECOND YEAR: The trainee learns about different commercial compressor and its dismantling, assembling, fault finding and rectification. They will be able to descaling in water cooled condensers**,** Evaporative condenser and Cooling tower, Selection of Expansion valves and its installations, Service air cooled evaporator and blower. The trainee shall be able to Install, service, maintenance, trouble shooting, fault finding and rectification, leak testing, evacuation and gas charging, electrical circuit repairing in water cooler & water dispenser, visible cooler, bottle cooler, deep freezer / display cabinet, ice cube machine and softy machine. They will be able to Service, operate, test electrical controls, test leak, evacuation and gas charging ,

Periodic maintenance in Ice candy plant, Ice plant, walk in cooler & reach in cabinet and cold storage.

The trainee learns about HVAC (study of psychrometry, blowers& fans, static and velocity pressure measurements). The trainee shall be able to make duct designing, duct making, insulating in ducts. The trainee shall be able to clean and fix air filters. The trainee shall be able to identify various components, Leak testing, evacuation, gas charging, Commissioning and troubleshooting of package A.C with air- and water-cooled condenser, split package. The trainee shall be able to trace electrical circuit, testing components, gas charging, Servicing AHU including fire dampers, Checking airflow, damper, temperature and pressure, operation, De-scaling condenser and cooling tower of central AC plant (Direct and Indirect). The trainee shall be able to Identify VRF / VRV system, Check and service of VRF / VRV system, connect master unit and IDU, identify the location of ODU, identify the size of piping's and laying work, Check control system and identify error code. The trainee shall be able to service and maintain the mobile A.C (bus, train).

The trainee also undergoes project work and Industrial visit/ In plant training at the end of each year which gives them more practical exposure and helps to build up confidence level.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

Refrigeration and Air Conditioning Technician trade under CTS is one of the most popular courses delivered nationwide through a network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill & knowledge and life skills. After passing out of the training programme, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read and interpret technical parameters/ documentation, plan and organize work processes, identify necessary materials and tools.
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations.
- Apply professional knowledge & employability skills while performing the job and modification & maintenance work.
- Check the components as per drawing for functioning, identify and rectify errors in components.
- Document the technical parameter related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship Certificate (NAC).

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two years:

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines.

The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.
Assessment will be evidence based, comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence

(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job.
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Mechanic Refrigeration and Air Conditioner; installs and repairs refrigeration or air conditioning plant by replacing or repairing defective parts, re-seating valves, refitting coils, insulting, requiring electrical connections, soldering etc. Installs at site assembled air conditioning unit and refrigerators giving necessary power connections and making changes to units as necessary to attain desired results. Examines faulty equipment to ascertain nature and location of defects. Dismantles equipment partly or completely according to nature of defects to remove damaged or worn out parts. Replaces or repairs defective parts. Replaces or repairs defective parts to units by re-seating valves, refitting coils, re-insulating system, etc. over hauls units and reassembles them after cleaning components and replacing defective or worn out parts of pumps, compressors, motors, etc., Removes faulty sealed units or sub-units of refrigerators or air conditioning plants and obtains replacements. Conducts vacuum and pressure test of pipe lines and charges system with fresh refrigerant. Sets plant to desired cooling conditions, prevents leakage and ensures attainment and maintenance of required temperature. Gets burnt out motors or generators repaired by Electrician or Electrical Winder and installs repaired ones to plant giving necessary electrical connections. May work in ice factory, cold storage plants, specialized air conditioning units or domestic refrigerators. Repair and service in refrigerator, water cooler, bottle cooler, deep freezer, Visi Cooler, Walk in Cooler, Ice candy plant, Cold storage, Ice plant, Split Air Conditioner, Package Air Conditioner, Central Air Conditioner, mobile Air Conditioner.

Plan and organize assigned work and detect & resolve issues during execution in his own work area within defined limit. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Reference NCO-2015:

i) 7127.0100 - Mechanic Refrigeration and Air Conditioner

Reference NOS: -- ELE/N1002, ELE/N3114, ELE/N3112, ELE/N 3108, CSC/N9413, CSC/N9414, ELE/N3140, ELE/N3141, CSC/N9415, CSC/N9416, CSC/N9417, CSC/N9418, CSC/N9419, CSC/N9420, CSC/N9421, CSC/N9422, CSC/N9423, CSC/N9401, CSC/N9402.

4. GENERAL INFORMATION

Name of the Trade	**REFRIGERATION AND AIR CONDITIONING TECHNICIAN**
Trade Code	DGT/1010
NCO - 2015	7127.0100
NOS Covered	ELE/N 1002, ELE/N3114, ELE/N3112, ELE/N 3108, CSC/N9413, CSC/N9414, ELE/N3140, ELE/N3141, CSC/N9415, CSC/N9416, CSC/N9417, CSC/N9418, CSC/N9419, CSC/N9420, CSC/N9421, CSC/N9422, CSC/N9423, CSC/N9401, CSC/N9402.
NSQF Level	Level-4
Duration of Craftsmen Training (Instructional Hours)	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD,CP,LC,DW,AA,,LV,DEAF,HH
Unit Strength (No. of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	80 Sq. m
Power Norms	6.82 KW
Instructors Qualification for	
(i) Refrigeration and Air Conditioning Technician Trade	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical Engineering from AICTE recognized board of technical education or relevant Advanced Diploma

	(Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the trade of "Mechanic Refrigeration & Air-conditioner" with three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***NOTE: - Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience.

	Essential Qualification: Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
(v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES

FIRSTYEAR

1. Identify trade related hazards and safety procedures following safety precautions. NOS: ELE/N 1002
2. Produce fitting jobs as per drawing (Range of operations: marking, sawing, filing, drilling, reaming, taping and dieing etc.). NOS: ELE/N3114
3. Produce Sheet metal components (range of operation – marking, metal cutting, bending, riveting and soldering etc.). NOS: ELE/N3114
4. Identify electrical safety. Join different wire, measure power, currents, volts and earth resistance etc. Connect single phase, 3 phase motors i.e. star and delta connections.NOS: ELE/N 1002
5. Identify the electronic components and their colour code i.e. transistor, capacitor, diode, amplifier, I.C and able to work soldering. NOS: ELE/N3112
6. Perform gas welding, brazing, soldering observing related safety. NOS: ELE/N3112
7. Identify RAC tools and equipment and recognise different parts of RAC system. Perform copper tube cutting, flaring, swaging, brazing. NOS ELE/N 3108
8. Test mechanical & electrical components. Perform leak test, vacuuming, gas charging, wiring & installation of refrigerator. NOS: ELE/N3112
9. Identify electrical and mechanical components of a refrigerator. NOS: ELE/N3112
10. Test compressor motor terminal, start compressor Direct with relay & without relay, technique of flushing, leak testing, replacing capillary & filter drier, evacuation & gas charging. NOS: ELE/N3112
11. Check components of frost-free refrigerator (electrical / mechanical), wiring of frost-free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging. NOS: ELE/N3112
12. Dismantle, repair and assemble hermetic, fixed and variable speed compressor, and test performance. NOS: ELE/N3112
13. Identify the terminals of sealed compressor and their wiring and measure current, volts, watts and use of DOL starter with different types of motors. NOS: ELE/N3112
14. Perform selection of Hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor. NOS: ELE/N3112
15. Identify the components of control system of Inverter A.C and wiring of control system NOS ELE/N3114

16. Perform servicing & de-scaling of condenser (internals &externals) used in different appliances NOS ELE/N3114
17. Perform fitting & adjustment of drier, filter & refrigerant controls used in different refrigeration system. NOS: CSC/N9413
18. Perform servicing of different evaporator used in different appliances. NOS: CSC/N9414
19. Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handling of gas cylinders. NOS ELE/N3114
20. Retrofit CFC/HFC machine with ozone friendly refrigerant with understanding of the compatibility. NOS ELE/N3114
21. Pack thermal insulation and prevent cooling leakage. NOS ELE/N3114
22. Install window AC, test Electrical & electronics components & Fault diagnosis & remedial measures. NOS ELE/N3114
23. Perform servicing of electrical & electronic control test, installation, wiring, fault finding & remedial measures of different split AC. NOS ELE/N3114
24. Perform servicing of car AC. Fault diagnosis & remedial measures NOS ELE/N3114
25. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401
26. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402

SECOND YEAR

27. Carry out servicing, dismantling, checking different parts of different types of commercial compressor, re-placing worn out parts, Check lubrication system. Assemble & check performance. NOS- ELE/N3140
28. Perform servicing of different types of water-cooled condenser. NOS- ELE/N3140
29. Perform servicing and performance test of Cooling tower NOS- ELE/N3141
30. Conduct Servicing, backwash & re-generate Water treatment plant of circulating water. NOS CSC/N9415
31. Perform Fitting of expansion valve, adjustment of refrigerant flow according to heat load. NOS- ELE/N3140
32. Perform servicing of evaporator & chillers. NOS- ELE/N3140
33. Carry out servicing and retrofit of Water cooler and dispenser. NOS CSC/N9416
34. Service, retrofit of visible cooler and bottle cooler and test performance. NOS CSC/N9417
35. Conduct servicing of deep freezer and test performance. NOS CSC/N9418
36. Install, service, repair, gas charging and testing performance of Ice Cube machine. NOS CSC/N9419
37. Repair, servicing & retrofit of ice candy plant. NOS CSC/N9420

38. Perform servicing of Ice plant and evaporative condenser. NOS CSC/N9421
39. Perform Servicing and preventive maintenance of walk in cooler & cold storage. NOS CSC/N9422
40. Study psychrometric chart and measure psychrometric properties using psychrometric, anemometer i.e. DBT, WBT, RH, air flow etc. NOS- ELE/N3140
41. Perform servicing of motor and blowers used in different air conditioning system. NOS-ELE/N3141
42. Construct, install, pack thermal and acoustic insulation of different air ducts. NOS-ELE/N3141
43. Perform servicing and maintenance of different types of air filters. NOS- ELE/N3141
44. Perform servicing, installation, fault diagnosis and remedial measures on Package AC with Air cooled condenser. NOS CSC/N9423
45. Carry out Servicing, installation, fault diagnosis and remedial measures in Package A.C. with water cooled condenser. NOS- ELE/N3140
46. Identify the various components of central AC test electrical components and make wiring. Servicing of A.H.U, damper, check air flow, De-scaling of condenser and CT servicing. NOS- ELE/N3141
47. Pump down the system, top up oil and gas and check temperature and pressure. NOS-ELE/N3140
48. Identify components of DX system. Test components, make wiring of DX system. Test leak and evacuate, gas charge the system and check the performance. Maintenance, trouble shoot and operate the plant. NOS- ELE/N3140
49. Identify the different parts of VRF/VRV system, check and service VRF/VRV system. NOS-ELE/N3141
50. Identify different parts of indirect or chillers system. Check components and make wiring, leak test, evacuate and gas charge/ top up. Servicing the plant and trouble shoot. NOS- ELE/N3141
51. Identify chilled water pipe line. Servicing of dampers, FCU and water control valves. NOS- ELE/N3141
52. Troubles shoot both Central A.C. plant DX and indirect system. Check different control system, installation of other major components, servicing of all parts including cooling tower and water treatment plant. NOS- ELE/N3141
53. Perform Servicing, fault diagnosis, repair and maintenance of mobile A.C. leak test, evacuation, gas charging, check magnetic clutch and make wiring. Test performance after start. NOS- ELE/N3141
54. Perform preventive maintenance of different plants. Maintain log book based on daily operation. NOS- ELE/N3141

55. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401
56. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
FIRST YEAR	
1. Identify trade related hazards and safety procedures following safety precautions. NOS ELE/N 1002	Demonstrate Safety precautions.
	Demonstrate First aid.
	Demonstrate firefighting.
	Demonstrate working at height using PPE's.
2. Produce fitting jobs as per drawing (Range of operations: marking, sawing, filing, drilling, reaming, taping and dieing etc.) . NOS ELE/N3114	Fix saw blade and cut materials as per requirements.
	Filing flat surface on M.S. plates.
	Marking as per drawing.
	Make the job as per drawing by filing, drilling, taping, etc.
	Make external thread by die.
	Check the job for its dimensional accuracy.
3. Produce Sheet metal components (range of operation – marking, metal cutting, bending, riveting and soldering etc.) NOS ELE/N3114	Mark sheet as per drawing
	Cut G.I. sheet as per drawing.
	Bend the sheet, fold, rivet and / or solder to join the sheet as per drawing.
	Check the job for its dimensional accuracy.
4. Identify electrical safety. Join different wire, measure power, currents, volts and earth resistance etc. Connect single phase, 3 phase motors i.e. star and delta connections. NOS ELE/N 1002	Cut wire and prepare different types of joints.
	Measure current, voltage, resistance, power, frequency, energy using analog and digital meter and identify the terminals of motor.
	Test continuity, insulation and earthing using megger.
	Make star and delta connection and show line voltage, line current, phase voltage and phase current.
	Measure power and power factor.
5. Identify the electronic components and their colour code i.e. transistor, capacitor, diode, amplifier, I.C and able to work soldering. NOS ELE/N3112	Identify the electronic components and their colour code.
	Verify Ohm's Law
	Construct and test full wave rectifier, bridge rectifier, series voltage regulator circuit, power supply, electronic timer
6. Perform gas welding, brazing, soldering observing	Setting of Oxy-acetylene cylinders, regulators etc and gas flame with proper pressure.

related safety. NOS ELE/N3112	Perform brazing between Cu to Cu and Cu to MS, Cu to aluminum pipe.
	Join metal plates by using gas welding (lap joint, butt joint, etc)
	Check the welded component and its measurements.
7. Identify RAC tools and equipment and recognise different parts of RAC system. Perform copper tube cutting, flaring, swaging, brazing. NOS ELE/N 3108	Identify the RAC tools and equipment.
	Identify the condensing and cooling unit.
	Copper pipe cutting, bending, swaging, flaring and brazing as per requirements and test pressure.
8. Test mechanical & electrical components. Perform leak test, vacuuming, gas charging, wiring & installation of refrigerator. NOS ELE/N3112	Leak testing of RAC unit use dry nitrogen.
	Evacuation the unit and test vacuum level.
	Gas charging unit.
	Make wiring of refrigerator.
	Install, run and check the performance.
9. Identify electrical and mechanical components of a refrigerator. NOS ELE/N3112	Install different types of electrical component of Refrigerator.
	Check and test different fault of electrical and other system of refrigerator
10. Test compressor motor terminal, start compressor Direct with relay & without relay, technique of flushing, leak testing, replacing capillary & filter drier, evacuation & gas charging. NOS ELE/N3112	Trace and test compressor / motor terminals.
	Start the compressor Direct / without relay.
	Start the compressor with relay.
	Flushing, cleaning of condenser, Evaporator coils.
	Joining of condensers, Evaporator capillary fitter drier by brazing.
	Test leakage, Evacuation and charge gas
	Test performance.
11. Check components of frost-free refrigerator (electrical / mechanical), wiring of frost-free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging. NOS ELE/N3112	Identification of frost-free refrigerator parts.
	Check electrical components and make wiring.
	Check air distribution duct and door cooling system.
	Leak test, evacuation, gas charging and test performance
12. Dismantle, repair and	Remove oil and cut the compressor dome.

assemble hermetic, fixed and variable speed compressor, and test performance. NOS ELE/N3112	Separate the compressor assembly from dome.
	Dismantle and check worn out parts.
	Clean the parts and assemble.
	Welds the dome and pressure check test the welded joints.
13. Identify the terminals of sealed compressor and their wiring and measure current, volts, watts and use of DOL starter with different types of motors. NOS ELE/N3112	Measure starting current and running current of hermetic compressor motor.
	Measure starting current and running current and changing of DOR of CSIR motor.
	Measure starting current and running current and changing of DOR of shaded pole motor.
14. Perform selection of Hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor. NOS ELE/N3112	Select and Install hermetic compressor in the system.
	Braze the major mechanical components.
	Test Pressure.
	Test electrical components and safety cut outs.
	Make wiring, run the machine and check performance.
15. Identify the components of control system of Inverter A.C and wiring of control system. NOS ELE/N3114	Identify components of control system of Inverter ACs.
	Make wiring of the control system.
16. Perform servicing & de-scaling of condenser (internals &externals) used in different appliances. NOS ELE/N3114	Perform servicing of Air-cooled condenser (external and internal bycleaning, flushing and leak test)
	Remove Water cooled condenser head.
	De- scaling by brush and chemical cleaning.
	Re assembles and test performance.
17. Perform Fitting & adjustment of drier, filter & refrigerant controls used in different refrigeration system. NOS CSC/N9413	Clean filter/strainer and refill desiccates in drier.
	Install different diameter capillary tube used in different type of cooling machines.
	Install with different types of expansion valves.
	Make adjustment of refrigerant feeding as per the heat load. Use A.E.V./T.E.V in RAC unit.
	Test and adjust the expansion valves fitted with machines.

18. Perform servicing of different evaporator used in different appliances. NOS CSC/N9414	Service evaporator coil: Strip out the evaporator coil from the system.
	Perform leak test, Flush and clean by dry Nitrogen.
	Re-Join the coil after removing oil and debris and test performance.
19. Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handling of gas cylinders. NOS ELE/N3114	Recover refrigerant (CFC/HFC).
	Transfer of refrigerant from cylinders to cylinders.
	Measure pressure-temperature of refrigerants and Identify flammability and toxicity of A3 and A2L of refrigerants.
	Demonstrate Good servicing practices onTest leak, evacuation and charge refrigerant in refrigerator by weight in capillary system.
20. Retrofit CFC/HFC machine with ozone friendly refrigerant with understanding of the compatibility. NOS ELE/N3114	Retrofit CFC/HFC unit by ozone friendly refrigerants.
	Run the machine and check the cooling performance.
21. Pack thermal insulation, prevent cooling leakage. NOS ELE/N3114	Pack thermal insulation in RAC unit.
	Check heat leakage and sweating problem.
22. Install window AC, test Electrical & electronics components &Fault diagnosis & remedial measures. NOS ELE/N3114	Test Electrical controls of Window AC.
	Test electronic components / PCB.
	Install, make wiring of window A.C and run the machine.
	Diagnosis the faults, remedies and check performance.
23. Perform servicing of electrical & electronic control test, Installation, wiring, fault finding & remedial measures of different split AC. NOS	Test electrical components of split A.C.
	Test electronic components / PCB.
	Install, make wiring and run the machine.
	Diagnosis the faults, remedies and check performance.

ELE/N3114	
24. Perform servicing of car AC. Fault diagnosis & remedial measures. NOS ELE/N3114	Make wiring and install car A.C.
	Servicing of Car A.C and test run.
	Diagnosis Fault, remedial measures and check performance
25. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
26. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
27. Carry out servicing, dismantling, checking different parts of different types of commercial compressor, re-placing worn out parts, Check lubrication system. Assemble & check performance. NOS-ELE/N3140	Identify different parts of commercial compressor
	Dismantling of compressor parts.
	Servicing of different parts and check. (Gasket making, lapping valve parts etc.)
	Replace/ renew the defective parts.
	Check lubrication system/ pump.
	Check / service capacity control system.
	Assemble and check performance.
28. Perform servicing of different types of water-cooled condenser. NOS- ELE/N3140	Service water-cooled condenser.
	Remove head, Pump down gas, cut gasket, test leakage, and De-scale.
	Assemble and check performance.
29. Perform servicingand	Service cooling tower, clean sump, nozzle, screws, pipe line.

performance test of Cooling tower. NOS- ELE/N3141	Check water supply and delivery pipe line.
	Service water pump.
	Assemble and Test performance.
30. Conduct Servicing, backwash & re-generate Water treatment plant of circulating water. NOS CSC/N9415	Dismantle, Servicing of impeller of water treatment plant.
	Repair defective parts of water treatment plant back wash and re-generate.
	Assemble and test performance.
31. PerformFitting of expansion valve, adjustment of refrigerant flow according to heat load. NOS- ELE/N3140	Install refrigerant control device as per head load.
	Adjust refrigerant flow.
	Check cooling performance.
32. Perform servicing of evaporator & chillers. NOS-ELE/N3140	Service coil evaporator.
	Service flooded chiller.
	Identify feeding device used in flooded chiller (Float valve, level master control, EXV etc.)
33. Carry out servicing and retrofit of Water cooler and dispenser. NOS CSC/N9416	Service water cooler (Pressure type/Storage type.)
	Service water cooler (Instant cooling type)
	Make wiring, thermostat setting, fault diagnosis and remedies.
	Retrofit CFC/HFC charged water cooler.
34. Service, retrofit of visible cooler and bottle cooler and test performance. NOS CSC/N9417	Service, Evacuation, flushing and retrofit with refrigerant the visible cooler.
	Service, Evacuation, flushing and retrofit with refrigerant the bottle cooler.
	Check wiring circuit, test components, replace and Test performance of the machine.
35. Conduct servicing of deep freezer and test performance. NOS CSC/N9418	Service and troubleshooting of deep freezer.
	Check wiring circuit, test and replace defective components.
	Retrofit CFC charged deep freezer and test performance.
36. Install, service, repair, gas charging and testing	Service different components of Ice cube machine
	Check Electric circuit, solenoid valve, pressure cut out,

performance of Ice Cube machine. NOS CSC/N9419	thermostat etc. of ice cube machine.
	Check and service flow system of gases, Test leakage, evacuation and charge gasat set pressure.
	Check defrosting system and overall performance
37. Repair, servicing & retrofit of ice candy plant. NOS CSC/N9420	Service, test, trouble shoot, and replace defective components of ice candy plant.
	Check function of agitator.
	Check wiring circuit, Test different electrical and mechanical controls, motor bets.
	Retrofit CFC charged ice candy (R22with R134a) and Test performance.
38. Perform servicing of Ice plant and evaporative condenser. NOS CSC/N9421	Check function of agitator.
	Check motor and wiring circuit, service and trouble shoot, Test components and replace defective parts.
	Service evaporative condenser.
	Service brine tank and descale of chilling pipe line.
	Evacuate and charge gas.
	Run the plant and record different parameters of performance.
39. Perform Servicing and preventive maintenance of walk in cooler & cold storage. NOS CSC/N9422	Service and trouble shoot, check wiring circuit, Test component and replace defective parts of walk in cooler / cold storage.
	Install gauge manifold, leak test, evacuate and charge gas.
	Service, Diagnosis faults and remedial measures.
	Preventive maintenance and record the log sheet
40. Study psychrometric chart and measure psychrometric properties using psychrometric, anemometer i.e. DBT, WBT, RH, air flow etc. NOS- ELE/N3140	Read Psychrometric chart and identify the different properties.
	Use Psychrometric and measure properties of air.
	Measure air velocity by anemometer.
41. Perform servicing of motor and blowers used in different air conditioning system. NOS-	Service blower motor and test performanceon power Input.
	Service blower and fans and check performance.

ELE/N3141	
42. Construct, installation, pack thermal and acoustic insulation of different air ducts. NOS- ELE/N3141	Construct and install duct as per layout drawing.
	Check air flow through Duct.
	Pack / Insulate duct, check for proper insulation and observe the noise.
43. Perform servicing and maintenance of different types of air filters. NOS-ELE/N3141	Disassemble and Service Air filters.
	Check performance and replace Air filter
44. Perform servicing, installation, fault diagnosis and remedial measures on Package AC with Air cooled condenser. NOS CSC/N9423	Service, Leak test, evacuate, charge gas on Package AC with Air cooled condenser.
	Install, run the A.C. and diagnose faults and rectify defects.
45. Carry out servicing, installation, fault diagnosis and remedial measures in Package A.C. with water cooled condenser. NOS-ELE/N3140	Service, descale, Leak test, evacuate, charge gas on Package AC with water cooled condenser.
	Install, run the A.C. and diagnose faults and rectify defects.
46. Identify the various components of central AC test electrical components and make wiring. Servicing of A.H.U, damper, check air flow, De-scaling of condenser and CT servicing. NOS-ELE/N3141	Check electrical accessories and make wiring with the safety cut outs and accessories.
	Service A.H.U., damper and check air circulation.
	De-scaling of condenser and cooling tower.
	Run and check the performance.
47. Pump down the system, top up oil and gas and check temperature and pressure. NOS- ELE/N3140	Pump down gas from central A.C. system.
	Top up oil and gas.
	Run the machine and check pressure and temperature.
48. Identify components of DX	Service DX system.

system. Test components, make wiring of DX system. Test leak and evacuate, gas charge the system and check the performance. Maintenance, trouble shoot and operate the plant. NOS-ELE/N3140	Test controls and re-connect the cut out and controls.
	Run the machine and check operation.
	Pump down the less cooling machine for repair.
	Leak test, evacuate, gas charge and test performance.
49. Identify the different part of VRF/VRV system, check and service VRF/VRV system. NOS- ELE/N3141	Identify the parts of VRF/VRV machine.
	Check and service VRV/VRF machine.
	Identify error code
50. Identify different part of indirect or chillers system. Check components and make wiring, leak test, evacuate and gas charge/ top up. Servicing the plant and trouble shoot. NOS-ELE/N3141	Service indirect (chiller) system.
	Run and check the performance.
	Top up oil/refrigerant.
	Diagnosis faults and rectify.
51. Identify chilled water pipe line. Servicing of dampers, FCU and water control valves. NOS- ELE/N3141	Check chill water line insulation and water flow.
	Service F.C.U. and related controls.
	Run and check performance.
52. Troubles shoot both central A.C. plant DX and indirect system. Check different control system, installation of other major components, servicing of all parts including cooling tower and water treatment plant. NOS-ELE/N3141	Service and Fault diagnosis of central A.C.
	Check machine and electrical controls, cut outs.
	Service cooling tower and pumps.
	Identify the water treatment plant components.
	Service water softening plant, re-generate, back wash and check the performance.
	Run the machine and check the performance.

53. Perform Servicing, fault diagnosis, repair and maintenance of mobile A.C. leak test, evacuation, gas charging, check magnetic clutch and make wiring. Test performance after start. NOS- ELE/N3141	Identify the parts of mobile A.C.
	Run the machine and check the different parameters i.e. pressure, temperature etc.
	Check magnetic clutch and other controls.
	Observe the cooling performance, air velocity inside the compartment.
	Check leakage.
	Evacuate and charge gas.
	Test run and check the cooling performance.
54. Perform Preventive maintenance of different plants. Maintain log book based on daily operation. NOS- ELE/N3141	Preventive maintenance of central A.C. DX system.
	Maintain operation data on log sheet.
	Preventive maintenance of central A.C. indirect system (Chiller system).
	Record chiller water in and out temperature.
	Cooling tower functioning data, i.e. CT range, Approach, condenser in and out water temperature.
	Condense and cooling tower pump maintenance water pressure check.
	A.H.U and Damper functioning servicing air filter and check air velocity etc.
55. Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
56. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR REFRIGERATION & AIR CONDITION TECHNICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs..**	**Professional Knowledge (Trade Theory)**
Professional Skill 25 Hrs.; Professional Knowledge 04 Hrs.	Identify trade related hazards and safety procedures following safety precautions. NOS ELE/N 1002	1. Identify workshop & machineries. (10 hrs.) 2. Demonstrate Safety precautions and First aid. (05 hrs.) 3. Demonstrate firefighting (05 hrs.) 4. Demonstrate working at height using PPE's and identify the hazards and take personal safety precautions. (5 hrs.)	Introduction to trade and related industries. General safety precautions and first aids, firefighting equipment and electrical safety. History of Refrigeration and Air conditioning. Grooming of technicians.(04 hrs..)
Professional Skill 25Hrs.; Professional Knowledge 5 Hrs.	Produce fitting jobs as per drawing (Range of operations, marking, sawing, filing, drilling.) NOS ELE/N3114	5. Identify general tools, instruments & equipment. Care and maintenance of tool, instruments and equipment. (10 hrs.) 6. Perform measuring, marking, punching, hacksawing and flat filing, to make a job as per drawing. (15 hrs.)	**Fitting** Different types of Fitting hand tools,- their use. Function, construction, working and Specification. Machineries and equipment used in fittings like drilling machine and grinding machine. (05 hrs)
Professional Skill 25 Hrs.; Professional Knowledge 04 Hrs.	Produce Sheet metal components (range of operation marking, metal cutting, bending, riveting and soldering etc.) NOS ELE/N3114	7. Perform Sheet Cutting by straight snip as per drawing. (07 hrs.) 8. Perform Sheet Cutting by bent snip as per drawing. (07 hrs.) 9. Bend, fold and join metal sheets in different process. (06 hrs.) 10. Join sheet metal by using rivet set and snap. (05 hrs.)	**Sheet Metal** Function, construction, working, use, and application, specification of Sheet metal tools, instruments and equipment. Care and maintenance of tools. Rivet & riveting- their types and use. (04 hrs..)
Professional	Identify electrical	11. Demonstrate electrical	**Electrical**

Skill 35 Hrs.; Professional Knowledge 06 Hrs.	safety. Join different wire, measure power, currents, volts and earth resistance etc. Connect single phase motors. NOS ELE/N 1002	safety precautions and first aid. (05 hrs.) 12. Identify, use and maintain electrical tools. (05 hrs.) 13. Measure current, voltage, resistance ,power, energy using analog and digital meter through a single phase circuit. (25 hrs.)	Electrical terms such as AC and DC supply, Voltage, Current, Resistance, Power, Energy, Frequency etc. Safety precautions to be observed while working on electricity. Conductors and Insulators, Materials used as conductors. Series and parallel circuit, open circuit, short circuit, etc. Measuring Instruments such as voltmeter, ammeter, ohm meter, watt meter, energy meter and frequency meter. Earthing and its importance. Earth resistance. Insulation and continuity test.(06 hrs..)
Professional Skill 47 Hrs.; Professional Knowledge 10 Hrs.	Identify the electronic components and their colour code i.e. transistor, capacitor, diode, amplifier, I.C and able to work soldering. NOS ELE/N3112	14. Identify basic electronic components, tools & instrument. (08 hrs.) 15. Colour coding of resistors. (05 hrs.) 16. Use voltmeter, ammeter and multimeter. (8 hrs.) 17. Practice soldering & de-soldering. (8 hrs.)	**Electronics** Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes. Solder – its composition and paste. (05 hrs..)
		18. Identify transistors, resistors, capacitors, diodes, S.C.R., U.J.T., amplifier and I.C. (08hrs.) 19. Construct and test full wave rectifier using diodes. (05hrs.) 20. Construct and test a bridge rectifier. (05hrs.)	Rectification, Zener diode as voltage regulator – transistors parameters- diodes, ICs. (05 hrs..)
Professional Skill 39 Hrs.; Professional Knowledge 7 Hrs.	Perform gas welding, brazing, soldering Observing related safety. NOS ELE/N3112	21. Identify gas welding equipment & accessories. (05 hrs.) 22. Demonstrate safety precaution in handling of Oxy-acetylene cylinders, regulators etc. (04 hrs.)	**Welding** Introduction to basic principles of commonly used Welding processes, oxy fuel gas welding / cutting, brazing & soldering, nozzles, base metal and filler metal. Use of flux.

		23. Setting up of AIR-LPG, O2-LPG and O2-C2H2 using can type portable flame set. (04 hrs.) 24. Oxy-acetylene gas welding, brazing and cutting on thin sheet metal. (7 hrs.) 25. Demonstrate Care & Safety of welding tools and equipment. Back fire arrester. (03 hrs.) 26. Set Oxy-acetylene plant, use two stage regulator, adjustment of flame, gas pressure – O2 and DA. (07 hrs.) 27. Perform brazing between Cu to Cu and Cu to MS, Cu to aluminum pipes. (9 hrs.)	Difference between soldering and Brazing in terms of temperatures, filler materials, joint strengths and application. Use of Oxy Acetylene, Oxy LPG, Air LPG and two stage regulators for brazing/soldering. Description of back fire arrester. (7 hrs..)
Professional Skill 100Hrs.; Professional Knowledge 15Hrs.	Identify RAC tools and equipment and recognize different parts of RAC system. Perform copper tube cutting, flaring, swaging, brazing. NOS ELE/N 3108	**Basic Refrigeration** 28. Identify & use of general hand tools, instruments & equipment used in refrigeration work. (12hrs.) 29. Identify & use of special tools, instruments & equipment used in refrigeration work.(13hrs.)	**Basic Refrigeration** Basic principle of refrigeration, working, use, specifications of refrigeration tools, instruments and equipment. Fundamentals Thermodynamics law.(05hrs..)
		30. Identify various refrigeration equipment and components of vapour compression system like compressor, condenser, expansion device 31. Unroll, cut and bend soft copper tubes. (04 hrs.) 32. Swage and make a brazed joint on copper tubing. (10 hrs.) 33. Make flare joints and test	Science related to refrigeration, work, power, energy, force, Heat and Temperature, Different temperature scales, Thermometers, Units of heat, sensible heat, latent heat, super heating and sub-cooling, saturation temperature, pressure, types, units. Types of Refrigeration systems, including vapour absorption refrigeration cycle

		them with flare fittings. (10 hrs.) 34. Pinch off copper tubing. (04 hrs.) 35. Use lock ring tool and various fittings of lock ring for servicing of appliances. (10 hrs.). 36. Brazing of Cu to Cu, Cu to steel, Cu to brass using AIR LPG suitable in RAC machine. (07 hrs.) 37. Brazing of Cu to Cu, Cu to steel, Cu to brass using Oxy- LPG. (07 hrs.) 38. Brazing of Cu to Cu, Cu to steel, Cu to brass using Oxy-Acetylene. (11 hrs.)	(VARC), water – combination. Study the construction and working of vapor compression cycle, low side & high side of vapour compression system. Applications of vapour compression cycle. Coefficient of Performance (COP), Ton of Refrigeration.(7 hrs..) Construction and working of V.C Cycle, fundamental operations, sub cooling and super heating.(03 hrs..)
Professional Skill 49 Hrs.; Professional Knowledge 10 Hrs.	Test mechanical & electrical components. Perform leak test, vacuuming, gas charging, wiring in refrigerator. NOS ELE/N3112	39. Identify electrical and mechanical components of refrigerator direct cool and frost free. (05 hrs.) 40. Check and replace electrical components of refrigerators. (14 hrs.) 41. Leak test, evacuation, gas charging in a refrigerator. (15 hrs.) 42. Wiring circuit of refrigerator. (15 hrs.)	**Refrigerator (Direct cool & Frost free)** Function, construction, working of single door direct cool refrigerator, frost free refrigerator, specifications, trouble shooting. Heat Insulation materials. Care and maintenance of refrigerators. (10 hrs.)
Professional Skill 16Hrs.; Professional Knowledge 03 Hrs.	Identify electrical and mechanical components of a refrigerator. NOS ELE/N3112	43. Installation of refrigerator. (8 hrs.) 44. Check, Find Fault and test the electrical and other system components of refrigerator. (8 hrs.)	**Refrigerator (Direct cool & Frost free)** Study the electrical components of refrigerator.
Professional Skill 30 Hrs.; Professional Knowledge 07 Hrs.	Test compressor motor terminal, start compressor with relay & without relay, technique of flushing, leak testing, replacing	45. Testing of compressor. (05 hrs.) 46. Identification of motor terminals. (05 hrs.) 47. Start the compressor with and without relay. (05 hrs.) 48. Test performance of	Importance of flushing in evaporator and condenser, use of dry nitrogen for flushing, necessity of replacing capillary and drier. Evacuation, leak testing, gas charging method in refrigerator, (07 hrs..)

	capillary & filter drier, evacuation & gas charging. NOS ELE/N3112	direct start refrigerator. (05 hrs.) 49. Cleaning and flushing of evaporator and condenser with dry nitrogen. (05 hrs.) 50. Replacement of capillary tube and drier. (05 hrs.)	
Professional Skill 42 Hrs.; Professional Knowledge 10 Hrs.	Check components of frost-free refrigerator (electrical mechanical), wiring of frost-free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging. NOS ELE/N3112	51. Tracing electrical circuit of Frost-Free refrigerator. (10 hrs.) 52. Checking, fault finding and testing of electrical accessories like thermostat, timer, defrost heaters, bi- metal, air louvers etc. and other system components. (10 hrs.) 53. Checking air distribution system. (03 hrs.) 54. Servicing of refrigerator. (07 hrs.) 55. Testing the performance of refrigerator. (02 hrs.)	**Frost Free Refrigerator** Study the construction and working of Frost Free (2 or 3 door) Refrigerator parts particularly, the forced draft cooling, Air Duct circuit, temperature control in Freezer & cabinet of Refrigerator, air flapper / louver used in refrigerator section, automatic defrost system. Study of Electrical accessories & their functions (Timer, Heater, Bimetal, Relay, OLP, T/S etc.) Refrigerator cabinet volume calculation. 5hrs..)
		56. Identify three and four door no frost refrigerator. (07 hrs.) 57. Testing components of three/four door refrigerator. (03 hrs.)	**Refrigerator (Inverter Technology)** Study the construction and its working of two and three door frost free refrigerator with inverter technology Care and maintenance. (05 hrs..)
Professional Skill 39 Hrs.; Professional Knowledge 10 Hrs.	Dismantle, repair and assemble hermetic, fixed and variable speed compressor, and test performance. NOS ELE/N3112	58. Identify different types of compressor. (09 hrs.)	**Compressor** Function, construction, working, application of hermetic compressor,(Fixed speed and variable speed compressor)like Reciprocating, rotary, scroll and inverter type. 5 Hrs..)
		59. Dismantle /assembling reciprocating/rotary compressor. (15 hrs.) 60. Identify different parts of	Study the construction & working of reciprocating, rotary, scroll, wobble & swash plate compressor. wet compression,

		dismantled compressor. (15 hrs.)	oil, properties, lubrication methods. (05 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 8 Hrs.	Identify the terminals of sealed compressor and their wiring and measure current, volts, watts and use of DOL starter with different types of motors NOS ELE/N3112	61. Identify terminal sequence of hermetic compressor motor by using digital multimeter and measure starting current and running current by using ammeter and AVO meter. (12 hrs.) 62. Identification of terminal sequence of CSIR motor by using digital multimeter and measure starting current and running current by using Ammeter and AVO meter. (13 hrs.)	AC motors and their types. Advantages of AC motor over DC motor. Split phase induction motors, working principle and construction. Starting winding and running winding. Starting current and running current. Study the shaded pole motor, RSIR, CSIR, CSR and PSC motors. 6 Hrs..)
		63. Start CSR motor and measure starting current and running current. (07 hrs.) 64. Start shaded pole motor and measure starting current (18 hrs.)	Centrifugal switch and its function. Common faults, causes and remedies in motors. (02 hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 4 Hrs.	Perform selection of Hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor. NOS ELE/N3112	65. Test open, short, continuity and earth of a hermetic compressor. (04 hrs.) 66. Start the compressor motor by RSIR, CSIR, PSC & CSR method by using different type relay, capacitors, OLP's, etc. (10 hrs.) 67. Check and Test different type relay, Capacitors, OLP's, find out faults and rectification(11 hrs.)	**Motors** Function of Starting relay, Capacitors, OLP's.(04 hrs..)
Professional Skill 16Hrs.; Professional Knowledge 04	Identify the Components of control system of Inverter AC and wiring of control	68. Check control circuit of variable speed air conditioners (Inverter ACs). (08 hrs.) 69. Identify components of	Working principle of inverter technology, advantages of variable speed technology over fixed speed. Working principle of control system for inverter

Hrs.	system. NOS ELE/N3114	control system of Inverter ACs including printed circuit board (PCB) NTC,PTC e.g. Power PCB, Filter PCB, Heat sink reactor. (08 hrs.)	Air Conditioners (ACs). (04 hrs..)
Professional Skill 46 Hrs.; Professional Knowledge 10 Hrs.	Perform servicing & de scaling of condenser (internals &externals) used in different appliances. NOS CSC/N9413 Perform Fitting &adjustment of drier, filter & refrigerant controls used in different refrigeration system. NOS ELE/N3114	70. Familiarize with different types of condensers used in refrigerators, Bottle coolers, visible coolers, deep freezers, Window and Split AC. (10 hrs.) 71. Clean, flush, service and leak test different type of air- cooled condensers, micro channel condensers. Remove dust from fins in air cooled condenser, micro channel condensers. (10 hrs.) 72. Identify different items necessary for de-scaling like diluted Hcl, Pump & motor, hose, etc. (07 hrs.)	**Condenser** Function of condenser, types, Construction of air-cooled condenser. Effect of chocked condenser. Advantages, de scaling of air-cooled condenser, application, and advantages. Liquid receiver, pump down, application, types, function and working. **Drier** Function of drier, types, application and its advantage. Description of desiccants.
		73. Identify drier and capillary tube used in different cooling machines. (09 hrs.) 74. Replace drier and capillary tube at the time of gas charging according to manufacturer's direction. (10 hrs.)	**Expansion Valve** Expansion valve used in domestic refrigeration and air conditioning
Professional Skill 16 Hrs.; Professional Knowledge 05 Hrs.	Perform servicing of different evaporator used in different appliances. NOS CSC/N9414	75. Identify and service different types of evaporators like plate and tube type, Fin and tube type, etc. fitted in refrigerators, Bottle coolers, water cooler, Window and split AC. (08 hrs.) 76. Perform leak test, flush to remove oil by dry nitrogen	**Evaporator** Working principle, Function, types of evaporators used in refrigerator, water coolers, bottle coolers, window and split A.C, Super heating in evaporators, Function of accumulator and types. Methods of defrosting. (05 hrs..)

		in evaporator. (08 hrs.)	
Professional Skill 30 Hrs.; Professional Knowledge 06 Hrs.	Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handing of gas cylinders. NOS ELE/N3114	77. Identify and explain different colour code of different type refrigerant cylinder like HCFCs (HCFC-22, HCFC-123). HFCs (HFC-134a, HFC-32, R- 410A, R-407C and R-404A) and low-Global Warming Potential (GWP) refrigerants like ammonia, R-290, HFC- 32, blends of HFCs (R-410A, R-404A, R-407C etc.) and hydro Fluor olefins (HFOs: HFO-1234yf, HFO-1234ze, HFO-1233zd, HFO-1336mz), blends of HFCs and HFOs. (10 hrs.) 78. Recover refrigerant from a faulty machine. (07 hrs.) 79. Transfer refrigerant from one cylinder to another using ice. (04 hrs.) 80. Measure pressure and temperature of refrigerants including HCFC-22, ammonia, R-290, HFC-32, HFC-134a, R-404A, R-407C and R-410A, HFOs. Identify flammability and toxicity of A3 and A2L of refrigerants. (09 hrs.)	**Refrigerant** Classification of refrigerants, nomenclature of refrigerants including chemical name and formulas, hydrochlorofluorocarbons (HCFCs), hydro fluorocarbons (HFCs) and hydro fluoroolefins (HFOs), blends of HFCs and blends of HFCs/HFOs. Climatic impact of refrigerants: Stratospheric ozone depletion, global warming, mechanism of ozone depletion; the Montreal Protocol phase-out schedule of ozone depleting refrigerants (HCFCs) and high global warming refrigerants (HFCs). Brief introduction of Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its amendments. Introduction of properties of refrigerants; environment related properties: Ozone Depleting Potential (ODP), GWP; ODP and GWP of various refrigerants, thermo chemical properties: flammability and toxicity of refrigerants, lower flammability limit (LFL) and upper flammability limit of A3 and A2L refrigerants. Thermo physical properties: pressure temperature of different refrigerants.(06 hrs..)
Professional Skill 22 Hrs.; Professional Knowledge 07 Hrs.	Retrofit CFC/HFC machine with ozone friendly refrigerant with understanding of	81. Demonstrate safe handling of refrigeration cylinders. (10 hrs.) 82. Recover CFC by recovery pump and cylinder on CFC filled domestic	Safe handling of flammable refrigerants. Refrigerant leak detection methods, evacuation and charging of refrigerant, temperature glides of refrigerant blends, procedure

	the compatibility. NOS ELE/N3114	refrigerator. (12 hrs.)	of charging of refrigerant blends especially the zeotropic blends, hydrocarbon blends, HFC blends (R-404A, R-407C, R-410A) and blends of HFC/HFO. **Retrofitting** Changes of components & practices while retrofitting CFC appliances with HC Refrigerants. Properties of HCs (07 hrs..)
Professional Skill 13 Hrs.; Professional Knowledge 02 Hrs.	Pack thermal insulation and prevent cooling leakage. NOS ELE/N3114	83. Identify different insulating materials.(polyurethane rigid foam and polystyrene). (03 hrs.) 84. Fill with insulation material like PUF and glass wool. (10hrs.)	**Thermal Insulation** Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems. (02 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 7 Hrs.	Install window AC, test Electrical & electronics components & Fault diagnosis & remedial measures. NOS ELE/N3114	85. Acquainting with mechanical and electrical components (electrical components like selector switch, thermostat switch, relay, starting capacitor, running capacitor, overload protector, remote and PCB control, etc.) used in window air-conditioner. (15 hrs.) 86. Troubleshooting, installation, tracing wiring circuit. (5 hrs..) 87. Leak testing, evacuation and gas charging, Show discharge pressure and suction pressure during running time. (15 hrs.) 88. Hands on practice on installation of window AC following step by step procedure. (15 hrs.)	**Window Air Conditioner** Study

Professional Skill 100 Hrs.; Professional Knowledge 18Hrs.	Perform servicing of electrical& electronic control, test, Installation, wiring, fault finding & remedial measures of different split AC. NOS ELE/N3114	**Split AC (wall/floor/Cassette)** 89. Identify various components of split AC like wall mounted, floor and ceiling mounted, duct able and multi split AC. (04hrs.) 90. Identify electrical circuits of wall mounted split AC. (04hrs.) 91. Test different components and fault finding. (03 hrs.) 92. Leak testing of the system, evacuation and gas charging. (03hrs.) 93. Trouble shooting in split AC. (06hrs.)	**Split AC (wall/floor/Cassette)** Construction
		94. Install IDU and ODU of wall mounted split AC. (16hrs.)	**Split AC (Wall Mounted)** Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		95. Install IDU of floor, Ceiling /Cassette mounted Split AC. (16hrs.)	**SPLIT A.C (floor, Ceiling /Cassette mounted Split A.C)** Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		96. Install IDU and Duct of Ductable split AC. (16hrs.)	**SPLIT A.C (Ducted**) Study of the Duct able split AC, its Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		97. Servicing of Multi Split AC. (16hrs.)	**MULTI SPLIT A.C** Study the construction and working, various components,

			electrical circuits, testing components, fault detection
		98. Identify the parts of Inverter Split AC. (16hrs.)	**INVERTER SPLIT A.C.** Study of construction and working principle of inverter AC and its components, electrical circuit and controls, installation, servicing, trouble shooting, fault detection, leak testing and gas charging. Concept of Indian Seasonal Energy Efficiency Ratio ISEER). Energy Efficiency leveling on inverter AC.(18 hrs..)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED: 40 Hrs.	Read and apply engineering drawing for different application in the field of work. NOS CSC/N9401	**ENGINEERING DRAWING:** **1.Introduction to Engineering Drawing and Drawing Instruments** • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument **2.Lines- Types and applications in drawing** **Free hand drawing of –** Geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools and measuring tools. **3.Drawing of Geometrical figures** Angle, Triangle, Circle, Rectangle, Square, Parallelogram. Lettering & Numbering – Single Stroke. 4.**Dimensioning** • Types of arrowhead • Leader line with text •Position of dimensioning 5.(**Unidirectional, Aligned)** **Symbolic representation –** • Different symbols used in the related trades. **6.Concept and reading of Drawing in** • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) **Reading of Job drawing related to trades.**	
Workshop Calculation & Science: 38			

Professional Knowledge WCS: 38Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS CSC/N9402	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Introduction of iron and cast iron Difference between iron & steel, alloy steel and carbon steel Properties of insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity, **numerical related to L,C,O section only** Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation Co-efficient of linear expansion and related problems with assignments Problem of heat loss and heat gain with assignments Thermal conductivity and insulators Concept of pressure - Units of pressure, atmospheric pressure,

		absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles
In-plant training / Project work: **Broad Area:** a) Assemble a car A.C Cycle b) Assemble window AC / Split AC		

SYLLABUS FOR REFRIGERATION & AIR CONDITION TECHNICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs.**	**Professional Knowledge (Trade Theory)**
Professional Skill 95 Hrs.; Professional Knowledge 20 Hrs.	Carry out Servicing, dismantling, checking different parts of different types of commercial compressor, re-placing worn out parts, Check lubrication system. Assemble & check performance. NOS-ELE/N3140	99. Familiarization with commercial type reciprocating compressor and centrifugal compressor. (04 hrs.) 100. Dismantling and checking of compressor & accessories. (10 hrs.) 101. Check and service valve plate and piston assembly. (05 hrs.) 102. Lapping valve plate, and refit. (05 hrs.) 103. Check belt tension and replace. (04 hrs.)	**COMMERCIAL COMPRESSOR (Fixed & Variable)** Function, types, Construction & working, applications of compressors used in commercial refrigeration. Volumetric efficiency, Capacity control. (05 hrs.)
		104. Check and test lubricating system. (05hrs.) 105. Servicing of filter and oil pump. (08 hrs.) 106. Cutting gasket. (04 hrs.)	Compressor lubricant oil, types, properties, types of lubrication methods such as splash, forced feed. Study the Construction and working principle of different commercial compressor, open type, (Reciprocating, centrifugal (05 hrs.)
		107. Assemble compressor and Test overall efficiency. (07 hrs.) 108. Star & Delta connection on a three-phase motor and show line voltage, line current, phase voltage and phase current insulation	Screw compressor. Star and Delta connection and their comparison. Production of rotating magnetic field by three phase AC supply. Working principle of three phase induction motor. Terms such as torque, slip, rotor

		test,and continuity. (10 hrs.) 109. Identify the terminals of a Squirrel cage induction motor. (06 hrs.) 110. Start the motor through DOL starter and measure starting current, running current and show changing of DOR. (06 hrs.) 111. Start the motor through Star Delta or Auto transformer starter and measure starting current, running current and show changing of DOR. (06 hrs.) 112. Familiarise with Slip-ring induction motor and identify it's terminals. (04 hrs.) 113. Start the Slip-ring induction motor through Rotor resistance starter and measure starting current, running current and show changing of DOR. (03 hrs.) 114. Rectify fault through insulation test, continuity, open circuit and short circuit test. (8 Hrs)	frequency and their relation. Construction of squirrel cage induction motor. Importance of phase sequence. Construction of slip ring induction motor Comparison between SCIM and SRIM. Three phase motor starters such as DOL starter, Star – Delta starter, Auto transformer starter and Rotor resistance starter. Common faults, causes and remedies in three phase AC motors. (10 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 15	Perform Servicing of different types of water-cooled condenser. NOS-ELE/N3140	115. Servicing of water-cooled condenser and receiver. (13 hrs..) 116. Testing its performance by inlet and outlet	**WATERCOOLED CONDENSER** Study the water-cooled Condenser, its type and capacity, construction and

Hrs.		pressure and temperature. (13 hrs.) 117. De-scaling by diluted HCl to increase efficiency. (12 hrs.)	working, de scaling, application. (08 hrs.)
		118. Pump down the gas for necessary servicing and repairing. (12 hrs.)	Evaporative condenser, function, construction and application. Liquid receiver, function. Drier, types and application. (07 hrs.)
Professional Skill 15 Hrs.; Professional Knowledge 06 Hrs.	Perform servicing of and performance test of Cooling tower. NOS-ELE/N3141	119. Servicing of natural draft, forced draft and induced draft cooling tower. (15 hrs.)	**COOLING TOWER** Cooling tower, types, Construction, capacity advantage & disadvantages of different types of cooling tower. Efficiency, approach and Cooling tower range. (06 hrs.)
Professional Skill 10 Hrs.; Professional Knowledge 06 Hrs.	Conduct servicing, & re- generate water treatment plant of circulating water. NOS CSC/N9415	120. Dismantle and Assemble water circulating pump. (10 hrs.)	**WATERTREATMENT** Causes for water contamination and water treatment. (6 Hrs)
Professional Skill 20 Hrs.; Professional Knowledge 11 Hrs.	Perform fitting of expansion valve, Adjustment of refrigerant flow according to heat load. NOS- ELE/N3140	121. Familiarize with thermostatic and Electronic expansion valve.(10 hrs.)	**EXPANSION VALVE** Types and function, construction, working principle, & their advantage& disadvantages. Thermostatic Expansion Valves (TXV), Automatic Expansion Valves (AXV), Float valves, fixed and modulating orifice controls & electronic Expansion Valves, LMC(level master control).(07 hrs.)
		122. Identify automatic expansion valve.(10 hrs.)	Selection of Expansion valves and capillaries for various Refrigeration and Air-conditioning applications. (04 hrs.)

Professional Skill 60 Hrs.; Professional Knowledge 13 Hrs.	Perform servicing of evaporator & chillers. NOS- ELE/N3140	123. Identify extended surface forced air-cooled evaporators.(05 hrs.) 124. Service air cooled evaporator by blower.(15 hrs.) 125. Service water cooled or brine cooled chiller.(15 hrs.) 126. Check de-frosting system and anti-freeze thermostat.(10 hrs.) 127. Oil removing from coil.(05 hrs.)	**EVAPORATOR** Function, types, Plate & Tube forced air DX evaporators. Types of Defrost system. Water/ Brine chillers. Types of brine used as secondary refrigerant. Accumulator, its function. (06 hrs.)
		128. Servicing of liquid suction heat exchanger used in central plant.(10 hrs.)	Liquid-suction-liquid Heat-exchanger, their function, construction, application & advantages. Study of Accumulator and Oil separator. (07 hrs.)
Professional Skill 40 Hrs.; Professional Knowledge 05 Hrs.	Carry out Servicing and retrofit of Water cooler and dispenser. NOS CSC/N9416	129. Identify parts, control, electric circuit, accessories of storage type water cooler and Bubble type water dispenser.(03 hrs.) 130. Trouble shoot of commonly faced problems like condenser fan motor failure, corrosion etc. (10 hrs.) 131. Install gauge manifold, Leak test and refrigerant charging after evacuation. (15 hrs.) 132. Installation, servicing and maintenance of water cooler and dispensers. (12 hrs.)	**WATER COOLER & WATER DISPENSER** Study the refrigeration cycle of storage type water cooler and dispenser types. Construction & working, Capacity & applications. Study the electrical and mechanical components of storage type water cooler. (05 hrs.)

Professional Skill 45 Hrs.; Professional Knowledge 05 Hrs.	Service, retrofit of visible cooler and bottle cooler and test performance. NOS CSC/N9417	133. Checking and servicing of visible cooler and bottle cooler and its parts.(10 hrs.) 134. Preventive maintenance and trouble shooting (05 hrs.) 135. Evacuation, flushing with dry nitrogen, Retrofit the machine with HFC 134a, R- 600a, R-290.(10 hrs.) 136. Check wiring circuit, test components & replace.(10 hrs.) 137. Install and Test performance of the machine. (10 hrs.)	**VISIBLE COOLER AND BOTTLE COOLER** Visible cooler & bottle coolers. Description, construction & working, with HFC-134a and hydrocarbons, safety especially for flammable refrigerants, maintenance, testing of mechanical and electrical components including sealed electrical components fitted in appliances using flammable refrigerants. (05 hrs.)
Professional Skill 35 Hrs.; Professional Knowledge 05 Hrs.	Conduct servicing of deep freezer and test performance. NOS CSC/N9418	138. Checking and servicing of horizontal and vertical deep freezer / display cabinet and their different parts. (10 hrs.) 139. Preventive maintenance and trouble shooting.(05 hrs.) 140. Check wiring circuit, test and replace defective components. (10 hrs.) 141. Install and test performance. (10 hrs.)	**DEEP FREEZER / DISPLAY CABINET** Description, Construction, working, specifications, function, care and maintenance, faults and remedies. (05 hrs.)
Professional Skill 15 Hrs.; Professional Knowledge 05 Hrs.	Install, service, repair, gas charging and testing performance of Ice Cube machine. NOS CSC/N9419	142. Checking and servicing of ice cube machine and its different components. (15hrs.)	**ICE CUBE MACHINE-** Description, Construction, working, reverse cycle functioning & Circuit diagram, installation method. **SOFTY MACHINE -**

			Description, Construction and function. (05 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 05 Hrs.	Repair, servicing & retrofit of ice candy plant. NOS CSC/N9420	143. Identify different parts, controls and accessories used in ice-candy plant. (10 hrs.) 144. Prepare brine solution, function of agitator and temperature maintained in brine. (10 hrs.)	**ICE CANDY PLANT-** Function, construction, working principle, Circuit diagram, capacity& types of compressor used. Brine composition to maintain required temperature. Operation, maintenance, retrofit. (05 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 06 Hrs.	Perform servicing of Ice plant and evaporative condenser. NOS CSC/N9421	145. Identify parts, accessories and controls of ice plant. (10 hrs.) 146. Check, service and operate ice plant (15 hrs.)	**ICE PLANT-** Details about components of Ice plant their functioning, (06 hrs.)
Professional Skill 55 Hrs.; Professional Knowledge 12 Hrs.	Perform Servicing and preventive maintenance of walk in cooler & cold storage. NOS CSC/N9422	147. Identify parts, accessories, controls and operation of walk in cooler and reach in cabinet. (10 hrs.) 148. Preventive maintenance, trouble shooting and servicing of components. (10 hrs.)	**WALK IN COOLER & REACH IN CABINET** Details about components, their functioning, working principle, Circuit diagram, capacity & types. Care and maintenance. (03 hrs.)
		149. Identify parts, controls and accessories of Cold storage plant. (05 hrs.) 150. Service and operation of cold storage plant. (10 hrs.)	**COLD STORAGE** Study of cold storage plant, parts, Construction, applications, controls & electrical diagram used in cold storage plant. Food preservation spoiling agents- controlling of spoiling agents, preservation by refrigeration system, maintaining temperature in different places. Types of cold storage and its details. (05 hrs.)

		151. Check the refrigeration system of the cold storage plant.(05hrs.) 152. Measure pressure and temperature.(05hrs.) 153. Evacuation by two stage rotary vacuum pumps and gas charging. (10hrs.)	capacity and specification. Use of vibration eliminator and shock absorber, Study the lay out . Cold storage plant operation, its common trouble & remedies. Deep freezing, freezing tunnel, blast freezer its function and working, its application.(04 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 11 Hrs.	Study psychrometric chart and measure psychrometric properties using psychrometric, anemometer i.e. DBT, WBT, RH, air flow etc. NOS- ELE/N3140	154. Find out DBT, WBT, RH & other properties by using psychrometric chart. (15 hrs.) 155. Use psychrometer for finding DBT and WBT.. (15 hrs.)	**HVAC (Plant) –** Introduction to HVAC, Fundamentals of Central Air Conditioning / HVAC plant, requirements of comfort A.C, study of psychometric terms, DBT, WBT, RH, enthalpy, dew point, and specific humidity. (05 hrs.)
		156. Use Anemometers for measuring air flow. (20 hrs.)	Types of Central air conditioning (Direct and indirect system) Construction, working, components, faults, care and maintenance. (06hrs.)
Professional Skill 20 Hrs.; Professional Knowledge (07 hrs)	Perform servicing of motor and blowers used in different air conditioning system. NOS- ELE/N3141	157. Service of fans and blowers used in air-conditioning system. (20 hrs.)	Description of blowers& fans, function and types, static and velocity pressure measurements. (07 hrs.)
Professional Skill 30 Hrs.; Professional Knowledge 05 Hrs.	Construct, install, pack thermal and acoustic insulation of different air ducts. NOS-ELE/N3141 Perform servicing and maintenance of different types of air filters. NOS- ELE/N3141	158. Construct Ducts as per duct layout drawing. (10 hrs.) 159. Insulate Ducts. (05hrs.) 160. Service and maintain different filters. (10 hrs.) 161. Placing of filters. (05 hrs.)	**DUCT** Function, types, materials, duct designing, duct insulation, properties o **AIR FILTERS** Function of air filters, types, construction, maintenance, effect of chocked Air filter, (05 hrs.)

Professional Skill 35 Hrs.; Professional Knowledge 6 Hrs.	Perform servicing, installation, fault diagnosis and remedial measures on Package AC with Air cooled condenser. NOS CSC/N9423	162. Identify various components of Package AC (Air Cooled Condenser). (15 hrs.) 163. Check electrical circuit of Package AC (Air Cooled Condensers). (20 hrs.)	**PACKAGE AC (with Air Cooled Condenser)** Study the Package AC (with Air Cooled Condensers),its construction and working principle, types, trouble shooting. (6hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 15 Hrs.	Carry out servicing, installation, fault diagnosis and remedial measures in Package A.C. with water cooled condenser. NOS-ELE/N3140	164. Identify various components of package AC, (Water cooled condenser). (06hrs.) 165. Identify various components of split package AC. (07 hrs.) 166. Electrical circuit of split package AC. (12 hrs.)	**PACKAGE A.C WITH WATER COOLED CONDENSER** Study Package AC, construction and working principle, Duct system, AHU. Care and maintenance. (15 hrs.)
Professional Skill 30 Hrs.; Professional Knowledge 07 Hrs.	Identify various components of central AC, test electrical components and make wiring. Servicing of A.H.U, damper, check air flow, De-scaling of condenser and CT servicing. NOS-ELE/N3141	167. Identify various components of central AC plant.(Direct) (04 hrs.) 168. Electrical circuit of central AC plant. (10 hrs.) 169. Servicing AHU including fire dampers. (06hrs.) 170. Checking airflow, damper, temperature and pressure. (10 hrs.)	**CENTRAL/ INDUSTRIAL AIRCONDITIONING.** Construction and working principle, types, maintenance of Industrial Air-conditioning plant. Humidification and dehumidification methods. Description of AHU and FCU (07 hrs.)
Professional Skill 10 Hrs.; Professional Knowledge 07 Hrs.	Pump down the system, top up oil and gas and check temperature and pressure. NOS-ELE/N3140	171. Pump down gas from central AC plant. (05 hrs.) 172. Check temperature and pressure control. (05 hrs.)	Temperature and pressure controls used in AC plant, its construction, working, safety devices, piping lines. (07 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 05 Hrs.	Identify components of DX system. Test components, make wiring of dx system. Test leak and evacuate, gas charge the system and check the performance.	173. Identify various components of direct expansion type central AC plants. (10 hrs.) 174. Electrical circuit of direct expansion type central AC plants. (10 hrs.)	**DIRECT EXPANSION SYSTEM** Study Direct expansion system. Operation & Preventive Maintenance Schedule of central AC plant. Maintain log book

	Maintenance, trouble shoot and operate the plant. NOS- ELE/N3140		for daily operation. (05 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 6 Hrs.	Identify the different part of VRF/VRV system, check and service VRF/VRV system. NOS-ELE/N3141	175. Identify VRF / VRV system. (05 hrs.) 176. Check and service VRF / VRV system. (10 hrs.) 177. Identify error code. (05 hrs.)	VRF / VRV system – description and function of different parts. Details of piping have and controls system, Common reason for error code, types of ODU and IDU. (6hrs.)
Professional Skill 15 Hrs.; Professional Knowledge 07 Hrs.	Identify different part of indirect or chiller system. Check components and make wiring, leak test, evacuate and gas charge/ top up. Servicing the plant and trouble shoot. NOS-ELE/N3141	178. Service various components of indirect expansion type central AC plants. (05 hrs.) 179. Check electrical circuit of indirect expansion type central AC plants. (10 hrs.)	**INDIRECT/CHILLER SYSTEM** Study central station AHU and FCU, **Air washers** used in chilled water system, understanding lay out, modulating valves for temperature control. Expansion valves & other related control – description and function. (07 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 05 Hrs.	Identify chilled water pipe line. Servicing of dampers, FCU and water control valves. NOS- ELE/N3141	180. Insulate chilled water piping's. (08 hrs.) 181. Servicing of FCU and water control valves. (12 hrs.)	Study of Humidification & De-humidification. Humidifiers & De-humidifier's. Humidity control. Use of hygrometer. (05 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 10 Hrs.	Troubles shoot of both central A.C. plant Dx and indirect system. Check different control system installation of other major components, servicing of all parts including cooling tower and water treatment plant. NOS- ELE/N3141	182. Check Vibration eliminator and water proofing insulation. (5 hrs.) 183. Check different controls used in central AC system. (10 hrs.) 184. Trouble shooting of central AC. (5hrs.)	Construction and study of commercial A.C plant, package chillers, screw chillers, reciprocating chillers. (5 hrs.) Controls used in AC system, Electromechanical, pneumatic and electronic. Detail study of heat load calculation for commercial and industrial buildings. (5 hrs.)
Professional Skill 35 Hrs.;	Perform servicing of car AC. Fault diagnosis	185. Identify various mechanical and	**CAR AIR CONDITIONING** Study various components

Professional Knowledge 10 Hrs.	& remedial measures. NOS- ELE/N3141	electrical components used in car AC. (03 hrs.) 186. Testing of system components & fault finding (08 hrs.) 187. Install gauge manifold to check suction and discharge pressure in charging time and running time. (04 hrs.) 188. Leak testing using dry nitrogen, evacuation and gas charging (HFC-134a, HFO- 1234yf and blends of HFCs and HFOs). (04 hrs.)	and cycle of Car AC, electrical circuits , Study of good service practice, trouble shooting, Magnetic clutch operation, free movement of flywheel (nonfunctioning of clutch),care and maintenance. (05 hrs..)
	Perform Servicing, fault diagnosis, repair and maintenance of mobile A.C. leak test, evacuation, gas charging, check magnetic clutch and make wiring. Test performance after start. NOS- ELE/N3141	189. Installation and trouble shooting (08 hrs.) 190. Testing magnetic clutch, compressor overhauling, condenser cleaning and add refrigerant Regular maintenance (08 hrs.)	**MOBILE AC (Bus, train)** Construction and working of bus AC. Construction & working of train AC and its operation. Trouble shooting in train A.C. (5 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Perform preventive maintenance of different plants. Maintain log book based on daily operation. NOS-ELE/N3141	191. Study/execute repair of different commercial units at site. (13 hrs.) 192. Study/execute preventive maintenance of different commercial units at site. (12 hrs.)	Planning for Preventive maintenance and scheduling of maintenance activities in large AC and Refrigeration plant. (05 hrs.)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED: 40 Hrs.;	Read and apply engineering drawing for different application in the field of work. NOS-CSC/N9401	**ENGINEERING DRAWING:** Reading of Electrical, Electronic & Mechanical Sign and Symbols used in RAC. Sketches of Electrical, Electronic & Mechanical components used in RAC. Reading of Electrical wiring diagram and Layout diagram Drawing of Electrical circuit diagram used in RAC.	

		Drawing of Block diagram of Instruments & equipment of trades.
Workshop Calculation & Science: 40 Hrs.		
Professional Knowledge WSC: 40 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. NOS- CSC/N9402	**<u>WORKSHOP CALCULATION & SCIENCE: (40 Hrs.)</u>** **Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment** Heat treatment and advantages Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalising and case hardening **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing
Project Work/ Plant Visit: - **Broad area:** a) Central AC plant visit where direct chilling system available. b) Central AC plant visit where indirect chilling system available. c) Survey a heat load of a commercial/industrial building. d) Make a duct for central A.C		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all trades) (120 Hrs + 60 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
REFRIGERATION AND AIR CONDITIONING TECHNICIAN (For batch of 24 candidates)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-21 is required additionally)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
1.	File flat rough double cut	200mm	5+ 1 nos.
2.	File, half round, fine double cut	length 150mm	5+ 1 nos.
3.	File, round, fine double cut	length 150mm	5+ 1 nos.
4.	File flat, fine double cut	length 150mm	5+ 1 nos.
5.	File square, fine double cut	length 150mm	5+ 1 nos.
6.	File triangular fine double cut	length 150mm	5+ 1 nos.
7.	Scriber	150mm length	5+ 1 nos.
8.	Centre punch	length 100mm	5+ 1 nos.
9.	Try square	150 mm	5+ 1 nos.
10.	Divider spring joint	length 150mm	5+ 1 nos.
11.	Caliper spring joint in side	length 150mm	5+ 1 nos.
12.	Caliper, odd leg, spring joint	length 150mm	5+ 1 nos.
13.	Hammer ball pane	220 gms	5+ 1 nos.
14.	Cold Chisel flat and cross cut	length 150mm	5+ 1 nos.
15.	Engineers rule	300mm long	5+ 1 nos.
16.	Tape measuring	10m graduation in mm	5+ 1 nos.
17.	Pliers combination insulated	length 200mm	5+ 1 nos.
18.	Pliers long nose	200 mm	5+ 1 nos.
19.	Pliers flat nose	150mm	5+ 1 nos.
20.	Line tester	500 v heavy duty	5+ 1 nos.
21.	Tweezers	10 cm	5+ 1 nos.
B. INSTRUMENT AND GENERAL SHOP OUTFIT			
GENERAL SHOP OUTFIT			
22.	Surface plate	45 x45 cms	1no.
23.	Oil can	500 ml	5 nos.

24.	Surface Gauge universal	150 mm	2 nos.
25.	Bench vice	150 to 300mm jaw	12 nos.
26.	Hack saw tubular metal frame adjustable	300mm	12 nos.
27.	Snip sheet metal straight nose	200 mm	6 nos.
28.	Snip sheet metal curved nose	200 mm	6 nos.
29.	Anvil	100X200mm	1no.
30.	Stakes [different Types]	100mm	1 no. each
31.	Tin smith	400mm	1 no.
32.	Wooden mallet /Nylon mallet	500 gm good finish	5 nos.
33.	Round Punch	3mm,4mm,6mm	5 Nos. each
34.	Electrical drill portable drill with chuck and key	capacity 6.4mm	5 nos.
35.	Screw driver, plastic handle,	6mm TIP length 100mm to 150mm	6nos.
36.	Screw driver, plastic handle, Flat tip	10mm TIP length 200mm & 250mm	6 nos. each
37.	Philips screw driver -	complete set in leather case	5 nos.
38.	Screw driver, plastic handle, Flat tip	handle 3mm TIP length 100mm to 150mm insulated	5 nos.
39.	Soldering iron exchangeable copper tip	65 watts	12 nos.
40.	Knife folded stainless steel -	150mm	12 nos.
41.	Tong tester (clamp on multi meter)	0-10-30 amps 0-500 v	5 nos.
42.	Tenon saw	250 mm	5nos.
43.	Firmer chisel	6,12,25mm	2 nos.
44.	Rawal plug tool	6 mm	2 nos.
45.	Fire extinguisher	ABC dry powder type2 kg capacity	2 no.
46.	Fire buckets	10 Litre	3 nos.
47.	D.E spanner	6-32 mm	5 set
48.	Ring spanner	6 -32 mm	5 set
49.	Quick couples, process tube adopter	¼" & 3/8" 5/16",3/16"	4 nos. each
50.	Tong Close mouth and pick		1 no.

51.	Welding table for gas/Arc	1200x760	1no. each
52.	Flaring tool set, single type for tube.	4.7mm to 16mm O.D	5 nos.
53.	Swaging tool, punch type, set of size for tube.	4.7mm to 16mm O.D	5sets
54.	Bending spring external type, for copper tube	3mm to 16mm DIA	5sets
55.	Pipe cutter miniature for copper tube	3mm to 16mm DIA	5sets
56.	Pinch of tool, for copper tube,	6mm to 18mm DIA	5sets
57.	Ratchet spanner	6.4 sq.mm reversible	5sets
58.	Capillary plug gauge		5sets
59.	Piercing pliers & reversing valve with access fitting	6-18mm	5sets
60.	Spanner double ended	4.7mm to 16mm	5sets
61.	Ring spanner off set	4.7mm to 16mm	5sets
62.	Wrench adjustable	length 150mm	5sets
63.	Wrench adjustable	length 200mm	5sets
64.	Wrench adjustable	length 250mm	5sets
65.	Valve key handle[Treated as consumable]	4.7mm & 6.4mm sq.	5sets
66.	(Hollo) Punch hole for cutting gasket	4.7-16mm die	2sets
67.	Scissor, gasket cutting stainless steel	length 25mm	5sets
68.	L-Allen key	set size 1.5mm to 6.4mm	5 sets
69.	T-Allen key set	size 5/32" to 1/8"	5sets
70.	Pipe cutter with built in reamer and space cutter, for copper tube	3mm to 32mm	5nos.
71.	Pipe /Tube bender lever type	3-16 mm	1 no each
72.	Spanner double ended	19mm to 31.8 mm	5nos.
73.	Pipe wrench	size 50mm to 150mm	5nos.
74.	Lapping plate	250mm x 200mm	2nos.
75.	Hammer ball peen	450 gms	5nos.

76.	Puller 3 legged with flexible arm	300mm	5nos.
77.	Hand blower portable complete	1/10 HP	2nos.
78.	Spirit level precision metallic	200mm	2nos.
79.	Tap set with matching drills	3 mm to 16mm	3nos.
80.	Tap set with matching drills	V to 5/8"	3nos.
81.	Refrigerant cylinder	2.5 Kg	3nos.
82.	Heating kit with infrared bulb	(200 w capacity)	2nos.
83.	Plumbing hammer weight	200 gm	2nos.
84.	Cylinder 134 a	5 kg	1 no.
85.	Torque Wrench	300mm-12.7mm	1 no.
86.	Piercing Valve	¼ Inch	2 nos.
87.	Feeler gauge	0.05mm to 1mm	3 nos.
88.	Four way reversible valve		1 no.
INSTRUMENT			
89.	Vernier height gauge	300mm, LC 0.02	1 set
90.	Tape measuring graduation in mm	2 m	5nos.
91.	Voltmeter, AC/DC portable precision grade Digital Panel board type	0 to 500 volts	5nos.
92.	Ammeter, AC/DC portable precision grade Digital Panel board type	0 to 30 amp	5nos.
93.	Megger	1000v	5nos.
94.	Wattmeter multi-range up	1 KW	1no.
95.	Multi meter digital type		5nos.
96.	K.W. meter	0 -1 K w	4 no.
97.	Service Oscillator		1 no.
98.	C.R.O Single beam	5 MHZ	2 nos.
99.	C.R.O Dual trace/ Double beam	60 MHZ	2 nos.
100.	A.F.O Oscillators		2 nos.
101.	Pressure gauge Digital type	diameter 63mm with recalibration set	5sets

102.	Compound gauge, Digital type	diameter 63mm, with recalibration set screw, scale vacuum 760mm. Pressure 15 Kg/sq.cm	5sets
103.	Service man thermometer in metal case	- 30^0C to +110^0 C	5sets
104.	Gas leak detector for halogen gas		2nos.
105.	Electronic leak detector		2 nos.
106.	Sling psychrometer mounted on aluminum back,	scale -10^0 C to +110^0 C	5nos.
107.	Stop watch		2nos.
108.	Vernier caliper	length 250mm	2nos.
109.	Micrometer outside measurement	0 to 25mm	2nos.
110.	Multi meter analogue type		5nos.
111.	Tachometer digital, multi range	0 r m p to 3000 r m p. Portable small size in leather case	2nos.
112.	Micron vacuum gauge	capable of reading up to 20 microns	2nos.
113.	Sensor thermometer (digital)	-50 degree Celsius to 150 degree Celsius	2nos.
114.	Fin straightened/fin comb.	With strong steel wire-based combing on wood	3nos.
115.	Filler gauge	0.05 mm - 1 mm	3nos.
116.	Wire gauge metric & British.	Steel plate embossing converse of British & Metric	2nos.
117.	Dial thermometer remote control, armored capillary dial	75mm - 50C to +50 C	3nos.
118.	Anemometer	Digital type	1no.
119.	Compressors testers for small hermetic compressors	Fixed with electrical input/ output indicating facilities	2nos.
120.	Digital thermometer	Graduated disc analogy type	1no.
121.	Temperature &Humidity recorder	Capacity to record 24 hrs. record	1no.
122.	Instrumentation screw driver set	100mm	5nos.
123.	Digital weighing machine	100 kg	1no.
GENERAL MACHINERY SHOP OUTFIT			
124.	Split phase induction motor	1hp, 230 V	1 no.
125.	BLDC motor with controller	15 – 30 watts,315 Volt DC	2 nos.

126.	IDU Pulse Generation type motor	15watt,230volt A.C	2 nos.
127.	Capacitor start induction motor	1 Hp, 230 V	1 no.
128.	AC 3 Phase motor, 400/50 Hz	2 Hp	1 no.
129.	Star delta starter	2 hp	1 no.
130.	Auto Transformer starter	3 hp	1 no.
131.	D.O.L Starter	2 hp	1 no.
132.	Portable air - LPG brazing kit	2 kg. LPG cylinder, torches, houses, stand make	1 no.
133.	Oxy-acetylene welding set complete	cylinders, regulators welding torches with difference nozzles	1 no.
134.	Single door direct cool refrigerator, carrying with HFC and HC	185 L / R 600/ HFC	1 each
135.	Frost free refrigerator	200L carrying with HC blend	2 nos.
136.	Three/four door refrigerator (Inverter type)	300L carrying with HC R-600a	2 nos.
137.	Core drill machine.		1 no
138.	Bench Drilling machine	20 mm capacity,200-2500rpm	1 no.
139.	Grinding Machine	200mm,3000rpm,Double ended1/2 hp	1 no.
140.	Evacuating and refrigerant charging station, consist of a) Rotary two stage vacuum pump and motor (with gas ballast and anti-such back) b) manifold with gauges and valves and capable of pulling vacuum up to 50 microns of Hg and with provision of connecting to a microns level vacuum gauge b) Graduated charging cylinder with provision for temperature correction and all necessary isolating valves	(CAP. 2 kg. In lieu of (b)above and with accuracyof + / - g for charging hydrocarbons)	1 no.
141.	Evacuating and charging station as above but fitted with weighing scale		1 no.
142.	Two stage rotary vacuum pump,3or 4 CFM.	capacity approx. 60 - 10rmp capable of evacuating to 50 microns of Hg and fitted with gas ballast,	1 no.

		anti-such back valve and single-phase motor	
143.	Dry N_2 cylinder	2 stage regulator or commercial N_2 in cylinder with drier unit and 2 stage regulator & meter cube	1 no.
144.	Window A.C	1 Ton with R-22 Blend reciprocating compressor	2 nos.
145.	Split A.C	1.5 Ton with R134a or R-22 reciprocating compressor	2 nos.
146.	Duct able split A.C 1.5 ton	1.5 Ton with R134a or R-22 reciprocating compressor	1 no.
147.	Recovery unit with cylinders	CFC, HFC&HCFC	1 each
148.	Decibel meter	30-100 db	1 no
149.	Cassette Air conditioner	4500 kcal/hr	1 no.
150.	De scaling pump set	with stainless steel impeller and housing complete with motor 1/2 hp and accessories	1 no.
151.	Fan coil unit	with water valves (2 & 3 way)	1 no.
152.	Shell and tube, DX chillers (small)	5 Ton with Cu tubing only	1 no.
153.	Circulating water pump (small)	0.5 H.P with stainless steel tank capacity 20 liters within let/ outlet provision.	1 no.
154.	Refrigerant Cylinder	10 kg capacity	2 nos.
155.	Gauge manifold with gauges	Different size of hoses for R 134a,R22 and R 410.	3 nos. each
156.	Shell and tube type condenser	5 Ton	1 no.
157.	Rotary hermetic compressor	2 Ton	1 no.
158.	Bottle cooler visible	200 L carrying with HFC-134a& reciprocating compressor	1 no.
159.	Deep freezer	200 L carrying with HFC-134a& reciprocating compressor	1 no.
160.	Display Cabinet	2 ton capacity	1 no.
161.	Water cooler storage type	200 L carrying with HFC-134a& reciprocating compressor	2 no.
162.	Water dispenser bubble type (Hot and Cold)	2.5 to 3ltr. Delivery capacity per hour	1 no.
163.	Ice candy plant	2 ton with capacity to make 32 ice candy at a time with Forma tray, stainless steel tank on trolley	1 no.
164.	Air-conditioning, direct system.	Complete with all controls including humidity control	1 no.

165.	Air-conditioning, indirect system. (water cooled)	Complete with all controls including humidity control	1 no.
166.	Package A/C	5-ton capacity, Air cooled type with open type compressor reciprocating type	1 no.
167.	Car A.C components (full kit) a) Wobble plate compressor with mounting brackets. b) Serpentine Evaporator c) Parallel Flow Condenser d) Hoses, tubes, Receiver, Ex.valve. e) Electrical components & wiring Harness		1 Set
168.	CAR AC tutorial model		1 set
169.	Bus AC tutorial model		1 set
170.	Automatic ice cube m/c	50 kg/hour	1 no.
171.	Storage type water cooler (hot and cold)		1 no.
172.	Visi cooler	185 L	
173.	VRF/VRV unit with two indoor units 2.5TR each and 5TR capacity out door unit complete with air cooled condenser, accessories and controls.		1 no.
174.	Split A/C (inverter technology)	1.5 TR	2 nos.
175.	Walk in cooler PUF insulated for cold room 6X4.5X8 cft.	temperature 0^0-5^0 c	1 complete set
176.	Absorption system	Small size	1 no
WORKSHOP FURNITURE			
177.	Class room table	One table for each trainee size of 2.5 provisions with open rack. Frame square conduit of1”. top sun mica ply board	24 nos.
178.	Work bench	2000 x1000 x 700 mm with 2" pipe frame. Top with teak slab and fixing with3/4" good quality rubber sheet.	6 nos.
179.	Almirah	195 x90 x 48 cm outer sheet 20 SWG inner partition with four selves of 22Swg	4 nos.
180.	Lockers	195 x 90 x 48 set six locker in one	2 nos.

		structure	
181.	Glass board portable	2.5'X4' with stand	2 nos.
182.	Instructor table	4'X2'X2.5' with steel tubular frame & sun mica top	1 no.
183.	Instructor chair	Standard revolving with wheel	1 no.
184.	Computer table	Standard with drawers & self to accommodate UPS&CPU	1 no.
185.	Computer chair	Revolving type metal based & metal wheel standard one	1 no.
186.	White board	4'X3' ferrous base sheet to hold magnetic duster with white finish surface.	1 no.
187.	Chart stand	6'X3' providing with hanging clip top & bottom plate	1 no.
188.	Desktop Computer	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch. Licensed Operating System and Antivirus compatible with trade related software.	1 no.
189.	LCD Projector / LED / LCD TV	Big Size	1 no.
190.	Laptop	Latest version	1 no.
191.	UPS		As Required
192.	Copier machine.		1 no
193.	Interactive Board	Latest version	1 no
194.	Stool	2’ x 1.5’	24 nos.
195.	Book Self with glass panel	6’ x 3’	1 No.
196.	Storage rack	6’ x 3’	2 nos.
197.	Storage shelf	6’ x 3’	2 nos.

Note:

1. *Tools and equipment items if not available as per specification may be procured similar item nearer to the specification.*

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

ELECTRICIAN

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – POWER

कौशल बलम्
Directorate General of Training

ELECTRICIAN

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN-81, Sector-V, Salt Lake City,
Kolkata – 700 091
www.cstaricalcutta.gov.in

During the two years duration of Electrician trade a candidate is trained on professional skills & knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered during the course are given below:

FIRST YEAR: In this year the trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. He gets the idea of trade tools & its standardization, identifies different types of conductors, cables & their skinning & joint making. Basic electrical laws like Kirchhoff's law, ohm's law, laws of resistances and their application in different combinations of electrical circuit are practiced along with laws of magnetism. The trainee practices on circuit for single phase and poly-phase circuits for 3 wire /4 wire balanced & unbalanced loads. Skilling practice on different types & combination of cells for operation and maintenance is being done. Wiring practice with installation of different accessories like MCB, distribution fuse box and mounting energy meters are practiced as per IE rules for hostel/residential building, workshop and its fault detection are done by trainee. The trainee will practice for pipe & plate earthing. Different types of light fitting are to be done like HP/LP mercury vapour and sodium vapour are prominent. The trainee will practice on different types of measuring instruments for measurement of electrical parameters in single & three phase circuits. He will gain skill on range extension, calibration and testing of meters. Practice for dismantling, assembling and testing of heating element equipment, induction heating equipment, grinding machines and washing machines will be done by trainee. Skill will be gained on transformer for operation, efficiency, series parallel operation, replacement of transformer oil and combination of single-phase transformers for 3 phase operation. The trainee will practice on winding of small transformer.

SECOND YEAR: In this year the trainee will study the details of electrical rotating machines viz. DC machines, induction motors, alternators & MG sets and practice on them. The trainee will practice on determining characteristics, their performance analysis, starting, speed control and reversing direction of rotation of machines. He will practice on parallel operation & synchronization of alternators, winding practice and over hauling will be practiced for DC machine and induction motors. Practices on diodes for bridge rectifier, switching devices & amplifiers by electronic components, different wave shape generation and testing by CRO. Designing control cabinet, assembling control elements and their wiring are to be practiced. Speed control of AC/DC motors by electronic controller will be practiced. The trainee will practice on testing, analyzing and repairing of voltage stabilizer, emergency light, battery charger, UPS and inverter. He will gain knowledge of thermal, hydel, solar & wind energy systems. The trainee will practice on distribution system, domestic service line and accessories & their protection by practicing on relay and circuit breaker for operation and maintenance. Install and troubleshoot Electric Vehicle charging stations.

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

Electrician trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Employability Skills) impart requisite core skill, knowledge and life skills.After passing out of the training programme, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Trainees broadly need to demonstrate that they are able to:

- Read and interpret technical parameters/ documents, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge & employability skills while performing jobs.
- Check the job/ assembly as per drawing for functioning identify and rectify errors in job/ assembly.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education
- Can take admission in diploma course in notified branches of Engineering by lateral entry.

- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two-years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal)during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitive to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	● Demonstration of good skill in the use of hand tools, machine tools and workshop equipment ● 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. ● A fairly good level of neatness and consistency in the finish ● Occasional support in completing the project/job.
(b) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	● Good skill levels in the use of hand tools, machine tools and workshop equipment ● 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. ● A good level of neatness and consistency in the finish ● Little support in completing the project/job
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	● High skill levels in the use of hand tools, machine tools and workshop equipment ● Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. ● A high level of neatness and consistency in the finish. ● Minimal or no support in completing the project.

Electrician General; installs, maintains and repairs electrical machinery equipment and fittings in factories, workshops powerhouse, business and residential premises etc. Studies drawings and other specifications to determine electrical circuit, installation details etc. Positions and installs electrical motors, transformers, switchgears. Switch boards and other electrical equipment, fittings and lighting fixtures. Makes connections and solders terminals. Tests electrical installations and equipment and locates faults using megger, test lamps etc. Repairs or replaces defective wiring, burnt out fuses and defective parts and keeps fittings and fixtures in working order. May do armature winding, draw wires and cables and do simple cable jointing. May operate, attend and maintain electrical motors, pumps etc.

Electrical Fitter; fits and assembles electrical machinery and equipment such as motors, transformers, generators, switchgears, fans etc., Studies drawings and wiring diagrams of fittings, wiring and assemblies to be made. Collects prefabricated electrical and mechanical components according to drawing and wiring diagrams and checks them with gauges, megger etc. to ensure proper function and accuracy. Fits mechanical components, resistance, insulators, etc., as per specifications, doing supplementary tooling where necessary. Follows wiring diagrams, makes electrical connections and solders points as specified. Checks for continuity, resistance, circuit shorting, leakage, earthing, etc. at each stage of assembly using megger, ammeter, voltmeter and other appliances and ensures stipulated performance of both mechanical and electrical components filled in assembly. Erects various equipment such as bus bars, panel boards, electrical posts, fuse boxes switch gears, meters, relays etc. using non-conductors, insulation hoisting equipment as necessary for receipt and distribution of electrical current to feeder lines. Installs motors, generators, transformer etc. as per drawings using lifting and hoisting equipment as necessary, does prescribed electrical wiring, and connects to supply line. Locates faults in case of breakdown and replaces blown out fuse, burnt coils, switches, conductors etc. as required. Checks, dismantles, repairs and overhauls electrical units periodically or as required according to scheduled procedure. May test coils. May specialize in repairs of particular equipment manufacturing, installation or powerhouse work and be designated accordingly.

Reference NCO-2015:

(i) 7411.0100 – Electrician General
(ii) 7412.0200 – Electrical Fitter

Reference NOS:

(i) PSS/N2001
(ii) PSS/N0108
(iii) PSS/N6001

(iv) PSS/N6003
(v) PSS/N6002
(vi) PSS/N1707
(vii) PSS/N6003
(viii) PSS/N2406
(ix) PSS/N2407
(x) PSS/N4402
(xi) PSS/N1709
(xii) PSS/N170,
(xiii) PSS/N0106
(xiv) PSS/N7001

Name of the Trade	**ELECTRICIAN**
Trade Code	DGT/1001
NCO - 2015	7411.0100, 7412.0200
NOS Covered	PSS/N2001, PSS/N0108, PSS/N6001, PSS/N6003, PSS/N6002, PSS/N1707, PSS/N6003, PSS/N2406, PSS/N2407, PSS/N4402, PSS/N1709, PSS/N1709, PSS/N0106, PSS/N7001 PSS/N9401 PSS/N9402, PSS/N9403, PSS/N9404 PSS/N9405 PSS/N9406 PSS/N9407 PSS/N9408 PSS/N9409 PSS/N9410
NSQF Level	Level-4
Duration of Craftsmen Training (Instructional Hours)	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, DEAF, HH
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	98 Sq. m
Power Norms	5.2 KW (for two units in one shift)
Instructors Qualification for	
(i) Electrician Trade	B.Voc/Degree in Electrical/ Electrical and Electronics Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Electrical/ Electrical and Electronics Engineering from AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR**

	NTC/NAC passed in the trade of "Electrician" with three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***NOTE: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both must possess NCIC in any of its variants.***
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR**

	Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
(v) Minimum age for Instructor	21 years
List of Tools & Equipment	As per Annexure-I

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

FIRST YEAR

1. Prepare profile with an appropriate accuracy as per drawing following safety precautions. (NOS: PSS/N2001)
2. Prepare electrical wire joints; carry out soldering, crimping and measure insulation resistance of underground cable. (NOS: PSS/N0108)
3. Verify characteristics of electrical and magnetic circuits. (NOS: PSS/N6001, PSS/N6003)
4. Install, test and maintenance of batteries and solar cell. (NOS: PSS/N6001)
5. Estimate, Assemble, install and test wiring system. (NOS: PSS/N6001)
6. Plan and prepare Earthing installation. (NOS: PSS/N6002)
7. Plan and execute electrical illumination system and test. (NOS: PSS/N9403)
8. Select and perform measurements using analog / digital instruments and install/ diagnose smart meters. (NOS: PSS/N1707)
9. Perform testing, verify errors and calibrate instruments. (NOS: PSS/N9404)
10. Plan and carry out installation, fault detection and repairing of domestic appliances. (NOS: PSS/N6003)
11. Execute testing, evaluate performance and maintenance of transformer. (NOS: PSS/N2406, PSS/N2407)
12. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)
13. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

SECOND YEAR

14. Plan, execute commissioning and evaluate performance of DC machines. (NOS: PSS/N4402)
15. Execute testing, and maintenance of DC machines and motor starters. (NOS: PSS/N4402)
16. Plan, execute commissioning and evaluate performance of AC motors. (NOS: PSS/N1709)
17. Execute testing, and maintenance of AC motors and starters. (NOS: PSS/N1709)

18. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set. (NOS: PSS/PSS/N9405)
19. Execute parallel operation of alternators. (NOS: PSS/N9405)
20. Distinguish, organise and perform motor winding. (NOS: PSS/N4402)
21. Assemble simple electronic circuits and test for functioning. (NOS: PSS/N9406)
22. Assemble accessories and carry out wiring of control cabinets and equipment. (NOS: PSS/N9407)
23. Perform speed control of AC and DC motors by using solid state devices. (NOS: PSS/N9408)
24. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc. (NOS: PSS/N6002)
25. Plan, assemble and install solar panel. (NOS: PSS/N9409)
26. Erect overhead domestic service line, outline various power plant layout and explain smart distribution grid and its components. (NOS: PSS/N0106)
27. Examine the faults and carry out repairing of circuit breakers. (NOS: PSS/N7001)
28. Install and troubleshoot Electric Vehicle charging stations. (NOS: PSS/N9410)
29. Read and apply engineering drawing for different application in the field of work.(NOS: PSS/N9401)
30. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Prepare profile with an appropriate accuracy as per drawing. (NOS: PSS/N2001)	Identify the trade tools; demonstrate their uses with safety, care & maintenance.
	Prepare a simple half lap joint using firmer chisel with safety.
	Prepare tray using sheet metal with the safety.
	Demonstrate fixing of surface mounting type of accessories.
	Perform connections of electrical accessories.
	Make and wire up of a test board and test it.
2. Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable. (NOS: PSS/N0108)	Observe safety/ precaution during joints & soldering.
	Make simple straight twist and rat-tail joints in single strand conductors.
	Make married and 'T' (Tee) joint in stranded conductors.
	Prepare a Britannia straight and 'T' (Tee) joint in bare conductors.
	Prepare western union joint in bare conductor.
	Solder the finished copper conductor joints with precaution.
	Prepare termination of cable lugs by using crimping tool.
	Make straight joint in different types of underground cables.
	Measure insulation resistance of underground cable.
3. Verify characteristics of electrical and magnetic circuits. (NOS: PSS/N6001, PSS/N6003)	Identify types of wires, cables and verify their specifications.
	Verify the characteristics of series, parallel and its combination circuit.
	Analyze the effect of the short and open in series and parallel circuits.
	Verify the relation of voltage components of RLC series circuit in AC.

	Determine the power factor by direct and indirect methods in an AC single phase RLC parallel circuit.
	Identify the phase sequence of a 3 ø supply using a phase-sequence meter.
	Prepare/ connect a lamp load in star and delta and determine relationship between line and phase values with precaution.
	Connect balanced and unbalanced loads in 3 phase star system and measure the power of 3 phase loads.
	Make the solenoid and determine its polarity for the given direction of current.
	Group the given capacitors to get the required capacity and voltage rating.
4. Install, test and maintenance of batteries and solar cell. (NOS: PSS/N6001)	Assemble a DC source 6V/500 mA using 1.5V cells.
	Determine the internal resistance of cell and make grouping of cells.
	Explain charging of battery and test for its condition with safety/ precaution.
	Carry out installation and maintenance of batteries.
	Determine total number of cells required for a given power requirement.
5. Estimate, Assemble, install and test wiring system. (NOS: PSS/N6001)	Comply with safety & IE rules when performing the wiring.
	Prepare and mount the energy meter board.
	Draw and wire up the consumers main board with ICDP switch and distribution fuse box.
	Draw and wire up a bank/hostel/jail in PVC conduit.
	Identify the types of fuses their ratings and applications.
	Identify the parts of a relay, MCB & ELCB and check its operation.
	Estimate the cost of material for wiring in PVC channel for an office room having 2 lamps, 1 Fan, one 6A socket outlet and wire up.
	Estimate the requirement for conduit wiring (3 phase) and wire up.
	Estimate the materials and wire up the lighting circuit for a godown.
	Estimate the materials and wire up a lighting circuit for a corridor in conduit.
	Test, locate the fault and repair a domestic wiring installation.

6. Plan and prepare Earthing installation. (NOS: PSS/N6002)	Plan work in compliance with standard safety norms related with earthing installation.
	Install the pipe earthing and test it.
	Install the plate earthing and test it.
	Measure the earth electrode resistance using earth tester.
	Carry out earth resistance improvement.
7. Plan and execute electrical illumination system and test.	Plan work in compliance with standard safety norms related with electrical illumination system.
	Install light fitting with reflectors for direct and indirect lighting.
	Assemble and connect a single twin tube fluorescent light.
	Connect, install and test the HPMV & HPSV lamp with accessories.
	Prepare and test a decorative serial lamp set for 240 V using 6V bulb and flasher.
	Install light fitting for show case window lighting.
8. Select and perform measurements using analog / digital instruments and install/ diagnose smart meters. (NOS: PSS/N1707)	Identify the type of electrical instruments.
	Extend the range of MC voltmeter and ammeter.
	Measure the frequency by frequency meter.
	Measure the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.
	Measure the value of resistance, voltage and current using digital multimeter.
	Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.
	Identify components of smart meters.
	Install and diagnose smart meters.
9. Perform testing, verify errors and calibrate instruments.	Test single phase energy meter for its errors.
	Determine the measurement errors while measuring resistance by voltage drop method.
	Calibrate the analogmultimeter.
10. Plan and carry out	Plan work in compliance with standard safety norms related with domestic appliances.

installation, fault detection and repairing of domestic appliances. (NOS: PSS/N6003)	Service and Repair of calling bell/ buzzer/ Alarm.
	Service and repair an automatic iron.
	Repair and service of oven having multi-range heat control.
	Replace the heating element in a kettle and test.
	Service and repair an induction heater.
	Service and repair a geyser.
	Service and repair a mixer.
	Service and repair of washing machine.
	Install a pump set.
	Service and repair of table fan.
	Service, repair and install a ceiling fan.
11. Execute testing, evaluate performance and maintenance of transformer. (NOS: PSS/N2406, PSS/N2407)	Plan work in compliance with standard safety norms related with transformer.
	Identify the types of transformers and their specifications.
	Identify the terminals; verify the transformation ratio of a single-phase transformer.
	Connect and test a single-phase auto- transformer.
	Determine the losses (iron loss and copper loss) and the regulation of a single-phase transformer at different loads.
	Measure the current and voltage using CT and PT.
	Carry out winding for small transformer of 1KVA rating.
	Test the transformer oil with oil testing kit.
	Connect 3 single phase transformers for 3 phase operation of delta-delta /delta-star /star-star /star-delta.
	Connect the given two single phase transformers in parallel /series (secondary only) and measure voltage.
	Connect & test 3 phase transformer in parallel.
12. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
13. Demonstrate basic mathematical concept and principles to perform practical operations. Understand	Solve different mathematical problems
	Explain concept of basic science related to the field of study

and explain basic science in the field of study.	
SECOND YEAR	
14. Plan, execute commissioning and evaluate performance of DC machines. (NOS: PSS/N4402)	Plan work in compliance with standard safety norms related with DC machines.
	Determine the load performance of a different type of DC generator on load.
	Connect, start, run and reverse direction of rotation of different types of DC motors.
	Conduct the load performance tests on different type of DC motor.
	Control the speed of a DC motor by different method.
15. Execute testing, and maintenance of DC machines and motor starters. (NOS: PSS/N4402)	Test a DC machine for continuity and insulation resistance.
	Maintenance, troubleshooting & servicing of DC machines.
	Test armature by using growler.
	Maintain, service and troubleshoot the DC motor starter.
16. Plan, execute commissioning and evaluate performance of AC motors. (NOS: PSS/N1709)	Plan work in compliance with standard safety norms related with AC motors.
	Draw circuit diagram and connect forward & reverse a 3-phase squirrel cage induction motor.
	Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	Measure the slip of 3 phase squirrel cage induction motor by tachometer for different output. Draw slip/ load characteristics of the motor.
	Determine the efficiency of 3 phase squirrel cage induction motor by no load test/ blocked rotor test and brake test.
	Plot the speed torque (Slip/Torque) characteristics of slip ring induction motor.
	Demonstrate speed control of 3 phase induction motor.
	Connect, start and run a 3-phase synchronous motor.

	Connect start, run, control speed and reverse the DOR of different type of single-phase motors.
	Install a single-phase AC motor.
17. Execute testing, and maintenance of AC motors and starters. (NOS: PSS/N1709)	Test continuity and insulation of various AC motors.
	Maintain, service and troubleshoot of three phase AC motors.
	Maintain, service and troubleshoot of different types of single-phase AC motors.
	Maintain, service and troubleshoot the AC motor starter.
18. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set.	Plan work in compliance with standard safety norms related with Alternator & MG set.
	Connect start and run an alternator and build up the voltage.
	Determine the load performance of a 3-phase alternator.
	Start and load a MG set with 3 phase induction motor coupled to DC shunt generator and build up the voltage.
	Perform/ Explain alignment of MG set.
	Preventive and breakdown maintenance of alternator / MG set.
	Explain the effect of excitation current in terms of V-curves of synchronous motor.
19. Execute parallel operation of alternators.	Demonstrate parallel operation of an alternator Bright lamp method/ Dark lamp method/ Bright and dark lamp method.
	Parallel operation of an alternator by using synchroscope.
20. Distinguish, organise and perform motor winding. (NOS: PSS/N4402)	Rewind the field coil /armature winding/ table fan /ceiling fan.
	Draw winding diagram & rewind a single-phase split type motor (Concentric coil winding).
	Draw winding diagram & rewind a 3-phase squirrel cage induction motor (single layer distributed winding).
	Draw winding diagram & rewind a 3-phase induction motor (single layer concentric type half coil connection).
	Draw winding diagram & rewind a 3-phase squired cage induction motor. (Double layer distributed type winding)

21. Assemble simple electronic circuits and test for functioning.	Perform soldering on components/ lug / board with safety.
	Identify the passive /active components by visual appearance, code number and test for their condition.
	Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
	Construct and test a half &full wave rectifier with and without filter circuits.
	Construct circuit by using transistor as a switch.
	Construct and test a UJT as relaxation oscillator & electronic timer.
	Construct amplifier circuit using Transistor, FET and JFET and test.
	Construct and test lamp dimmer using TRIAC/DIAC.
	Test IGBT and use in circuit for suitable operation.
	Construct and test the universal motor speed controller using SCR with safety.
	Construct and test logic gate circuits.
22. Assemble accessories and carry out wiring of control cabinets and equipment.	Draw the layout diagram of 3 phase AC motor control cabinet.
	Mount the control elements & wiring accessories on the control panel.
	Carry out wiring in control cabinet for local and remote control of induction motor.
	Draw & wire up the control panel for forward/ reverse operation of induction motor.
	Perform wiring for automatic start delta starter.
	Draw & wire up control panel for sequential motor control for three motors.
	Draw & wire up the control panel for a given circuit diagram and connect the motor.
	Test the control panel for all the required logics.
23. Perform speed control of AC and DC motors by using solid state devices.	Control the speed of DC motor by using DC drive.
	Speed control of universal motor by using SCR.
	Control speed and reverse the direction of rotation of different type of three phase induction motors using VVVF control /AC drive
24. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency	Operation and maintenance of inverter.
	Troubleshoot and service a voltage stabilizer.
	Identify the parts, trace the connection and test the DC regulated power supply with safety.
	Troubleshoot and service a DC regulated power supply.

light and UPS etc. (NOS: PSS/N6002)	Test battery charger for its operation.
	Prepare an emergency light.
	Carryout maintenance of UPS.
25. Plan, assemble and install solar panel.	Plan work in compliance with solar panel installation norms.
	Combination of solar cells for given power requirement.
	Assemble and install solar panel.
	Check the functionality of solar panel.
26. Erect overhead domestic service line and outline various power plant layout and explain smart distribution grid and its components. (NOS: PSS/N0106)	Prepare single line diagram of thermal/ hydel/ Solar /Wind power plants.
	Prepare layout plan and single line diagram of transmission line.
	Draw an overhead and domestic service line.
	Explain erection ofan overhead service line pole for single phase 240V distribution system.
	Identify different type of insulator used in HT and LT line.
	Fasten jumper in insulators.
	Connect feeder cable with domestic service line.
	Identify components and equipment of smart distribution grid.
	Explain Smart Grid Communication infrastructure components.
27. Examine the faults and carry out repairing of circuit breakers. (NOS: PSS/N7001)	Prepare layout plan and single line diagram of Distribution substation
	Illustrate application of relays in control circuits and examine its operation.
	Identify parts of circuit breaker and check its operation.
28. Install and troubleshoot Electric Vehicle charging stations.	Explain charger specifications.
	Demonstrate installation of EV charging Station for Public places/ Home.
29. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

30. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems
	Explain concept of basic science related to the field of study

SYLLABUS FOR ELECTRICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 40 Hrs.; Professional Knowledge 10 Hrs.	Prepare profile with an appropriate accuracy as per drawing following safety precautions. **(Mapped NOS: PSS/N2001)**	1. Visit various sections of the institutes and location of electrical installations. (01hrs.) 2. Identify safety symbols and hazards. (02Hrs.) 3. Preventive measures for electrical accidents and practice steps to be taken in such accidents. (03hrs.) 4. Practice safe methods of fire fighting in case of	Scope of the electrician trade. Safety rules and safety signs. Types and working of fire extinguishers. (03 hrs.)

		electrical fire. (02hrs.) 5. Use of fire extinguishers. (03Hrs.)	
		6. Practice elementary first aid. (02hrs.) 7. Rescue a person and practice artificial respiration. (01Hrs.) 8. Disposal procedure of waste materials. (01Hrs.) 9. Use of personal protective equipment. (01hrs.) 10. Practice on cleanliness and procedure to maintain it. (02 hrs.)	First aid safety practice. Hazard identification and prevention. Personal safety and factory safety. Response to emergencies e.g. power failure, system failure and fire etc. (03 hrs.)
		11. Identify trade tools and machineries. (03Hrs.) 12. Practice safe methods of lifting and handling of tools & equipment. (03Hrs.) 13. Select proper tools for operation and precautions in operation. (03Hrs.) 14. Care & maintenance of trade tools. (03Hrs.)	Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National Electrical Code-2011. (02 hrs.)
		15. Operations of allied trade tools. (05 Hrs.) 16. Workshop practice on filing and hacksawing. (05Hrs.)	Allied trades: Introduction to fitting tools, safety precautions. Description of files, hammers, chisels hacksaw frames, blades, their specification and grades. Types of drills, description & drilling machines. (02 hrs.)
Professional Skill 95 Hrs.; Professional Knowledge	Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance	17. Prepare terminations of cable ends (03 hrs.) 18. Practice on skinning, twisting and crimping. (08 Hrs.)	Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators. Conducting materials and

20 Hrs.	of underground cable. **(Mapped NOS: PSS/N0108)**	19. Identify various types of cables and measure conductor size using SWG and micrometer. (06Hrs.)	their comparison. (06 hrs.)
		20. Make simple twist, married, Tee and western union joints. (15 Hrs.) 21. Make britannia straight, britannia Tee and rat tail joints. (15Hrs.) 22. Practice in Soldering of joints / lugs. (12 Hrs.)	Joints in electrical conductors. Techniques of soldering. Types of solders and flux. (07 hrs.)
		23. Identify various parts, skinning and dressing of underground cable. (10Hrs.) 24. Make straight joint of different types of underground cable. (10Hrs.) 25. Test insulation resistance of underground cable using megger. (06 hrs.) 26. Test underground cables for faults and remove the fault. (10Hrs.)	Underground cables: Description, types, various joints and testing procedure. Cable insulation & voltage grades Precautions in using various types of cables. (07 hrs.)
Professional Skill 160 Hrs.; Professional Knowledge 36 Hrs.	Verify characteristics of electrical and magnetic circuits. **(Mapped NOS: PSS/N6001, PSS/N6003)**	27. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources and analyse by drawing graphs. (08 Hrs.) 28. Measure current and voltage in electrical circuits to verify Kirchhoff's Law (08Hrs.) 29. Verify laws of series and	Ohm's Law; Simple electrical circuits and problems. Kirchoff's Laws and applications. Series and parallel circuits. Open and short circuits in series and parallel networks. (04 hrs.)

		parallel circuits with voltage source in different combinations. (05Hrs.) 30. Measure voltage and current against individual resistance in electrical circuit (05hrs.) 31. Measure current and voltage and analyse the effects of shorts and opens in series circuit. (05 Hrs.) 32. Measure current and voltage and analyse the effects of shorts and opens in parallel circuit. (05 Hrs.)	
		33. Measure resistance using voltage drop method. (03Hrs.) 34. Measure resistance using wheatstone bridge. (02 Hrs.) 35. Determine the thermal effect of electric current. (03Hrs.) 36. Determine the change in resistance due to temperature. (02Hrs.) 37. Verify the characteristics of series parallel combination of resistors. (03Hrs.)	Laws of Resistance and various types of resistors. Wheatstone bridge; principle and its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance. Series and parallel combinations of resistors. (04 hrs.)
		38. Determine the poles and plot the field of a magnet bar. (05Hrs.) 39. Wind a solenoid and determine the magnetic effect of electric current. (05Hrs.) 40. Determine direction of induced emf and current.	Magnetic terms, magnetic materials and properties of magnet. Principles and laws of electro-magnetism. Self and mutually induced EMFs. Electrostatics: Capacitor- Different types, functions, grouping and uses. (08 hrs.)

		(03hrs.) 41. Practice on generation of mutually induced emf. (03hrs.) 42. Measure the resistance, impedance and determine inductance of choke coils in different combinations. (05Hrs.) 43. Identify various types of capacitors, charging / discharging and testing. (05 Hrs.) 44. Group the given capacitors to get the required capacity and voltage rating. (05 Hrs.)	
		45. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC series circuits. (06Hrs.) 46. Measure the resonance frequency in AC series circuit and determine its effect on the circuit. (05hrs.) 47. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC parallel circuits. (06Hrs.) 48. Measure the resonance frequency in AC parallel circuit and determine its effects on the circuit. (05hrs.) 49. Measure power, energy for lagging and leading power factors in single phase circuits and compare characteristic graphically. (06Hrs.) 50. Measure Current, voltage,	Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Comparison and Advantages of DC and AC systems. Related terms frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, power factor and Impedance etc. Sine wave, phase and phase difference. Active and Reactive power. Single Phase and three-phase system. Problems on A.C. circuits. (10 hrs.)

		power, energy and power factor in three phase circuits. (05hrs.) 51. Practice improvement of PF by use of capacitor in three phase circuit.(03Hrs.)	
		52. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence using phase sequence meter. (07Hrs.) 53. Determine effect of broken neutral wire in three phase four wire system.(04hrs.) 54. Determine the relationship between Line and Phase values for star and delta connections. (07Hrs.) 55. Measure the Power of three phase circuit for balanced and unbalanced loads. (10Hrs.) 56. Measure current and voltage of two phases in case of one phase is short-circuited in three phase four wire system and compare with healthy system. (07hrs.)	Advantages of AC poly-phase system. Concept of three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Phase sequence meter. (10 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Install, test and maintenance of batteries and solar cell. **(Mapped NOS: PSS/N6001)**	57. Use of various types of cells. (08 Hrs.) 58. Practice on grouping of cells for specified voltage and current under different conditions and care. (12 Hrs.) 59. Prepare and practice on battery charging and details of charging circuit. (12 Hrs.) 60. Practice on routine, care/ maintenance and testing of batteries. (08 Hrs.) 61. Determine the number of solar cells in series / parallel	Chemical effect of electric current and Laws of electrolysis. Explanation of Anodes and cathodes. Types of cells, advantages / disadvantages and their applications. Lead acid cell; Principle of operation and components. Types of battery charging, Safety precautions, test equipment and maintenance. Basic principles of Electro-plating and cathodic

		for given power requirement. (10 Hrs.)	protection Grouping of cells for specified voltage and current. Principle and operation of solar cell. (10 Hrs.)
Professional Skill 200 Hrs.; Professional Knowledge 42 Hrs.	Estimate, Assemble, install and test wiring system. **(Mapped NOS: PSS/N6001)**	62. Identify various conduits and different electrical accessories. (8 Hrs.) 63. Practice cutting, threading of different sizes & laying Installations. (17 Hrs.) 64. Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB etc. (25 Hrs.)	I.E. rules on electrical wiring. Types of domestic and industrial wirings. Study of wiring accessories e.g. switches, fuses, relays, MCB, ELCB, MCCB etc. Grading of cables and current ratings. Principle of laying out of domestic wiring. Voltage drop concept. (14 Hrs.)
		65. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to more number of points of minimum 15 mtr length. (15 Hrs.) 66. Wire up PVC conduit wiring to control one lamp from two different places. (15 Hrs.) 67. Wire up PVC conduit wiring to control one lamp from three different places. (15 Hrs.) 68. Wire up PVC conduit wiring and practice control of sockets and lamps in different combinations using switching concepts. (15 Hrs.)	PVC conduit and Casing-capping wiring system. Different types of wiring - Power, control, Communication and entertainment wiring. Wiring circuits planning, permissible load in sub-circuit and main circuit. (14 Hrs.)
		69. Wire up the consumers main board with MCB & DB's switch and distribution fuse box. (15 Hrs.) 70. Prepare and mount the energy meter board. (15 Hrs.)	Estimation of load, cable size, bill of material and cost. Inspection and testing of wiring installations. Special wiring circuit e.g. godown, tunnel and workshop etc.

		71. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. (15 Hrs.) 72. Practice wiring of hostel and residential building as per IE rules. (15 Hrs.) 73. Practice wiring of institute and workshop as per IE rules. (15 Hrs.) 74. Practice testing / fault detection of domestic and industrial wiring installation and repair. (15Hrs.)	(14 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Plan and prepare Earthing installation. **(Mapped NOS: PSS/N6002)**	75. Prepare pipe earthing and measure earth resistance by earth tester / megger. (10 Hrs.) 76. Prepare plate earthing and measure earth resistance by earth tester / megger. (10 Hrs.) 77. Test earth leakage by ELCB and relay. (5 Hrs.)	Importance of Earthing. Plate earthing and pipe earthing methods and IEE regulations. Earth resistance and earth leakage circuit breaker. (5 Hrs.)
Professional Skill 45Hrs.; Professional Knowledge 10Hrs.	Plan and execute electrical illumination system and test.	78. Install light fitting with reflectors for direct and indirect lighting. (10 Hrs.) 79. Group different wattage of lamps in series for specified voltage. (5 Hrs.) 80. Practice installation of various lamps e.g. fluorescent tube, HP mercury vapour, LP mercury vapour, HP sodium vapour, LP sodium vapour, metal halide etc. (18 Hrs.) 81. Prepare decorative lamp circuit to produce rotating light effect/running light effect. (6 Hrs.) 82. Install light fitting for show case lighting. (6 Hrs.)	Laws of Illuminations. Types of illumination system. Illumination factors, intensity of light. Type of lamps, advantages/ disadvantages and their applications. Calculations of lumens and efficiency. (10 hrs.)

Professional Skill 50 Hrs.; Professional Knowledge 08 Hrs.	Select and perform measurements using analog / digital instruments and install/ diagnose smart meters. **(Mapped NOS: PSS/N1707)**	83. Practice on various analog and digital measuring Instruments. (5 Hrs.) 84. Practice on measuring instruments in single and three phase circuits e.g. multi-meter, Wattmeter, Energy meter, Phase sequence meter and Frequency meter etc. (12Hrs.) 85. Measure power in three phase circuit using two wattmeter methods. (8 Hrs.) 86. Measure power factor in three phase circuit by using power factor meter and verify the same with voltmeter, ammeter and wattmeter readings. (10Hrs.) 87. Measure electrical parameters using tong tester in three phase circuits. (08Hrs.) 88. Demonstrate Smart Meter, its physical components and Communication components. (03 Hrs.) 89. Perform meter readings, install and diagnose smart meters. (04 Hrs.)	Classification of electrical instruments and essential forces required in indicating instruments. PMMC and Moving iron instruments. Measurement of various electrical parameters using different analog and digital instruments. Measurement of energy in three phase circuit. Automatic meter reading infrastructures and Smart meter. Concept of Prosumer and distributed generation. Electrical supply requirements of smart meter, Detecting/clearing the tamper notifications of meter. (08 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 05Hrs.	Perform testing, verify errors and calibrate instruments.	90. Practice for range extension and calibration of various measuring instruments. (10 Hrs.) 91. Determine errors in resistance measurement by voltage drop method. (8 Hrs.) 92. Test single phase energy meter for its errors. (7 Hrs.)	Errors and corrections in measurement. Loading effect of voltmeter and voltage drop effect of ammeter in circuits. Extension of range and calibration of measuring instruments. (05 hrs.)
Professional Skill 75 Hrs.;	Plan and carry out installation, fault detection and	93. Dismantle and assemble electrical parts of various electrical appliances e.g.	Working principles and circuits of common domestic equipment and appliances.

Professional Knowledge 10 Hrs.	repairing of domestic appliances. **(Mapped NOS: PSS/N6003)**	cooking range, geyser, washing machine and pump set. (25 Hrs.) 94. Service and repair of electric iron, electric kettle, cooking range and geyser. (12 Hrs.) 95. Service and repair of induction heater and oven. (10 Hrs.) 96. Service and repair of mixer and grinder. (10 Hrs.) 97. Service and repair of washing machine. (13Hrs.)	Concept of Neutral and Earth. (10 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 12 Hrs.	Execute testing, evaluate performance and maintenance of transformer. **(Mapped NOS: PSS/N2406, PSS/N2407)**	98. Verify terminals, identify components and calculate transformation ratio of single-phase transformers. (8 Hrs.) 99. Perform OC and SC test to determine and efficiency of single-phase transformer. (12Hrs.) 100. Determine voltage regulation of single-phase transformer at different loads and power factors. (12 Hrs.) 101. Perform series and parallel operation of two single phase transformers. (12 Hrs.) 102. Verify the terminals and accessories of three phase transformer HT and LT side. (6Hrs.)	Working principle, construction and classification of transformer. Single phase and three phase transformers. Turn ratio and e.m.f. equation. Series and parallel operation of transformer. Voltage Regulation and efficiency. Auto Transformer and instrument transformers (CT & PT). (12 Hrs.)
		103. Perform 3 phase	Method of connecting three

		operation (i) delta-delta, (ii) delta-star, (iii) star-star, (iv) star-delta by use of three single phase transformers. (6 Hrs.) 104. Perform testing of transformer oil. (6 Hrs.) 105. Practice on winding of small transformer. (8 Hrs.) 106. Practice of general maintenance of transformer. (5 Hrs.)	single phase transformers for three phase operation. Types of Cooling, protective devices, bushings and termination etc. Testing of transformer oil. Materials used for winding and winding wires in small transformer. (06 Hrs.)
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**ENGINEERING DRAWING** Introduction to Engineering Drawing and Drawing Instruments – ● Conventions ● Sizes and layout of drawing sheets ● Title Block, its position and content ● Drawing Instrument Free hand drawing of – ● Geometrical figures and blocks with dimension ● Transferring measurement from the given object to the free hand sketches. ● Free hand drawing of hand tools. Drawing of Geometrical figures: ● Angle, Triangle, Circle, Rectangle, Square, Parallelogram. ● Lettering & Numbering – Single Stroke Dimensioning Practice ● Types of arrowhead Symbolic representation ● Different electrical symbols used in the related trades Reading of Electrical Circuit Diagram Reading of Electrical Layout drawing	
WORKSHOP CALCULATION & SCIENCE: 30 Hrs			
Professional Knowledge WCS- 30 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations.	**WORKSHOP CALCULATION & SCIENCE** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems	

	Understand and explain basic science in the field of study.	Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multilipication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and suare root Simple problems using calculator Applications of pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Precentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Introduction of iron and cast iron **Mass, Weight, Volume and Density** Mass, volume, density, weight Related problems for mass, volume, density, weight Work, power, energy, HP, IHP, BHP and efficiency Potential energy, kinetic energy and related problems with assignment **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, celsius, fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation. **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
Project work / Industrial visit **Broad Areas:** a) Overload protection of electrical equipment b) Automatic control of streetlight/night lamp		

c) Fuse and power failure indicator using relays
d) Door alarm/indicator
e) Decorative light with electrical flasher

SYLLABUS FOR ELECTRICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills** **(Trade Practical)** **With Indicative Hours**	**Professional Knowledge** **(Trade Theory)**
Professional Skill 35 Hrs.; Professional Knowledge 09 Hrs.	Plan, execute commissioning and evaluate performance of DC machines. **(Mapped NOS: PSS/N4402)**	107. Identify terminals, parts and connections of different types of DC machines. (05 Hrs.) 108. Measure field and armature resistance of DC machines. (05 Hrs.) 109. Determine build up voltage of DC shunt generator with varying field excitation and performance analysis on load. (10 Hrs.) 110. Test for continuity and insulation resistance of DC machine. (5 Hrs.) 111. Start, run and reverse direction of rotation of DC series, shunt and	General concept of rotating electrical machines. Principle of DC generator. Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring and Brushes, Laminated core etc. E.M.F. equation Separately excited and self-excited generators. Series, shunt and compound generators. (09 Hrs.)

		compound motors. (10 Hrs.)	
Professional Skill 77 Hrs.; Professional Knowledge 24 Hrs.	Execute testing, and maintenance of DC machines and motor starters. **(Mapped NOS: PSS/N4402)**	112. Perform no load and load test and determine characteristics of series and shunt generators. (08 Hrs.) 113. Perform no load and load test and determine characteristics of compound generators (cumulative and differential). (07 Hrs.) 114. Practice dismantling and assembling in DC shunt motor. (10 Hrs.) 115. Practice dismantling and assembling in DC compound generator. (10 Hrs.)	Armature reaction, Commutation, inter poles and connection of inter poles. Parallel Operation of DC Generators. Load characteristics of DC generators. Application, losses & efficiency of DC Generators. Routine & maintenance. (12 Hrs.)
		116. Conduct performance analysis of DC series, shunt and compound motors. (14 Hrs.) 117. Dismantle and identify parts of three point and four-point DC motor starters. (06 Hrs.) 118. Assemble, Service and repair three point and four-point DC motor starters. (10 Hrs.) 119. Practice maintenance of carbon brushes, brush holders, Commutator and sliprings. (12 Hrs.)	Principle and types of DC motor. Relation between applied voltage back e.m.f., armature voltage drop, speed and flux of DC motor. DC motor Starters, relation between torque, flux and armature current. Changing the direction of rotation. Characteristics, Losses & Efficiency of DC motors. Routine and maintenance. (12 Hrs.)

Professional Skill 35 Hrs.; Professional Knowledge 09 Hrs.	Distinguish, organise and perform motor winding. **(Mapped NOS: PSS/N4402)**	120. Perform speed control of DC motors - field and armature control method. (10 Hrs.) 121. Carry out overhauling of DC machines. (10 Hrs.) 122. Perform DC machine winding by developing connection diagram, test on growler and assemble. (15 Hrs.)	Methods of speed control of DC motors. Lap and wave winding and related terms. (09 Hrs.)
Professional Skill 80 Hrs.; Professional Knowledge 26 Hrs.	Plan, Execute commissioning and evaluate performance of AC motors. **(Mapped NOS: PSS/N1709)** Execute testing, and maintenance of AC motors and starters. **(Mapped NOS: PSS/N1709)**	123. Identify parts and terminals of three phase AC motors. (5 Hrs.) 124. Make an internal connection of automatic star-delta starter with three contactors. (10 Hrs.) 125. Connect, start and run three phase induction motors by using DOL, star-delta and auto-transformer starters. (17 Hrs.) 126. Connect, start, run and reverse direction of rotation of slip-ring motor through rotor resistance starter and determine performance characteristic. (13 Hrs.)	Working principle of three phase induction motor. Squirrel Cage Induction motor, Slip-ring induction motor; construction, characteristics, Slip and Torque. Different types of starters for three phase induction motors, its necessity, basic contactor circuit, parts and their functions. (13 Hrs.)
		127. Determine the efficiency of squirrel cage induction motor by brake test. (05 Hrs.) 128. Determine the efficiency of three phase squirrel cage induction motor by no load test and blocked rotor test.	Single phasing prevention. No load test and blocked rotor test of induction motor. Losses & efficiency. Various methods of speed control. Braking system of motor. Maintenance and repair. (13 Hrs.)

		(05 Hrs.) 129. Measure slip and power factor to draw speed-torque (slip/torque) characteristics. (10 Hrs.) 130. Test for continuity and insulation resistance of three phase induction motors. (5 Hrs.) 131. Perform speed control of three phase induction motors by various methods like rheostatic control, autotransformer etc. (10 Hrs.)	
Professional Skill 23 Hrs.; Professional Knowledge 09 Hrs.	Distinguish, organise and perform motor winding. **(Mapped NOS: PSS/N4402)**	132. Perform winding of three phase AC motor by developing connection diagram, test and assemble. (18 Hrs.) 133. Maintain, service and troubleshoot the AC motor starter. (05 Hrs.)	Concentric/ distributed, single/ double layer winding and related terms.
Professional Skill 39 Hrs.; Professional Knowledge 12 Hrs.	Plan, Execute commissioning and evaluate performance of AC motors. **(Mapped NOS: PSS/N1709)** Execute testing, and maintenance of AC motors and starters. **(Mapped NOS: PSS/N1709)**	134. Identify parts and terminals of different types of single-phase AC motors. (5 Hrs.) 135. Install, connect and determine performance of single-phase AC motors. (10 Hrs.) 136. Start, run and reverse the direction of rotation of single-phase AC motors. (08 Hrs.) 137. Practice on speed control of single-phase AC motors. (08 Hrs.)	Working principle, different method of starting and running of various single-phase AC motors. Domestic and industrial applications of different single-phase AC motors. Characteristics, losses and efficiency. (12 hrs.)

		138. Compare starting and running winding currents of a capacitor run motor at various loads and measure the speed. (08 Hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 12 Hrs.	Distinguish, organise and perform motor winding. **(Mapped NOS: PSS/N4402)**	139. Carry out maintenance, service and repair of single-phase AC motors. (10 Hrs.) 140. Practice on single/double layer and concentric winding for AC motors, testing and assembling. (25 Hrs.) 141. Connect, start, run and reverse the direction of rotation of universal motor. (10 Hrs.) 142. Carry out maintenance and servicing of universal motor. (05 Hrs.)	Concentric/ distributed, single/ double layer winding and related terms. Troubleshooting of single-phase AC induction motors and universal motor. (12 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 22 Hrs.	Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set. Execute parallel operation of alternators.	143. Install an alternator, identify parts and terminals of alternator. (5 Hrs.) 144. Test for continuity and insulation resistance of alternator. (5 Hrs.) 145. Connect, start and run an alternator and build up the voltage. (5 Hrs.) 146. Determine the load performance and voltage regulation of three phase alternator. (5 Hrs.) 147. Parallel operation and synchronization of three	Principle of alternator, e.m.f. equation, relation between poles, speed and frequency. Types and construction. Efficiency, characteristics, regulation, phase sequence and parallel operation. Effect of changing the field excitation and power factor correction. (10 Hrs.)

		phase alternators. (15 Hrs.)	
		148. Install a synchronous motor, identify its parts and terminals. (10 Hrs.) 149. Connect, start and plot V-curves for synchronous motor under different excitation and load conditions. (10 Hrs.)	Working principle of synchronous motor. Effect of change of excitation and load. V and anti V curve. Power factor improvement. (06 Hrs.)
		150. Identify parts and terminals of MG set. (5 Hrs.) 151. Start and load MG set with 3 phase induction motor coupled to DC shunt generator. (15 Hrs.)	Rotary Converter, MG Set description and Maintenance. (06 Hrs.)
Professional Skill 99 Hrs.; Professional Knowledge 31 Hrs.	Assemble simple electronic circuits and test for functioning.	152. Determine the value of resistance by colour code and identify types. (03 Hrs.) 153. Test active and passive electronic components and its applications. (05 Hrs.)	Resistors – colour code, types and characteristics. Active and passive components. Atomic structure and semiconductor theory. (04 Hrs.)
		154. Determine V-I characteristics of semiconductor diode. (05 Hrs.) 155. Construct half wave, full wave and bridge rectifiers using semiconductor diode. (08 Hrs.) 156. Check transistors for their functioning by identifying its type and terminals. (10 Hrs.)	P-N junction, classification, specifications, biasing and characteristics of diodes. Rectifier circuit - half wave, full wave, bridge rectifiers and filters. Principle of operation, types, characteristics and various configuration of transistor. Application of transistor as a switch, voltage regulator and amplifier. (12 Hrs.)

		157. Bias the transistor and determine its characteristics. (05Hrs.) 158. Use transistor as an electronic switch and series voltage regulator. (05Hrs.)	
		159. Operate and set the required frequency using function generator. (05Hrs.) 160. Make a printed circuit board for power supply. (09 Hrs.) 161. Construct simple circuits containing UJT for triggering and FET as an amplifier. (05 Hrs.) 162. Troubleshoot defects in simple power supplies. (09 Hrs.)	Basic concept of power electronics devices. IC voltage regulators Digital Electronics - Binary numbers, logic gates and combinational circuits. (06 hrs.)
		163. Construct power control circuit by SCR, Diac, Triac and IGBT. (12 Hrs.) 164. Construct variable DC stabilized power supply using IC. (08 Hrs.) 165. Practice on various logics by use of logic gates and circuits. (05 Hrs.) 166. Generate and demonstrate wave shapes for voltage and current of rectifier, single stage amplifier and oscillator using CRO. (05 Hrs.)	Working principle and uses of oscilloscope. Construction and working of SCR, DIAC, TRIAC and IGBT. (09 Hrs.)
Professional Skill 82 Hrs.;	Assemble accessories and	167. Design layout of control	Study and understand Layout drawing of control cabinet,

Professional Knowledge 24 Hrs.	carry out wiring of control cabinets and equipment.	cabinet, assemble control elements and wiring accessories for: (i) Local and remote control of induction motor. (09 Hrs.) (ii) Forward and reverse operation of induction motor. (09 Hrs.) (iii) Automatic star-delta starter with change of direction of rotation. (12 Hrs.) (iv) Sequential control of three motors. (09 Hrs.)	power and control circuits. Various control elements: Isolators, pushbuttons, switches, indicators, MCB, fuses, relays, timers and limit switches etc. (12 Hrs.)
		168. Carry out wiring of control cabinet as per wiring diagram, bunching of XLPE cables, channeling, tying and checking etc. (13 Hrs.) 169. Mount various control elements e.g. circuit breakers, relays, contactors and timers etc. (09 Hrs.) 170. Identify and install required measuring instruments and sensors in control panel. (09 Hrs.) 171. Test the control panel for its performance. (12 Hrs.)	Wiring accessories: Race ways/ cable channel, DIN rail, terminal connectors, thimbles, lugs, ferrules, cable binding strap, buttons, cable ties, sleeves, gromats and clips etc. Testing of various control elements and circuits. (12 Hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 11 Hrs.	Perform speed control of AC and DC motors by using solid state devices.	172. Perform speed control of DC motor using thyristors / DC drive. (18 Hrs.) 173. Perform speed control and reversing the direction of rotation of AC motors by using thyristors / AC drive.	Working, parameters and applications of AC / DC drive. Speed control of 3 phase induction motor by using VVVF/AC Drive. (11 Hrs.)

		(18 Hrs.) 174. Construct and test a universal motor speed controller using SCR. (14 Hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc. **(Mapped NOS: PSS/N6002)**	175. Assemble circuits of voltage stabilizer and UPS. (10 Hrs.) 176. Prepare an emergency light. (10 Hrs.) 177. Assemble circuits of battery charger and inverter. (10Hrs.) 178. Test, analyze defects and repair voltage stabilizer, emergency light and UPS. (05Hrs.) 179. Maintain, service and troubleshoot battery charger and inverter. (07Hrs.) 180. Install an Inverter with battery and connect it in domestic wiring for operation. (08Hrs.)	Basic concept, block diagram and working of voltage stabilizer, battery charger, emergency light, inverter and UPS. Preventive and breakdown maintenance. (10 Hrs.)
Professional Skill 23 Hrs.; Professional Knowledge 04 Hrs.	Erect overhead domestic service line, outline various power plant layout and explain smart distribution grid and its components. **(Mapped NOS: PSS/N0106)**	181. Draw layout of thermal power plant and identify function of different layout elements. (5 Hrs.) 182. Draw layout of hydel power plant and identify functions of different layout elements. (5 Hrs.) 183. Visit to transmission / distribution substation. (08 Hrs.) 184. Draw actual circuit diagram of substation visited and	Conventional and non-conventional sources of energy and their comparison. Power generation by thermal and hydel power plants. (04 Hrs.)

		indicate various components. (5 Hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Plan, assemble and install solar panel.	185. Prepare layout plan and Identify different elements of solar power system. (05 Hrs.) 186. Prepare layout plan and Identify different elements of wind power system. (05 Hrs.) 187. Assemble and connect solar panel for illumination. (15 Hrs.)	Various ways of electrical power generation by non-conventional methods. Power generation by solar and wind energy. Principle and operation of solar panel. (07 Hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Erect overhead domestic service line, outline various power plant layout and explain smart distribution grid and its components. **(Mapped NOS: PSS/N0106)**	188. Practice installation of insulators used in HT/LT line for a given voltage range. (04hrs.) 189. Draw single line diagram of transmission and distribution system. (04Hrs.) 190. Measure current carrying capacity of conductor for given power supply. (04hrs.) 191. Fasten jumper in pin, shackle and suspension type insulators. (07Hrs.)	Transmission and distribution networks. Line insulators, overhead poles and method of joining aluminum conductors. (05 Hrs.)
		192. Erect an overhead service line pole for single phase 230V distribution system in open space. (10 Hrs.) 193. Practice on laying of domestic service line. (10 Hrs.) 194. Install bus bar and bus coupler on LT line. (5 Hrs.)	Safety precautions and IE rules pertaining to domestic service connections. Various substations. Various terms like – maximum demand, average demand, load factor, diversity factor, plant utility factor etc. (05 Hrs.)

Professional Skill 25 Hrs.; Professional Knowledge 04 Hrs.	Examine the faults and carry out repairing of circuit breakers. **(Mapped NOS: PSS/N7001)**	195. Identify various parts of relay and ascertain the operation. (5 Hrs.) 196. Practice setting of pick up current and time setting multiplier for relay operation. (5 hrs.) 197. Identify the parts of circuit breaker, check its operation. (5Hrs.) 198. Test tripping characteristic of circuit breaker for over current and short circuit current. (5 hrs.) 199. Practice on repair and maintenance of circuit breaker. (5 hrs.)	Types of relays and its operation. Types of circuit breakers, their applications and functioning. Production of arc and quenching. (04 Hrs)
Professional Skill 22 Hrs.; Professional Knowledge 04 Hrs.	Install and troubleshoot Electric Vehicle charging stations.	200. Demonstrate different charger specifications. (05 hrs) 201. Perform installation of EV charging Station for Public places. (10 hrs) 202. Perform installation of Home EV charging stations. (10 hrs)	EV scenario in India and EV Charging basic theory. EV Charging safety requirements. (04 Hrs)
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**ENGINEERING DRAWING:** Reading of Electrical Sign and Symbols. Sketches of Electrical components. Reading of Electrical wiring diagram and Layout diagram. Reading of Electrical earthing diagram. Drawing the schematic diagram of plate and pipe earthing. Drawing of Electrical circuit diagram. Drawing of Block diagram of Instruments & equipment of trades.	
WORKSHOP CALCULATION & SCIENCE: 32 Hrs			
Professional Knowledge WCS- 32 Hrs.	Demonstrate basic mathematical concept and principles to	**WORKSHOP CALCULATION & SCIENCE:** **Friction** Friction - Lubrication **Algebra**	

	perform practical operations. Understand and explain basic science in the field of study.	Algebra - Addition , subtraction, multiplication & division Algebra - Theory of indices, algebraic formula, related problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus **Profit and Loss** Profit and loss - Simple problems on profit & loss Profit and loss - Simple and compound interest **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade. Estimation and costing - Problems on estimation and costing
Project work / Industrial visit: a) Battery charger/Emergency light b) Control of motor pump with tank level c) DC voltage converter using SCRs d) Logic control circuits using relays e) Alarm/indicator circuits using sensors		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately inwww.bharatskills.gov.in/ dgt.gov.in

List of Tools & Equipment			
ELECTRICIAN (for batch of 20candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Measuring Steel Tape	5 meter	(20 +1) Nos.
2.	Combination Plier Insulated	200 mm	(20 +1) Nos.
3.	Screwdriver Insulated	4mm X 150 mm, Diamond Head	(20 +1) Nos.
4.	Screwdriver Insulated	6mm X 150 mm	(20 +1) Nos.
5.	Electrician screwdriver thin stem insulated handle	4mm X 100 mm	(20 +1) Nos.
6.	Heavy Duty Screwdriver insulated	5mm X 200 mm	(20 +1) Nos.
7.	Electrician Screwdriver thin stem insulated handle	4mm X 250 mm	(20 +1) Nos.
8.	Punch Centre	9mm X 150 mm	(20 +1) Nos.
9.	Knife Double Bladed Electrician	100 mm	(20 +1) Nos.
10.	Neon Tester	500 V	(20 +1) Nos.
11.	Steel Rule Graduated both in Metric and English Unit	300 mm with precision of 1/4th mm	(20 +1) Nos.
12.	Hammer, cross peen with handle	250 grams	(20 +1) Nos.
B. SHOP TOOLS & EQUIPMENT – For 2 (1+1) units no additional items are required			
(i) List of Tools & Accessories			
13.	Hammer, ball peen With handle	500 grams	4 Nos.
14.	Pincer	150 mm	4 Nos.
15.	C- Clamp	200 mm and 100 mm	2 Nos. each
16.	Spanner Adjustable drop forged, SS	150 mm & 300mm	2 Nos. each
17.	Blow lamp brass	0.5 ltr	1 No.
18.	Chisel Cold	25 mm X 200 mm	2 Nos.
19.	Chisel firmer with wooden Handle	6 mm X 200 mm	2 Nos.
20.	Allen Key alloy steel	1.5-10 mm (set of 9)	1 Set
21.	Grease Gun	0.5 ltr. Capacity	1 No
22.	Bradawl		2 Nos.
23.	Pully Puller with 3 legs	150 mm & 300mm	1 each
24.	Bearing Puller (inside and outside)	200 mm	1 No. each
25.	Pipe vice Cast Iron with hardened	100 mm	2 Nos.

	jaw open type		
26.	Scissors blade, SS	200mm	4 Nos.
27.	Scissors blade, SS	150 mm	2 Nos.
28.	Crimping Tool	1.5 sq mm to 16 sq mm	2 Nos.
		16 sq mm to 95 sq mm	2 Nos.
29.	Wire Cutter and Stripper	150 mm	4 Nos.
30.	Mallet hard wood	0.50 kg	4 Nos.
31.	Hammer Extractor type	250 grams	4 Nos.
32.	Hacksaw frame	Adjustable 300 mm Fixed 150 mm	2 Nos. each
33.	Try Square	150 mm blade	4 Nos.
34.	Outside Calliper	150 mm spring type	2 Nos.
35.	Inside Calliper	150 mm spring type	2 Nos.
36.	Divider	150 mm spring type	2 Nos.
37.	Pliers long nose insulated	150 mm	4 Nos.
38.	Pliers flat nose insulated	200 mm	4 Nos.
39.	Pliers round nose insulated	100 mm	4 Nos.
40.	Tweezers	150 mm	4 Nos.
41.	Snip Straight and Bent heavy duty	250 mm	2 Nos. each
42.	D.E. metric Spanner Double Ended	6 - 32 mm	2 Set
43.	Drill hand brace	0-100mm	4 Nos.
44.	Drill S.S. Twist block	2 mm, 5 mm and 6 mm set of 3	4 Set
45.	Plane cutters	50 mm X 200mm	2 Nos.
46.	Smoothing cutters	50 mm X 200mm	2 Nos.
47.	Gauge, wire imperial stainlees steel marked in SWG & mm	Wire Gauge - Metric	4 Nos.
48.	File flat	200 mm 2nd cut with handle	8 Nos.
49.	File half round	200 mm 2nd cut with handle	4 Nos.
50.	File round	200 mm 2nd cut with handle	4 Nos.
51.	File flat rough	150 mm with handle	4 Nos.
52.	File flat bastard	250 mm with handle	4 Nos.
53.	File flat smooth	250 mm with handle	4 Nos.
54.	File Rasp, half round	200 mm bastard with handle	4 Nos.
55.	Copper bit soldering iron.	0.25 kg	2 Nos.
56.	De soldering Gun	Heat proof nozzle, PVC type, 250mm	4 Nos.
57.	Hand Vice	50 mm jaw	4 Nos.
58.	Table Vice	100 mm jaw	8 Nos.
59.	Oil Can	250 ml	2 Nos.

60.	Contactor & auxiliary contacts	3 phase, 415 Volt, 25 Amp with 2 NO and 2 NC	2 Nos. each
61.	Contactor & auxiliary contacts.	3 phase, 415 volt, 32 Amp with 2 NO and 2 NC	2 Nos. each
62.	Limit Switch	Limit Switch, Liver operated 2A 500v, 2-contacts	2 Nos.
63.	Rotary Switch	16 A/440v	2 Nos.
64.	Relay- a. Cut out Relays b. Reverse current c. Over current d. Under voltage	 a. 16A, 440V b. 16A, 440V c. 16A, 440V d. 360V-440V	2 No. each
65.	Pin Type, shackle type, egg type & suspension type insulators including hardware fitting		2 Nos. each
66.	Hydrometer		2 Nos.
67.	Hand Drill Machine	0-6 mm capacity	2 Nos.
68.	Portable Electric Drill Machine	0-12 mm capacity 750w, 240v with chuck and key	1 No.
69.	Load Bank (Lamp / heater Type)	6 KW, 3Ph	1 No.
70.	Brake Test arrangement with two spring balance rating	0 to 25 kg	1 No.
71.	Laboratory Type Induction Coil	1000 W	2 Nos.
72.	Out Side Micrometer	0 - 25 mm least count 0.01mm	2 Nos.
73.	Thermometer Digital	0° C - 150° C	1 No.
74.	Series Test Lamp	230V, 60W	4 Nos.
75.	Knife Switch DPDT fitted with fuse terminals	16 Amp	4 Nos.
76.	Knife Switch TPDT fitted with fuse terminals	16 Amp/ 440 V	4 Nos.
77.	Miniature circuit Breaker	16 amp	2 Nos.
78.	Earth Plate	60cm X 60cm X 3.15mm Copper Plate 60cm X 60cm X 6mm GI Plate	1 Each
79.	Earth Electrode	Primary Electrode 2100x28x3.25mm Secondary Cu Strip 20x5mm	1 No.
80.	MCCB	100Amps, Triple pole	1 No.
81.	ELCB and RCCB	25Amps, double pole and 25Amps, double pole, IΔn 30 mA	1 Each
82.	Fuses	HRC Glass Rewire Type	4 Each
83.	Rheostat (Sliding type)	0 - 25 Ohm, 2 Amp 0 - 300 Ohm, 2 Amp	1 No. each

		0 -1 Ohm, 10Amp 0 -10 Ohm, 5 Amp	
84.	Capacitors	Electrolytic Ceramic Polyester film Variable Dual run	2 Each
85.	Various Electronic components	Resistors, Diode, Transistor, UJT, FET, SCR, DIAC, TRAIC, IGBT, Small transformer etc.	As required
86.	Various Lamps	Halogen Incandescent Lamp Fluorescent tube HP mercury vapor Lamp High-pressure sodium Lamp Low-pressure sodium Lamp LED	1 Each
87.	Plug socket Piano Switch Lamp Holder	230 V, 5 A	2 Each
88.	Cables: Twisted Pair Non-Metallic Sheathed Cable Underground Feeder Cable Ribbon Cable Metallic Sheathed Cable Multi-Conductor Cable Coaxial Cable Direct-Buried Cable	1 mtr each	1 Each
89.	Bus bar with brackets	1 mtr each	3 Nos.
90.	Rubber mat	2’ x 4’ x 1”	2 Nos.
91.	Electrician Helmet	Yellow Colour	2 Nos.
92.	RCC Pole with accessories (MS angle iron, ‘C’ clamp, stay insulator etc.) and materials	6 Mtr	1 No.
93.	Safety Belt	Standard quality	2 Nos.
(ii) List of Equipment			
94.	Ohm Meter; Series Type & Shunt Type, portable box type	50/2000-ohm analog	2 Nos. each
95.	Digital Multi Meter	DC 200mv -1000v,0 – 10A & AC 200mv- 750v , 0-10A, resistance 0-20 MΩ and 3 1/2 digit	12 Nos.
96.	A.C. Voltmeter M.I. analog, portable box type housed in Bakelite case	Multi range 75 V - 150V - 300V - 600V	3 Nos.

97.	Milli Voltmeter centre zero analog, portable box type housed in Bakelite case	100 – 0 – 100 mV	2 Nos.
98.	Ammeter MC analog, portable box type housed in Bakelite case	0 - 500 mA, 0-5 A, 0-25 A	2 Nos. each
99.	AC Ammeter MI, analog, portable box type housed in Bakelite case	0 - 1 A, 0-5 A, 0-25 A	2 Nos. each
100.	Kilo Wattmeter Analog	0-1.5-3KW, pressure coil rating-240v/440v, current rating-5A/10A Analoge, portable type Housed in Bakelite case	2 Nos.
101.	Digital Wattmeter	230 V, 1 KW, 50 Hz	2 Nos.
102.	A.C. Energy Meter	Single Phase, 10 A, 240 V induction type	2 Nos.
103.	A.C. Energy Meter	Three Phase, 15 A , 440 V induction type	2 Nos.
104.	Power Factor Meter Digital	440 V, 20 A, Three Phase portable box type	2 Nos.
105.	Frequency Meter	45 to 55 Hz	2 Nos.
106.	Magnetic Flux Meter	0-500 tesla	2 Nos.
107.	Lux meter	lux meter LCD read out 0.05 to 7000 lumens with battery.	2 Nos.
108.	Tachometer	Analog Type - 10000 RPM	1 No.
109.	Tachometer	Digital Photo Sensor Type - 10000 RPM	1 No.
110.	Tong Tester / Clamp Meter	0 - 100 A (Digital Type)	2 Nos.
111.	Megger	Analog - 500 V	2 Nos.
112.	3- point D.C. Starter	For 2.5 KW DC motor	1 No.
113.	4- point D.C. Starter	For 2.5 KW DC motor	1 No.
114.	Wheat Stone Bridge with galvanometer and battery		2 Nos.
115.	Single Phase Variable Auto Transformer	0 - 270 V, 10Amp (Air cooled)	2 Nos.
116.	Phase Sequence Indicator	3 Phase, 415 V	2 Nos.
117.	Growler	230 V, 50 Hz, Single Phase, Adjustable jaws, Testing armature with ampere meter and testing probes.	1 No.

118.	AC Starters: - a. Resistance type starter b. Direct online Starter c. Star Delta Starter- Manual d. Star Delta Starter – Semi automatic e. Star Delta Starter – Fully automatic f. Star Delta Starter - Soft starter g. Auto Transformer type	For A.C Motors of 2 to 5 H.P.	1 No. each
119.	Oscilloscope Dual Trace	20 MHz	1 No.
120.	Function Generator	2 to 200 KHz, Sine, Square, Triangular 220 V, 50 Hz, Single Phase	1 No.
121.	Soldering Iron	25-Watt, 65 Watt and 120-Watt, 230 Volt	2 Nos. each
122.	Temperature controlled Soldering Iron	50-Watt, 230 Volt	2 Nos.
123.	Discrete Component Trainer	Discrete Component (for diode and transistor circuit) with regulated power supply +5,0- 5 V,+12 ,0-12 V	2 Nos.
124.	Linear I.C. Trainer	Linear I.C. Trainer with regulated power supply 1.2V to 15V PIC socket 16pin and 20 pins with bread board	1 No.
125.	Digital I.C. Trainer	Digital I.C. Trainer 7 segment display and bread board	1 No.
126.	Domestic Appliances –		
	a. Electric Induction plate	a. 1500 Watt, 240V	1 No. each
	b. Electric Kettle	b. 1500 Watts, 240V	
	c. Electric Iron	c. Automatic - 750 W, 240 V	
	d. Immersion Heater	d. 1500 Watt, 240V	
	e. A.C. Ceiling Fan and AC Table Fan	e. 68-Watt, 230 V	
	f. Geyser (Storage type)	f. 10 litre	
	g. Mixture & Grinder	g. 750 W, 240 V	
	h. Washing Machine Semi-Automatic	h. 5 Kg,	
	i. Motor Pump set	i. 1 HP, 1 Phase, 240 V	
127.	Oil Testing Kit	Oil Testing Kit 230 V, single phase 50 Hz 60 VA output 0-60 KV Variable	1 No.
128.	Inverter with Battery	1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	1 No.
129.	Voltage Stabilizer	AC Input - 150 - 250 V, 600 VA AC Output - 240 V, 10 A	1 No.

130.	DC Power Supply	0 - 30 V, 5 A	2 Nos.
131.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30amp	1 No.
132.	Current Transformer	415 V, 50Hz, CT Ratio 25 / 5 A, 5VA	2 Nos.
133.	Potential Transformer	415 V, 50Hz, PT Ratio, 440V/110V, 10VA	2 Nos.
134.	Solar panel with Battery	18 Watt	1 Set
135.	I 5 AND I7 COMPUTER OR latest VERSION	2.8 GHz & above, 1 GB RAM, 80 GB HDD, DVD Combo Drive, 19/21" Monitor, optical scroll mouse, multimedia keyboard, 32 bit LAN card with UPP port, necessary Drivers, etc. OR (Latest Version)	2 Nos.
136.	Ink jet/ laser printer		1 No.
C. Shop Machinery - For 4 (2+2) units no additional items are required			
137.	D.C. Shunt Generator with control panel	D.C. Shunt Generator with control panel,2.5 KW, 220V &3phase Squirrel cage Induction Motor, 5HP, 440V with control panel & star delta starter	1 No.
138.	Motor-Generator (AC to DC)	Squirrel Cage Induction Motor with star delta starter and directly coupled to DC shunt generator and switch board mounted with regulator, air breaker, ammeter, voltmeter, knife blade switches and fuses, set complete with case iron and plate, fixing bolts, foundation bolts and flexible coupling. Induction Motor rating: 7.5 HP, 415V, 50 cycles, 3 phases. DC Shunt Generator rating: 5 KW, 440V (Output voltage varies 110-440v)	1 No.
139.	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker, 2.5 KW, 220V &3phase Squirrel cage Induction Motor, 5HP, 440V, with control panel & star delta starter	1 No.

140.	DC Series Motor coupled with spring balance load	2.5 KW, 220 Volts	1 No.
141.	DC Shunt Motor	2.5 KW, 220 V	1 No.
142.	DC compound Motor with starter and switch	2.5 KW ,220 volts	1 No.
143.	Motor Generator(DC to AC) set consisting of - Shunt Motor with starting compensator and switch directly coupled to AC generator with exciter and switch board mounted with regulator, breaker, ammeter, voltmeter frequency meter, knife blade switch and fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts and flexible coupling.	Shunt Motor rating: 5 HP, 440V AC Generator rating : 3-Phase, 4 wire, 3.5 KVA, 400/230 Volts, 0.8 pf, 50cycles	1 No.
144.	AC Squirrel Cage Motor with star delta starter and triple pole iron clad switch fuse with Mechanical Load.	5 HP, 3-Phase, 415 V, 50 Hz	1 No.
145.	AC phase-wound slip ring Motor with starter switch	5 HP, 440 V, 3 Phase, 50 Hz	1 No.
146.	Universal Motor with starter/switch	240 V, 50 Hz, 1 HP	1 No.
147.	Synchronous motor with accessories like starter, excitation arrangements.	3 Phase, 3 HP, 440V, 50Hz, 4 Pole	1 No.
148.	Thyristor /IGBT controlled D.C. motor drive with tacho-generator feedback arrangement	1 HP	1 No.
149.	Thyristor/IGBT controlled A.C. motor drive with	VVVF control 3 Phase, 2 HP	1 No.
150.	Single phase Transformer, core type, air cooled	1 KVA , 240/415 V, 50 Hz	3 Nos.
151.	Three phase transformer, shell type oil cooled with Delta/ Star	3 KVA , 415/240 V, 50 Hz	2 Nos.
152.	Electrical Machine Trainer –	Suitable for demonstrating the construction and functioning of different types of DC machines and AC machines (single phase and three phase). Should be fitted with friction brake arrangement, dynamo meter, instrument panel and power supply unit	1 for 8 (4+4) Units

153.	Diesel Generator Set with changeover switch, over current breaker and water/ air-cooled with armature, star-delta connections AC 3 phase	7.5 KVA, 415 volt or higher rating	1 No. per institute
154.	Used DC Generators-series, shunt and compound type for overhauling practice		1 No. Each
155.	Pillar Electric Drill Machine Motorized	12-20 mm Capacity, 1HP, 440V, 3 phase, Induction Motor with DOL starter, Bench Type	1 No.
156.	Motorised Bench Grinder	1 HP. 3 phase, 440V with DOL starter, Double side with smooth and rough wheel with Tool Base	1 No.
157.	A.C. Series type Motor	1 HP, 240 V, 50 Hz	1 No.
158.	Single Phase Capacitor Motor with starter switch	1 HP, 240 V, 50 Hz	1 No.
159.	Manual Motor coil Winding Machine	With step arbor	1 No.
160.	Ceiling fan coil Winding Machine	250V, 50 Hz, 1-Φ, with speed control	1 No.
161.	Primary current injection set	220V, 50 Hz, 1-Φ, output current - 200 A (min) with timer	1 No.
162.	Stepper Motor with Digital Controller		1 No.
163.	Shaded Pole Motor	Fractional HP, 240 V, 50 Hz	1 No.
164.	Smart Meter	1 Phase - Smart Energy Meter 3 Phase - Smart Energy Meter	1 No. each
165.	EV Charger	3 phase input	1 No.
166.	EV Charger (Home)	1 Phase input	1 No.
D. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required			
167.	Working Bench	2.5 m x 1.20 m x 0.75 m	4 Nos.
168.	Wiring Board	3-meter x1 meter with 0.5 meter projection on the top	1 No.
169.	Instructor's table		1 No.
170.	Instructor's chair		2 Nos.
171.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
172.	Lockers with drawers		1 for Each Trainee
173.	Almirah	2.5 m x 1.20 m x 0.5 m	1 No.
174.	Black board/white board	(minimum 4X6 feet)	1 No.
175.	Fire Extinguisher CO2	2 KG	2 Nos.
176.	Fire Buckets	Standard size	2 Nos.

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*
2. *Internet facility is desired to be provided in the class room.*

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

PLUMBER

(Duration: One Year)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3

SECTOR – PLUMBING

Directorate General of Training

PLUMBER

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
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CONTENTS

1. COURSE INFORMATION

During the one-year duration a candidate of Plumber trade is trained on subjects Professional Skill, Professional Knowledge, and Employability Skills related to job role. In addition to this a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The practical part starts with basic pipe work viz. cutting of pipes, threading, joining, etc. and finally to fitting, fixing and laying of hot & cold water pipe line, repairing and reconditioning of waste pipe line at the end of the course. The broad components covered under Professional Skill subject are as below:

The practical part starts with basic fitting in the beginning and the candidate imparted training on allied trades viz., carpenter, Welding (Gas & Arc), Masonry which leads to multi-skilling. In the basic fitting the skills imparted are marking, sawing, chipping, filing, measurement, soldering, brazing, drilling, grinding and observation of all safety aspects is mandatory. The accuracy achieved is of±0.25 mm. The safety aspects cover components like OSH&E, PPE, Fire extinguisher, First Aid etc. Cutting Pipes in different angle. Joining of pipes of different diameter and angles by gas welding, thread cutting on different types of pipes & fittings accessories. Making of brick wall and RCC casting. Brick wall cutting for concealing pipe line. Bending of Pipes, making of pipe line circuit for water distribution, fixing Cocks & valve, Water analysis test, Water Pressure test are being taught. Alignment and laying of humid pipeline & maintenance of drainage pipe line. Installation and maintenance of Electric pumps, Construction of inspection chamber, manhole, gutter, septic tank, socket etc. Testing of drainage pipe, Removal of leakage pipe line, Installation, fixing & maintenance of valve & cock, water meter, Fixtures, hot & cold water pipe line, Repairing & reconditioning of waste pipe line, Repairing & reconditioning, scraping & painting of sanitary fittings are being taught in the practical.

Professional Knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition, components like Physical properties of engineering materials, different types of iron, properties and uses, Heat & Temperature are also covered under theory part.

Total three projects need to be completed by the candidates in a group. In addition to above components the core skills components viz., employability skills are also covered. These core skills are essential skills which are necessary to perform the job in any given situation.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variantsand Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for propagating vocational training.

Plumber trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of one year duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional - skills and knowledge, while Core area (Employability Skills) imparts requisite core skills, knowledge and life skills. After passing out of the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join advanced diploma (Vocational) courses conducted by DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one year: -

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	840
2	Professional Knowledge (Trade Theory)	240
3	Employability Skills	120
	Total	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment (Internal)** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The examiner during final examination will also check** the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted while assessing for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the

	project/job.
(b) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marks in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Plumber, General; lays out, assembles, installs and maintains sanitary fittings and fixtures, sewage and drainage systems, heating and sanitary systems, gas and water pipe lines etc. Receives instructions from Sanitary Engineer or Civil Engineer regarding lay out of pipes, gas or water mains, position of fixtures and fittings, etc. Examines drawings or other specifications regarding size and dimensions of area where sanitary fittings or pipe are to be fitted or laid. Marks points at places to indicate position for fixing brackets and laying pipes. Drills passage holes in walls or floor of premises and fixes necessary brackets, stands, holders etc. to keep or hold fittings and fixtures in position, using nuts, bolts, clamps etc. and tightens them with hand tools. Cuts reams, threads and bends pipes as appropriate. Ensures that pipe lines are laid properly by Pipe Fitter. Joins pipes with sockets, Tees, elbow etc. or with molten lead or lead wool. Caulks joints (operation of making joint seam tight to withstand pressure) and tests them for leaks with pneumatic or hydraulic pressure. May repair and maintain sewerage and pipe lines by replacing washers on leaky faucets, mending burst pipes, opening clogged drains, etc. May do lead burning, dressing and bossing of lead pipe and sheet lead, inlaying of wooden tanks, construction of septic tanks etc.

Plumber, Operations; is responsible for operation of plumbing system used in housing, commercial and institutional setups.

Plumber, General-Installation and Repair; Plumber (General)-II is responsible for installation and repair plumbing systems including those of advanced sanitary fixtures as per manufacturer's specifications in housing, commercial and institutional setups.

Plumber, General Helper; is responsible for helping Plumber (General) by carrying and handling of tools and materials required in installation, minor repair and maintenance of plumbing systems.

Plumber, General Assistant; is responsible for assistance in, preliminary installation and minor repair work of basic plumbing systems in domestic, commercial and institutional setups.

Plumber, Maintenance and Servicing Assistant; is responsible for assistance in maintenance and servicing of pipes and sanitary fixtures in housing, commercial and institutional setups.

Plumber, Maintenance and Servicing; is responsible for assistance in maintenance and servicing of pipes and sanitary fixtures in housing, commercial and institutional setups.

Pipe Layer/Plumber Pipeline; Sewer Pipe Layer lays concrete, stone ware or clay pipes to form sanitary drains and sewers. Receives instructions regarding size and type of concrete, stone ware or clay pipe to be laid. Digs or gets earth dug along marked lines using spade, picks etc. to make trenches for laying pipes. Levels and smoothens bottom of trenches to proper gradient by scooping with shovels. Receives pipes of required size lowered into trench manually or by pulley and adjusts their position by hand or crow-bar for correct levelling and vertical and horizontal

alignment. Joints pipes together using appropriate couplings, joints, rings etc. and closes joints by caulking with fibre and cement to prevent leakage. Tests joints by hydraulic or pneumatic pressure after sealing. Fills trench with earth to cover laid pipe and rams earth to avoid sinking. Is designated as Pipe Layer Water Mains or Water Mains Fitter if engaged in laying cast iron or galvanized iron water pipe mains and in caulking their joints with lead to prevent leakage. May lay pipe lines to provide water connection to houses, sanitary sewers etc. May fix meters to stopcocks, remove defects from pipe lines and replace defective ones.

Pipe Fitter; lays, repairs and maintains, pipes for supply of water, gas, oil or steam in buildings, gardens, workshops, stores, ships etc., according to drawings or instructions. Examines drawings and other specifications or receives relevant instructions. Cuts passage holes for laying pipes in walls and floors. Cuts reams, threads and bends pipes according to specifications. Lays pipes in cut passage and assembles pipe sections with couplings, sockets, Tee's elbows etc. Levels position of pipes using sprit level for gravitational flow. Caulks joints, tests them for leakage with pneumatic or hydraulic pressure and secures pipe line to structure with clamps, brackets, and hangers. Fits water meters, taps etc. to pipe where necessary. Repairs and replaces leaky pipe lines, taps and joints and provides connections to overhead water tanks. Helps Plumber, General in fittings sanitary fittings to buildings. May join pipe sections and fittings.

Plumbers and Pipe Fitters, Other; perform number of routine and low skilled tasks such as assisting in laying pipes, making water tight joints, fitting sockets and reducers, threading pipes with taps and dies, removing leakages, etc., and are designated as Plumber Mate or Pipe Fitter Helper according to type of work done.

Plumber (Welder)/Plumbing (Sanitary Fixtures) Fitter Assistant; is responsible for welding activities related to plumbing works in housing, commercial and institutional setups.

Plumber (Welder) Assistant; is responsible for assistance in welding activities related to plumbing works in housing, commercial and institutional setups.

Plumber (Pumps and E/M Mechanic); is responsible for installation and repair of Pumps and E/M equipment used for different plumbing applications of housing, commercial and institutional Set ups.

Reference NCO-2015:

i) 7126.0101 - Plumber, General
ii) 7126.0102 - Plumber, Operations
iii) 7126.0103 - Plumber, General – Installation and Repair
iv) 7126.0104 - Plumber, General Helper
v) 7126.0105 - Plumber, General Assistant
vi) 7126.0106 - Plumber, Maintenance and Servicing Assistant
vii) 7126.0107 - Plumber, Maintenance and Servicing
viii) 7126.0201 - Pipe Layer/Plumber Pipeline
ix) 7126.9900 - Plumbers and Pipe Fitters, Other
x) 7212.0101 - Plumber (Welder)/Plumbing (Sanitary Fixtures) Fitter Assistant

xi) 7212.0102 - Plumber (Welder) Assistant
xii) 7233.1301 - Plumber (Pumps & E/M Mechanic)
xiii) 7126.0301 - Pipe Fitter

Reference NOS:

i) NOS: PSC/NO133v1.0
ii) NOS: PSC/NO132
iii) NOS: PSC/NO134
iv) NOS: PSC/NO135
v) NOS: PSC/N9901 v 1.0
vi) NOS: PSC/NO136
vii) CSC/N9401
viii) CSC/N9402

4. GENERAL INFORMATION

Name of the Trade	**PLUMBER**
Trade Code	DGT/1014
NCO - 2015	7126.0101, 7126.0102, 7126.0103,7126.0104, 7126.0105, 7126.0106, 7126.0107, 7126.0201, 7126.0301, 7126.9900, 7212.0101, 7212.0102,7233.1301
NOS Covered	NOS: PSC/NO133v1.0, NOS: PSC/NO132, NOS: PSC/NO134, NOS: PSC/NO135, NOS: PSC/N9901 v 1.0, NOS: PSC/NO136 CSC/N9401 CSC/N9402
NSQF Level	Level-3
Duration of Craftsmen Training	One Year (1200 hours +150 hours OJT/ Group Project)
Entry Qualification	Passed 8thclass Examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF
Unit Strength (No. Of Student)	24(There is no separate provision of supernumerary seats)
Space Norms	80 sq. m
Power Norms	3 KW
Instructors Qualification for:	
i) Plumber Trade	B.Voc/Degree in Civil/ Mechanical engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Civil / Mechanical engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC / NAC passed in Plumber or relevant trade with 3 years' experience. **<u>Essential Qualification:</u>** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***Note: Out of two Instructors required for the unit of 2 (1+1), one***

	must have Degree/Diploma and other must have NTC/NAC qualifications. However both of them must possess NCIC in any of its variants.
ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
iv) Employability Skill	MBA/ BBA/ Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills.

	(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. [Basic fitting operation – marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]
   (NOS:PSC/NO133v1.0), (NOS:PSC/NO132), (NOS:PSC/NO134), (NOS:PSC/NO135), (NOS:PSC/N9901 v 1.0)
2. Perform Inner & Outer Thread cutting on Metal & Studs and thread cutting on different types of pipes & fittings accessories. (NOS:PSC/NO133)
3. Carry out cutting of Pipes of different Dia in different angle and Joining of pipes by gas welding, Soldering and Brazing. (NOS:PSC/NO133)
4. Construct Masonry brick wall and RCC casting. Brick wall cutting for concealing pipe line. (NOS:PSC/NO133),(NOS:PSC/NO134),(NOS:PSC/NO134)
5. Carry out Cutting and Bending of Pipes using Plumber's tools and equipment. (NOS:PSC/NO133)
6. Join various type of PVC pipe by heat process or Welding. (NOS:PSC/NO133)
7. Construct complete pipe line circuit with different types of Joints and fixing Cocks & valve on Pipe line. (NOS:PSC/NO133)
8. Carry out cutting of different Types of PVC Pipe, joining and laying. (NOS:PSC/NO133)
9. Perform Water analysis test, Water Pressure test and Water distribution system by using Pipe line.(NOS:PSC/NO133)
10. Align and lay humid pipe line of different dia. and fitting & maintenance of drainage pipe line. (NOS:PSC/NO135)
11. Install and maintain different Electric pumps. (NOS:PSC/NO135)
12. Join fittings for different purposes on PVC pipe line. (NOS:PSC/NO133)
13. Construct inspection chamber, manhole, gutter, septic tank, socket etc. (NOS:PSC/NO135)
14. Test pipe line as per site drainage pipe line layout. (NOS:PSC/NO135)
15. Perform removal of leakage pipe line. (NOS:PSC/NO133)
16. Install, fix & maintain different valve & cock. (NOS:PSC/NO136)
17. Install& maintain water metre and water supply for fixture. (NOS:PSC/NO133)
18. Demonstrate method of bending for different materials & different pipe joint. (NOS:PSC/NO133)
19. Perform fitting and maintenance of Fixture at different place. (NOS:PSC/NO136)

20. Carry out fitting, fixing & laying installation of hot & cold water pipe line and symbolizing. (NOS:PSC/NO133)
21. Perform repairing & reconditioning of waste pipe line. (NOS:PSC/NO133)
22. Perform repairing & reconditioning, scraping & painting of sanitary fittings pipe line. (NOS:PSC/NO133)
23. Read and apply engineering drawing for different application in the field of work.CSC/N9401
24. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. *[Basic fitting operation – marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]*(NOS:PSC/NO133v 1.0) (NOS:PSC/NO132) (NOS:PSC/NO134) (NOS:PSC/NO135), (NOS:PSC/ N9901 v 1.0)	Plan & Identify tools, instruments and equipment for marking and make this available for use in a timely manner.
	Select raw material and inspect visually for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hack sawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hack sawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Observe safety procedure during above operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
2. Perform Inner& Outer Thread cutting on Metal &Studs and then thread cutting on different types of pipes & fittings accessories. (NOS:PSC/NO133)	Identify Hand Tools for Plumber work.
	Identify Hand Tools for Cutting Inner thread and Outer thread.
	Identify the pipe fittings.
	Perform Inner thread cutting as per drawing.
	Perform Outer thread cutting as per drawing.
	Prepare the Pipe line circuit with fittings as per drawing.
	Observe safety procedure during thread cuttingas per standard norms and company guidelines.
	Check and verify the job as per drawing.
3. Carry out cutting of Pipes of different Dia in different angle and Joining of pipes by gas welding, Soldering and Brazing. (NOS:PSC/NO133)	Identify different components/parts of Gas (oxy-acetylene) machine, collect desired information and set each components/parts as per standard procedure.
	Observe safety/ precaution during operation.
	Select appropriate material & plan for gas cutting & joining operation.
	Cut & join metal parts / mechanical components as per specification observing standard procedure.

	Check cut portion/ joined part to ascertain proper welding.
	Identify hand tools for Soldering and Brazing.
	Mark and develop various forms as per drawing using sheet metals.
	Make of simple items with sheet metal as per drawing.
	Perform Soldering and Brazing.
	Observe safety procedure during operation
	Check and verify the job as per drawing.
4. Construct Masonry brick wall and RCC casting. Brick wall cutting for concealing pipe line.(NOS:PSC/NO133) (NOS:PSC/NO134) (NOS:PSC/NO134)	Identify different types of Mason's hand tools.
	Identify the Construction materials.
	Make a simple construction of different type of Brick joints with mortar.
	Prepare a job Masonry work and RCC casting as per drawing.
	Check & verify the job as per drawing.
5. Carry out Cutting and Bending of Pipes using Plumber's tools and equipment. (NOS:PSC/NO133)	Identify different types of Plumber's hand tools.
	Demonstrate care of hand tools.
	Cutting the pipe with Pipe cutter.
	Demonstrate working of Bending Machine and accessories.
	Make desired bend on pipe as per drawing.
	Check the job as per Drawing.
6. Join various type of PVC pipe by heat process or Welding. (NOS:PSC/NO133)	Identify different types of PVC Pipe.
	Demonstrate working of Electric Welding Machine and accessories for PVC pipes
	Simple joint of PVC pipe by Welding Machine.
	Making a job with PVC fittings and pipe as per drawing.
	Observe safety procedure during operation.
7. Construct complete pipe line circuit with different types of Joints and fixing Cocks & valve on Pipe line.(NOS:PSC/NO133)	Identify different types of Joints.
	Identify different types of tools different types of Joints.
	Make a Flange joint as per drawing.
	Make a Detachable joint as per drawing.
	Make a Spigot & Socket joint as per drawing.
	Make a Socket joint as per drawing.
	Identify GI fittings.
	Identify Cocks & Valves.
	Identify Tools for fixing of fittings with GI pipe, Cocks & Valves.
	Make a simple job on GI Pipe with fittings, Cocks, and Valves as per drawing.

	Check & verify the job as per drawing.
8. Carry out cutting of different Types of PVC Pipe, joining and laying.(NOS:PSC/NO133)	Identify Tools and materials for Cutting & Joining of PVC pipes.
	Make a job of Pipe line Circuit as per drawing.
	Check & verify the job as per drawing.
9. Perform water analysis test, Water Pressure test and Water distribution system by using Pipe line.(NOS:PSC/NO133)	Prepare water for test.
	Preparation of water analysis kits.
	Test water for pH, TDS, Temperature as per requirements.
	Preparation of Hydraulic Pressure Test Machine.
	Pressure test on Cistern and Tank.
	Check and verify test result.
10. Align and lay humid pipe line of different dia. and fitting & maintenance of drainage pipe line. (NOS:PSC/NO135)	Plan and identify tools, instrument and equipment for marking and make this available for use on a timed manner.
	Select of raw materials and visually inspect for defects.
	Check the defect of humid pipe line.
	Prepare the job, tools & raw materials.
	Observe safety procedure for desired operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
11. Install and maintain different Electric pumps. (NOS:PSC/NO135)	Select the pump and inspect for defects.
	Select the tools, instrument and equipment for the pump installation and repairing.
	Check and calculate output of the pumps.
	Install pump Observing standard procedure and method as per specification using appropriate tools and raw material.
	Check performance of the pump.
12. Join fittings for different purposes on PVC pipe line.(NOS:PSC/NO133)	Identify tools, instrument and equipment for marking and make this available for use in a timely manner.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Join fittings for desired purpose on PVC pipe line.
	Measure all dimensions in accordance with the drawing.
	Observe safety procedure during desired operation as per standard norms.
	Check for dimensional accuracy as per standard procedure.
13. Construct inspection chamber, manhole, gutter,	Plan and identify tools and equipment for desired purpose and make this available for use in a timely manner.

septic tank, socket etc. (NOS:PSC/NO135)	Select raw materials and inspect for defect.
	Mark as per drawing applying desired mathematical calculation and observing standard procedure.
	Construct inspection chamber, manhole, gutter, septic tank, socket etc. as per drawing.
	Measure all dimensions in accordance with standard specification and tolerance.
	Observe safety procedure during desired operation as per standard norms.
	Check for dimensional accuracy as per standard procedure.
14. Test pipe line as per site drainage pipe line layout. (NOS:PSC/NO135)	Identify tools and equipment for testing pipe line.
	Prepare the job for different testing for pipe line.
	Test pipe line observing standard procedure.
	Observe safety precaution during operation.
15. Perform removal of leakage pipe line.(NOS:PSC/NO133)	Identify the leakage pipe.
	Remove out pipe leakages as per standard procedure.
	Observe safety procedure during desired operation as per standard norms.
	Check performance after removal of leakages.
16. Install, fix &maintain different valve & cock.(NOS:PSC/NO136)	Plan and identify tools, instrument &equipment for Installation, fixing & maintenance of different valve & cock and make this available for use in a timely manner.
	Select valve and cock, inspect for defects.
	Install desired Valve & Cock observing standard procedure.
	Identify the problem with valve & cock fitted and solved the problem.
	Observe safety procedure during the operation as per standard norms.
	Check different parameters and functionality of the system.
17. Install &maintain water metre and water supply for fixture. (NOS:PSC/NO133)	Plan and identify tools, instrument &equipment for Installation, fixing & maintenance of different water meter and water supply for fixture and make this available for use in a timely manner.
	Select water meter and water supply for fixture, inspect for defects.
	Install desired water meter and water supply for fixture observing standard procedure.
	Identify the problem with water meter and water supply for fixture fitted and solved the problem.
	Observe safety procedure during the operation as per standard

	norms.
	Check different parameters and functionality of the system.
18. Demonstrate method of bending for different materials & different pipe joint. (NOS:PSC/NO133)	Plan and identify tools, instrument &equipment for marking and make this available for use in a timely manner.
	Select desired material and machine and inspect for defects.
	Bend G.I. pipe as per drawing and measurement.
	Bend PVC pipe of different diameter in different angle.
	Observe safety procedure during desired operation as per standard norms and schedule drawing.
	Check for dimensional accuracy as per drawing.
19. Perform fitting and maintenance of Fixture at different place (NOS:PSC/NO136)	Plan and identify tools, instrument &equipment for marking and make this available for use in a timely manner.
	Select raw material and inspect for defects.
	Cut & join C.I. pipe for waste pipe line in accordance with standard specification and drawing.
	Fix external soil pipe as per drawing observing standard procedure.
	Fix rain water gutter outlet and ground pipe as per standard norms and schedule drawing.
	Check different parameters and functionality of the system.
20. Carry out fitting, fixing & laying installation of hot & cold water pipe line and symbolizing. (NOS:PSC/NO133)	Plan and identify tools, instrument &equipment for desired work and make this available for use in a timely manner.
	Install pipe line for distribution of hot & cold water according to drawing.
	Install hot water system & solar water heating system in accordance with standard specification and drawing.
	Observe safety procedure during desired operation as per standard norms and schedule drawing.
	Check different parameters and functionality of the system.
21. Perform repairing & reconditioning of waste pipe line. (NOS:PSC/NO133)	Plan and identify tools, instrument &equipment for desired work and make this available for use in a timely manner.
	Perform fitting of different trap, valve, cistern etc.
	Construct over head tank as per drawing and measurement.
	Perform pressure test by hydraulic test machine.
	Observe safety procedure during desired operation as per standard norms and schedule drawing.
	Check different parameters and functionality of the system.
22. Perform repairing &	Plan and identify tools, instrument &equipment for desired work

reconditioning, scraping & painting of sanitary fittings pipe line. (NOS:PSC/NO133)	and make this available for use in a timely manner.
	Perform cleaning of sanitary pipe line and remove corrosion from pipe line.
	Remove corrosion from pipe line and Perform scraping & painting of pipe line in accordance with standard guidelines.
	Replace broken or cracked sanitary fitting.
	Observe safety procedure during desired operation as per standard norms and schedule drawing.
	Check different parameters and functionality of the system.
23. Read and apply engineering drawing for different application in the field of work.CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
24. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9401	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR PLUMBER TRADE			
DURATION: ONE YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) with Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 100Hrs; Professional Knowledge 18Hrs	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions.*[Basic fitting operation – marking, Hacksawing, Chiseling, Filing, Drilling, Taping, Threading and Grinding etc. Accuracy: ± 0.25mm]* (Mapped NOS:PSC/NO133v1.0, PSC/NO132, PSC/NO134, PSC/NO135, PSC/ N9901 v 1.0)	1. Importance of trade training, List of tools & Machinery used in the trade. (08hr) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (5 hrs) 3. First Aid Method and basic training. (08hrs) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (05hrs) 5. Hazard identification and avoidance. (2 hrs) 6. Safety signs for Danger, Warning, caution & personal safety message. (06 hrs) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (04 hrs) 8. Use of Fire extinguishers. (7 hrs) 9. Practice and understand precautions to be followed while working in the trade. (04hrs) 10. Safe use of tools and equipment used in the trade. (1 hr)	• Importance of safety and general precautions required for the trade. • Importance of the trade. • Types of work to be done by trainees in the institute. • Scope of a plumbing work. • Types of services have to plan. • Basic Bench fitting (04hrs)
		11. Use Steel rule and Steel Tape for measuring, Use Scriber and Divider for marking on	• Plumber's common hand tools - names, description and material

		raw materials. (10hrs) 12. Demonstrate use of different types of Vice: - Bench vice, Pipe vice, Chain Vice, Hand vice, Chain Wrench. (20 hrs) 13. Demonstrate use of various Hand Tools: - Different Files, Hammer, Centre Punch, Hacksaw, Chisel, Callipers, Pipe Wrench, Stock & Dies, Taps and Holders. (20hrs)	from which they are made. • Description, types and uses of holding device, hammers & cold chisels, cutting tools. • Description of simple fitting operations hack sawing, punching and filing. • Types of files used commonly. • Marking instruments and their use of simple drilling machine. • Method of using drills. • Description of simple bench drilling Machine. • Description of Grinding and Chisel. • Description of different types of locking and fastening devices. (14 hrs)
Professional Skill 15 Hrs; Professional Knowledge 06 Hrs	Perform Inner & Outer Thread cutting on Metal & Studs and thread cutting on different types of pipes & fittings accessories. (Mapped NOS:PSC/NO133)	14. Thread Inner on M.S. flat by using Tap.(5 hrs) 15. Use various locking device.(5 hrs) 16. Outer thread on Pipe by using Die. (3 hrs) 17. Fixing of different Pipe fittings in different position of Pipe. (2 hrs)	• About different types of pipes-GI, CI, DI, PVC/ CPVC, PPR and HDPE etc. • About different Types of Pipe Fittings: - Socket, Elbow, Tee, Union, Bend, Cap, Plug, Cross, Ferrule etc. • About different types of Thread cutting. (06hrs)
Professional Skill 20Hrs; Professional Knowledge 08Hrs	Carry out cutting of Pipes of Different dia in different angle and Joining of pipes by gas welding, Soldering and Brazing. (Mapped NOS:PSC/NO133)	18. Cutting different diameter of MS pipes in different angles. (10 hrs) 19. Joining of Pipe in same dia by gas welding. (05hrs) 20. Joining of Pipes in different dia by gas welding. (05hrs)	**Gas Welding :-** • Purpose of Gas welding. • Method of gas welding • Safety precautions to be observed -Methods of soldering and brazing - fluxes used & Types of fluxes precautions to be

			observed. • Hard & soft solders - their properties, composition and uses. (08hrs)
Professional Skill 35Hrs; Professional Knowledge 08Hrs	Construct Masonry brick wall and RCC casting. Brick wall cutting for concealing pipe line. (Mapped NOS:PSC/NO133, PSC/NO134, PSC/NO134)	21. Demonstrate proper handling of Mason's hand tools: - Straight edge, Spirit level, Plumb bob, Square, Trowel etc. (5 hrs) 22. Setting out work with Tape, Rule, Square, Line pin and level as per drawing. (5hrs) 23. Prepare Cement mortars in different proportions to suit various purposes. (5 hrs) 24. Prepare Plane Cement Concrete and RCC in different proportions to suit various purposes. (5 hrs) 25. Benching and Channelling of base plate. (5hrs) 26. Damp proofing. (2 hrs) 27. Plastering the walls. (3 hrs) 28. Cutting of Masonry wall for concealing with Electric Cutting Tools. (5 hrs)	**Mason's works :-** • Names and description of Mason's hand tools and their uses. • Method of making holes in walls and floors. • Types of tools used and various Processes. • Concept of bricks, lime and cement. • Preparation of mortars with various materials of varying composition. • Common brick joints. • Description of bonds. • Scaffolding &plastering. • Define Plain cement concrete, RCC and its proportion, • Grades of coarse aggregate and fine aggregate, • Knowledge of waterproofing compound. • Knowledge of Building Plan and Cross section of wall. • Identify plumbing services required for each type of building according to usage. (08hrs)
Professional Skill 40 Hrs; Professional Knowledge	Carry out Cutting and Bending of Pipes using Plumber's tools and equipment. (Mapped NOS:PSC/NO133)	29. Demonstrate proper handling of Plumber's Tools & Equipment. (05hrs) 30. Use and care of Plumber's Tools and Equipment.	• Description of plumber tools and Equipment- Ratchet brace, Threading die, Pipe wrench, sliding wrench,

10Hrs		(05hrs) 31. Cutting of G.I Pipes of different Diameter and Sizes by cutting tools. (05hrs) 32. Cutting of C.I Pipe of different Diameter and Sizes by cutting tools. (05hrs) 33. Cutting of all kinds of PVC Pipe of different Diameter and Sizes by cutting tools. (05 hrs) 34. Bending of G.I Pipe as per drawing using Bending Machine up to 50 mm dia. (10 hrs) 35. Bending of PVC Pipe as per drawing using heat process up to 50 mm dia. (5 hrs)	Spanner set, Chain Wrench etc. and their safety. • Care & use of tools. • Pipes of different kinds • Method of Pipe bending in different dia. • Plumbing Symbols and Code for Tools & Materials on water line. (10hrs)
Professional Skill 25Hrs; Professional Knowledge 08Hrs	Join Various type of PVC pipe by heat process or Welding. (Mapped NOS:PSC/NO133)	36. Preparation of PVC pipe & Fittings in different dia. (1 hr) 37. Preparation and precaution of Electric Hot Plate. (1hr) 38. PVC Pipe welding various dia, using welding machine. (13hrs) 39. Weld various type of PVC Pipe with various dia, using welding machine. (5hrs) 40. PPR pipe welding joint various dia of pipe using welding machine.(5hrs)	• Equipment and tools for hot gas welding and electric hot plate for PPR pipe joints. (08hrs)
Professional Skill 25Hrs; Professional Knowledge 08Hrs	Construct complete pipe line circuit with different types of Joints and fixing Cocks & valve on Pipe line. (Mapped NOS: PSC/NO133)	41. CI/HCI Pipe Flange joint with Bend and Tee. (5hrs) 42. Socket joint of CI Pipes with lead. (5 hrs) 43. Detachable joint of AC pressure Pipe. (5 hrs) 44. Titan/Socket & Spigot joint of Ductile Iron (DI) Pipe with Rubber ring.(4hrs) 45. Prepare and Study the drawing of Pipe line circuit and schedule use of Tools and accessories.(2hrs)	• Types of fittings for different joints & different pipes.: - CI,HCI,AC,AC Pressure, DI, GI Pipes. Joints: - Flange joint, Socket joint with lead, Detachable joint, Socket & Spigot joints etc. • Description of pipe fittings. • Methods of joining and

		46. Make a Pipe line circuit on GI Pipe with Socket, Elbow, Bend, Flange, Tee, Union etc. And Fixing Cocks & Valves as per drawing. (4hrs)	their uses. • Precautions to be taken while fixing (08hrs)
Professional Skill 25Hrs; Professional Knowledge 06Hrs	Carry out Cutting of Different Types of PVC Pipe, joining and laying. (Mapped NOS: PSC/NO133)	47. PVC pipe cutting & shaping in various dia, using Hacksaw and Pipe cutters. (10 hrs) 48. Preparation of PVC pipe and Fittings with emery paper. (5hrs) 49. Use & fixing of PVC fittings use Solvent Cement etc. (5hrs) 50. Layout of PVC pipe according to drawing. (5hrs)	• Different kinds of Joints, Fittings and Materials in joining pipes: - PVC/CPVC, PPR and HDPE etc. (06hrs)
Professional Skill 25Hrs; Professional Knowledge 06Hrs	Perform Water analysis test, Water Pressure test and Water distribution system by using Pipe line. (Mapped NOS:PSC/NO133)	51. Preparation of Water and Water analysis kit. (1 hr) 52. Water Analysis Test by Analysis Kits. pH, TDS, Temperature etc. (4hrs) 53. Preparation of Hydraulic Pressure Test Machine. (1 hr) 54. Static water pressure test by Hydraulic Pressure Test Machine apply on Plastic Water bottle. (4hrs) 55. Static water pressure test by Hydraulic Pressure Test Machine apply on Cistern and Tank. (4hrs) 56. Steps of simple pipe line connection as per drawing. (3 hrs) 57. Make a pipe line for water distribution as per drawing. (4hrs) 58. Make a pipe line for OHR water distribution system as	**Composition of Water: -** • Sources of water • Hard & Soft water, temporary hardness &permanent hardness. • Impurities of water – organic and inorganic impurities. • Water purification stages and methods. • Static water pressures and measurement of pressures. Bursting pressure, • Expansion of water on freezing and heating. • Bernoulli's principles • Pascal's law. • Pressure of water on the sides of cistern or tank. • Water hammer in pipes. • Description and working

		per drawing. (02hrs) 59. Installation of water hammer arrester. (02 hrs)	of water hammer arrester. (08hrs)
Professional Skill 45Hrs; Professional Knowledge 10Hrs	Align and lay humid pipe line of different dia. and fitting & maintenance of drainage pipe line. (Mapped NOS: PSC/NO135)	60. Interpret drawing of sanitary plumbing. (08hrs) 61. Lay & align hummed pipe. (05hrs) 62. Demonstrate use of specific dia in different location. (04hrs)	• Use of hummed pipes of different sizes. • Method of laying out pipes alignment and joining. (05hrs)
		63. Use various sanitary fitting. (06 hrs) 64. Use various fitting of different materials. (06 hrs) 65. Use joining materials of pipe. (10 hrs) 66. Join pipe as per laid down Procedure. (06 hrs)	• Description of various pipe joints- straight, Branch, Taft and blow, Expansion joints. Solders and fluxes used in joints. (05hrs)
Professional Skill 60Hrs; Professional Knowledge 10Hrs	Install and maintain different Electric pumps. (Mapped NOS: PSC/NO135)	67. Demonstrate use of different pump. (10 hrs) 68. Demonstrate installation of electric pump (10 hrs) 69. Demonstrate maintenance of electric pump. (10 hrs) 70. Demonstrate working process of centrifugal, reciprocating, submersible pump. (15 hrs) 71. Demonstrate delivery of water to overhead tank through pump, presser head, delivery pipe, suction pipe, etc, (15 hrs)	• Description of Plumber's materials Lead, tin, Zinc, solder, copper, red lead etc. and their uses. • Water supply system of a small town. • Description and types of pumps viz. suction pump, Centrifugal pump etc. Contamination of water in a well. (10 hrs)
Professional Skill 30 Hrs; Professional Knowledge 06 Hrs	Join fittings for different purposes on PVC pipe line. (Mapped NOS:PSC/NO133)	72. Produce BSP thread on pipe. (05 hrs) 73. Produce Internal and external thread on PVC pipes of different dia. (05 hrs) 74. Join PVC pipe with thread. (05hrs) 75. Join PVC pipe with solvent cement and heat process(05hrs)	• Description of pipe dies, their uses, care and precaution. • Metric specification of various pipes. • Standard pipe threads. • Method employed for bending, Joining and fixing PVC pipe. • Joining material for

		76. Join PVC pipe as per layout. (10hrs)	water and gas pipes. • Use of blow lamp. (06 hrs)
Professional Skill 25Hrs; Professional Knowledge 07 Hrs	Construct inspection chamber, manhole, gutter, septic tank, socket etc. (Mapped NOS: PSC/NO135)	77. Demonstrate inspection chamber, manhole, gully trap, septic tank, soak pit. (04 hrs) 78. Construct inspection chambers, cesspool, septic tank, soak pit etc. (21 hrs)	• Inspection chamber, septic tank, description of drains, cesspools, soak pits etc. • Types of traps • layout of drainage system (07 hrs)
Professional Skill 25Hrs; Professional Knowledge 05Hrs	Test pipe line as per site drainage pipe line layout. (Mapped NOS: PSC/NO135)	79. Demonstrate drawing layout of drainage pipe line. (06 hrs) 80. Perform testing for smoke test, water test, smell test, ball test mirror test. (10 hrs) 81. Join heavy cast iron socket pipe. (03 hrs) 82. Sealing of heavy cast iron pipe joint with lead & caulking tools. (06 hrs)	• Method of bending pipes by hot and cold process. • Method of testing drainage lines (05hrs)
Professional Skill 25Hrs; Professional Knowledge 04 Hrs	Perform removal of leakage in pipe line. (Mapped NOS: PSC/NO133)	83. Identify location of leakage pipe. (06 hrs) 84. Removing out leakages pipe. (10 hrs) 85. Removing of air locks (06 hrs) 86. Demonstrate rain water harvesting system. (03 hrs)	• Method of dismantling and renewal of the valves and pipes. Leaks in pipes and noises in plumbing. • Installation of water meters. Air lock in pipes and its removal. (04hrs)
Professional Skill 75 Hrs; Professional Knowledge 10 Hrs	Install, fix & maintain different valve & cock and sensor system of sanitary fittings. (Mapped NOS: PSC/NO136)	87. Demonstrate different cocks & valves including materials. (10 hrs) 88. Employ cocks & valves at different place. (20 hrs) 89. Employ different cock& valve with sensor system. (20 hrs) 90. Demonstrate maintenance of different cocks & valves. (15 hrs) 91. Demonstrate use of packing washer gasket of different cock & valve. (10 hrs)	• Description of cocks & valves-their types, materials & advantages for particular work. • Description of different type of diverts i.e. two way and three way • Sensor system for urinals and wash basin etc.(10hrs)
Professional	Install & maintain	92. Demonstrate location of	• Erecting rain water and

Skill 75 Hrs; Professional Knowledge 14 Hrs	water meter and water supply for different fixtures. (Mapped NOS: PSC/NO133)	meter. Fitting of water meter, bath tub, wash basin. (10 hrs) 93. Install water metre, bath tub, hand wash basin, water closet urinal, sink etc with sensor system. (20 hrs) 94. Demonstrate maintenance of water metre, bath tub, hand wash basin, water closet urinal, sink etc. (15 hrs) 95. Demonstrate testing of water metre, Bath Tub, Hand wash basin. (10 hrs) 96. Demonstrate rain water and drainage pipe system. (10 hrs) 97. Installation of concealed flushing cistern. (10 hrs)	drainage pipe system, • Installation of sanitary fitting s, inspection and testing of water supply system. • -Pipe alignment and slope. -Prevention of water hammer. • Storage tanks for general water supply propose. • Test for water supply pipes. • Description of sanitary fittings, • general points to be observed when choosing sanitary. • Description of concealed flushing cistern (14hrs)
Professional Skill 50Hrs; Professional Knowledge 05Hrs	Demonstrate method of bending for different materials & different pipe joint. (Mapped NOS: PSC/NO133)	98. Demonstrate bending of pipes in bending machine. (08 hrs) 99. Bend GI pipe of different diameter in different angle. (14 hrs) 100. Bend G.I. pipe as per drawing and measurement. (14 hrs) 101. Bend PVC pipe of different diameter in different angle with dry sand by heating. (14 hrs)	Method of bending galvanized mand other heavy pipes. (05hrs)
Professional Skill 50Hrs; Professional Knowledge 05Hrs	Perform fitting and maintenance of Fixture at different place. (Mapped NOS: PSC/NO136)	102. Demonstrate process of C.I pipe cutting & joining. (12 hrs) 103. Process of C.I. pipe fitting for waste pipe line in different section. (08 hrs) 104. Employ Process of fixing of external soil pipe. (12 hrs) 105. Demonstrate process of fixing of rain water gutter outlet and ground pipe. (10	**Domestic drainage system:** General layout, one pipe system, specifications of Materials required. Method of testing leakage. Different types of traps, ventilation, anti-syphonage and sinks. About Fire hydrants and their fittings. (05hrs)

		hrs) 106. Demonstrate process of measurement of waste pipe line. (08 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 06 Hrs	Carry out fitting, fixing & laying installation of hot & cold water pipe line and symbolizing. (Mapped NOS:PSC/NO133)	107. Demonstrate working of solar water heating system. (02 hrs) 108. Analyse temperature of water (hot and cold). (02 hrs) 109. Layout pipe line for hot and cold water distribution as per drawing. (04 hrs) 110. Install pipe line for distribution of hot & cold water. (08 hrs) 111. Install hot water system & solar water heating system. (08 hrs) 112. Symbolise distribution of hot & cold water pipe line. (01 hr)	Concept of heat and Temperature. Method of transmission of heat. Heating system by different thermal units. Domestic hot and cold water. General layout, specification of materials required and Connection of pipes to mains. Tracing leakage. Repairs to service main. Domestic boilers and Geysers. Method of ventilating pipe. Precaution against air Poisoning. Fixing of solar water system. (06hrs)
Professional Skill 25Hrs; Professional Knowledge 06Hrs	Perform repairing & reconditioning of waste pipe line. (Mapped NOS: PSC/NO133)	113. Perform repairing of different trap, valve, cistern etc. (03 hrs) 114. Demonstrate construction of over head tank as per measurement. (08 hrs) 115. Maintenance and recondition pipe line. (10 hrs) 116. Perform smoke test far waste pipe line. (04 hrs)	Plumbing and sanitary symbols and plumbing codes for all tools and materials (06hrs)
Professional Skill 20Hrs; Professional Knowledge 02Hrs	Perform repairing& reconditioning, scraping & painting of sanitary fittings pipe line. (Mapped NOS: PSC/NO133)	117. Demonstrate cleaning of sanitary pipe line. (02 hrs) 118. Perform cleaning of sanitary pipe line. (02hrs) 119. Remove corrosion from pipe line. (02hrs) 120. Demonstrate scraping & painting. (02 hrs)	Corrosion - causes and remedies, prevention. Corrosion due to electrolytic action. Effect of water and frost on materials. Layout of pipes as per drawing.

		121. Perform scraping & painting of pipe line. (02hrs) 122. Maintenance of broken or cracked sanitary fitting. (05 hrs) 123. Estimate and work out abstract cost of plumbing work as per drawing/layout. (05 hrs)	Analysis quantity measurement and abstract rate of plumbing and sanitary work. **Bill of Quantity and Estimation :-** • Preparation of bill of quantity • Preparation of Estimation(02hrs)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.CSC/N9401	**Engineering Drawing : (40 Hrs.)** Introduction to Engineering Drawing and Drawing Instruments– • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Free hand drawing of– • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the sketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Reading of dimension and Dimensioning Practice. Symbolic representation– • Different symbols and Pipe joints used in the trade. Reading of layout plan drawing in piping	
Workshop Calculation & Science: 32 Hrs.			
Professional Knowledge WCS- 32 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9401	**WORKSHOP CALCULATION &SCIENCE: (32 Hrs.)** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root	

		Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non-ferrous metals Physical and mechanical properties of metals Properties and uses of insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity. Related problems for mass, volume, density, weight and specific gravity **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature **Basic Electricity** Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC their comparison, voltage, resistance and their units **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Trigonometry** Measurement of angles Trigonometrical ratios

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in /dgt.gov.in

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
PLUMBER (For Batch of 24 Candidates)			
Sl. No.	**Name of the Tool &Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Rule Steel	300 mm both in inch and mm	25 Nos.
2.	Hacksaw Frame adjustable	250 to 300 mm	25 Nos.
3.	Scriber	200 mm	25 Nos.
4.	Centre punch	100 mm	25 Nos.
5.	Chisel Cold, flat	20 mm	25 Nos.
6.	Hammer ball peen	800 grams	25 Nos.
7.	File flat rough	300 mm	25 Nos.
8.	Level spirit wooden	300 mm	25 Nos.
9.	Plumb bob	50 grams	25 Nos.
10.	Trowel	C-125-I S: 6013	25 Nos.
11.	Stillson wrench	200 & 350 mm	25 Nos.
12.	Screw Driver	250 mm	25 Nos.
13.	Cutting pliers 200mm	I S : 3650	25 Nos.
14.	Steel tape	5m	25 Nos.
B. TOOLS, MEASURING INSTRUMENTS AND GENERAL SHOP OUTFIT			
15.	Hand Vice, Jaw	50 mm	2nos.
16.	File Flat, Smooth	200 mm	2nos.
17.	File Half Round, Rough	300 mm	2nos.
18.	File, Square, rough	250 mm	2nos.
19.	File, Square, Smooth	200 mm	2nos.
20.	File Triangular Rough	250 mm	2nos.
21.	File Flat Rasp	250 mm	2nos.
22.	File Triangular Smooth	200 mm	2nos.
23.	Chisel Cold Flat	20 mmX300mm	2nos.
24.	Chisel Cross Cut	6X150 mm I S-402	2nos.
25.	Chisel Round Nose	3X150 mm I S -402	2nos.
26.	Chisel Diamond Point	6X150mm	2nos.
27.	Punch, Letter set		1no.

28.	Punch , Number set		1no.
29.	Spanner monkey up to	50mm	2Nos.
30.	Cutter, Pipe, wheel type	6mm to 25mm	1 Nos.
31.	Oil stone	150X50X25mm	2 Nos
32.	Soldering Iron, Copper, Bit, Fire heated, Hatched, Straight	500 grams	4 Nos.
33.	Try square	200mm	2 Nos.
34.	Inside Caliper	150mm	2 Nos
35.	Caliper outside	150mm	2 Nos
36.	Odd leg caliper	200mm	2 Nos.
37.	Mirror	100X150 mm	2 Nos.
38.	Soil pot with brush		1 No.
39.	D. E. Spanners	7X8, 10X11, 13X17, 19X22, 24X27 IS:2028	2 Sets
40.	Bending Spring		1 Set
41.	Plumbers Laddle		2nos
42.	Tool caulking		2 nos.
43.	Plumbers' metal melting pot	10 kg	1 no.
44.	Pipe stock and dies complete with stocks, bushing, bushing holders, Taps and wrenches sizes covered, to suit pipes	bore dia 6, 8, 10, 20, 25, 32, 40 & 50 mm	4 sets
45.	Pipe vice	to grip up to 77 mm IS - 2587	8 nos.
46.	Stillson pattern pipe wrenches	450 mm to take pipe up to 52 mm dial S -4003	2sets
47.	Stillson pattern pipe wrenches	300mm to take pipe 20 mm to 32mm	2sets
48.	Chain :pipe wrench	90mm -650 IS 4123	2sets
49.	Adjustable, spanner, A-375, IS- 6149		2nos
50.	Pipe bender, manually operated		1no
51.	Leg vice, 75mm jaw on Stand IS -2588		1no
52.	Hand drill 6mm capacity with drill chuck (Electric)		1no
53.	Drill Twist (straight shank)	3mm to 6mm	1set
54.	working bench	2400x1200x750mm with 4 voice 125 mm jaws	2nos.
55.	Bath tub small size		1no.
56.	Wash Basin Equivalent metric	(16"X14"X10")	2nos.

57.	Water Heater	10 litres	1no
58.	Water closet (European type p) complete with overhead cistern		1set
59.	Water closet (Indian type) complete with overhead cistern		1set
60.	Urinal wall type complete with automatic system		1set
61.	Water meter		2nos.
62.	Steel lockers	with 8 drawers Metal rack (1800x1500x450mm)	3nos.
63.	Metal rack	(1800X1500X450mm)	1no
64.	Desk		12 nos.
65.	Black Board with glass		1no
66.	Fire Extinguisher		1no
67.	Fire Buckets with stand		1no
68.	Steel Almirah (large)		1no
69.	Hammering drilling machine		1no.
70.	Electric PPR pipe welding machine		1 No
71.	Electric pump	1 HP	1 no.
72.	Hydraulic pressure machine for testing leakage in GI pipe fittings etc.		1No.
73.	Rachet pipe die	15 mm to 32 mm	1 No.
74.	Double face hammers		2 No.
75.	Dormat, Pickaxe, Spade, Girmale		1 each
76.	Pipe bender (Hydraulic type)		1 No.
77.	Instructor table		1 No.
78.	Instructor chair		1 No.
79.	Solar water heater system		1No
80.	CPVC/UPVC Pipe cutter	Up to 50mm	10 nos
81.	Chase cutter (electric)	Blade dia 7cm to 15 cm	02 nos
82.	Caulking Tools	300 mm 20 mm	05 nos
C. LIST OF CONSUMABLES			
83.	M.S FLAT		As Required
84.	M.S ROD		As Required
85.	GI pipe "B" grade	½"Ø, ¾"Ø, 1"Ø	As Required
86.	GI pipe fittings Socket Tee	½"Ø, ¾"Ø, 1"Ø	As Required

	Bend Union Hex Nipple		
87.	River sand AFS	no.100 ~ 40	As Required
88.	Stone aggregate		As Required
89.	Cement portland		As Required
90.	PVC pipes heavy duty	(suitable to use dies and tap) ½"Ø, ¾"Ø, 1"Ø, 1½"Ø, 2"Ø , 4"Ø, 6" Ø	As Required
91.	PVC pipe light duty	½"Ø, ¾"Ø, 1"Ø, 1½"Ø, 2"Ø	As Required
92.	PVC fittings - reducer FTA Reducer, Plain coupling, TEE, Bend, Elbow, MTA, FTA, socket	½"Ø, ¾"Ø, 1"Ø, 1½"Ø, 2"Ø, 4"Ø, 6" Ø	As Required
93.	C.PVC pipe	20 mm Ø	As Required
94.	PPR pipe	20mm Ø	As Required
95.	Wheel valve		As Required
96.	Globe valve		As Required
97.	PVC ball valve		As Required
98.	Water tap/ PVC, S.S, Brass size	½", ¾", 1"	As Required
99.	Non- return valve, Air valve		As Required
100.	M.S flange		As Required
101.	Lubricating oil		As Required
102.	Lead		As Required
103.	Spum yarn		As Required
104.	Water meter		As Required
105.	PVC bend	100 mm	As Required
106.	PVC Y branch	100 mm	As Required
107.	PVC Dod bend	100 mm	As Required
108.	PVC pipe sloe		As Required
109.	C.P piller tap	15 mm	As Required
110.	C.P waste coupling	35 mm	As Required
111.	PVC waste pipe	32 mm	As Required
112.	PVC connection flexible tube		As Required
113.	Hot and cold water mixer tap		As Required
114.	PPR pipe fittings	PPR - TEE 20 mm PPR - Elbow 20 mm	As Required
115.	PVC floor trap		As Required
116.	PVC gully trap		As Required
117.	PVC multi trap		As Required
118.	PVC multi floor trap		As Required
119.	White cement		As Required
120.	P O P (Plaster of Paris)		As Required

121.	Push Cock		As Required
122.	Wall mounted water closet	With concealed flushing cistern	1set
123.	Wall mounted Bidet	With Hot and cold mixture	1set
124.	Urinal wall type	With automatic sensor flushing system	1set
125.	Bathroom concealed Diverter	Two way and three way both	1set
126.	Towel Rail (Stainless steel)	600 mm length	As Required
127.	C.P Piler tap	Automatic sensor type 15mm	As Required
128.	C.P Bib Tap/Cock	15 mm	As Required
129.	C.P Central hole automatic basin mixer	Sensor type 15mm	As Required
130.	C.P Shower	15mm	As Required
131.	Bricks	A Class	As Required
132.	Plastic water tank	500/750 liters	As Required
133.	Water tank overflow alarm	Automatic sensor type	As Required
134.	Butane/Propane disposable Cylinder	150-200 gm	10 nos
135.	Butane/Propane disposable blow torch	150-200 gm	05 nos
136.	Electronic light for Butane cylinder		02 nos
137.	Water Hammer Arrester		As Required

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

MASON (BUILDING CONSTRUCTOR)

(Duration: One Year)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3

SECTOR – CONSTRUCTION

Directorate General of Training

MASON
(BUILDING CONSTRUCTOR)

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3

Developed By

Ministry of Skill Development and Entrepreneurship
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CONTENTS

1. COURSE INFORMATION

During the one-year duration a candidate of Mason (Building Constructor) trade is trained on subjects Professional Skill, Professional Knowledge and Employability Skills related to job role. In addition to this a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The practical part starts with basic constructional work viz. cutting of bricks / stones, Masonry (brick/stone), Cutting of rods, R.C.C work, etc. and finally to constructing building, finishing work, centering shuttering for R.C.C beams, column, lintels etc. at the end of the course. The broad components covered under Professional Skill subject are as below:

The practical part starts with basic constructional parts (Masonry) and the candidate imparted training on allied trades viz., carpenter (which leads to multi-skilling). In the basic carpentry the skills imparted are marking, sawing, Planning, chiseling, measurement, drilling, grinding of tools and observation of all safety aspects is mandatory. The safety aspects cover components like OSH&E, PPE, Fire extinguisher, First Aid etc. Masonry deals with making masonry brick wall as per drawing leaving space for door & window opening, Preparation of R.C.C casting, Construction of cavity wall, Laying out of building plan, diagonal check-up, fixing up of excavation lines, Wall & ceiling plastering, Making of different types of floor determining and Formation of Slope.

Further, laying of drain pipe, jointing, fittings & fixing of W.C. pan, urinals, gully trap. Construction of manhole etc., Construction of septic tank, Fixing& fittings of wash basin, flushing cistern, sink, vent pipe, etc., Construction of stone wall, Laying of marble on floor & stair, Construction of circular brick & hollow block walls, Preparing & mixing of concrete, formwork, casting of roof slab, beams, lintels, stair, column etc., cutting & setting of glazed tiles to walls, Laying of mosaic, terrazzo & tile flooring, Construction of R.C.C. & Brick stairs are being taught in the practical.

Professional Knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition components like Physical properties of materials, different types of constructional materials such as bricks, properties of good bricks, various types of cement with their properties, types of bonding in masonry work, foundation related knowledge, about R.C.Care also covered under theory part.

Projects need to be completed by the candidates in a group. In addition to above components the core skills components viz., Workshop calculation & Science, Engineering Drawing, Employability Skills are also covered. These core skills are essential skills which are necessary to perform the job in any given situation.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

Mason (Building Constructor) trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of one-year duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skills, knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one year:-

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	840
2	Professional Knowledge (Trade Theory)	240
3	Employability Skills	120
	Total	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

On the Job Training (OJT)/ Group Project	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be the basis for setting question papers for final**

assessment. The examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the	• Demonstration of good skill in the use of

candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marks in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Bricklayer, Construction; Brick Mason lays brick with mortar, and other construction material to construct and repair building walls, arches, chimneys, floors, pillars and other structures. Receives instructions regarding nature and type of work to be done. Directs Labourers to prepare mortar in required proportions and water bricks. Spreads mortar by trowel over foundation or laid bricks and lays bricks by hand in horizontal rows or designs and shapes per approved specification. Taps bricks with trowel to embed them firmly in mortar and ensures correct vertical and horizontal alignment of brick setting by sight or with string and plumb bob. Closes gaps in between bricks by filling with half bricks and mortar and by tapping with trowel. Fixes wooden frames, lay lime concrete over roofing and sets girders in position. May dismantle masonry for reconstruction or facility of work. May do plastering, decoration pointing and repair work. May erect scaffolding.

Helper Mason; needs to support Assistant Mason and Mason which are at level-2 and level-3 in semi-skilled and skilled category for carrying out the related works such as shifting of materials, handling tools, tackles and housekeeping. The responsibilities include site development and clearance, provide support for laying of bricks and blocks, mortar and cement concrete mixing, rendering coat plastering, help in setting and layout, knowing importance of scaffolding and have the basic knowledge in the environment, health, safety pertaining to the trade.

Plumbing Mason; is responsible for making masonry manholes, laying pipes in masonry works and other earth work related to plumbing.

Paviour; lays bricks and stone on leveled ground to make floors, pavements, streets etc. Receives instructions regarding type of pavement, floor or street to be laid and other specifications and collects materials required. Directs Labourers to level surface for laying bricks and stones for required construction. Lays stone slabs or bricks in line on leveled ground, by sizing them if necessary, with brick hammer and trowel and tapes them to get set firmly in position. Checks alignment while laying using straight edge and spirit level and fills gaps in between with chips, bricks bits, cement etc.; May do pre-stressed and R.C. (reinforced concrete) work.

Assistant Mason; needs to work as semiskilled category tradesman and perform tasks under instruction and close supervision of Mason Level-3 as Assistant Mason. He is expected to carry out the setting and layout, laying of bricks and blocks, rendering coat plastering, finishing of concrete, fixing doors and windows in a room/cubical while effectively engaging and

supervising the Helper Mason under him for all trade relevant tasks. He should ensure trade specific compliance to environment, health and safety aspects

Assistant Shuttering Carpenter; works as semi-skilled category tradesman and performs tasks under instructions and close supervision of Shuttering Carpenter Level-3 as an Assistant Shuttering Carpenter. He is expected to make, assemble, erect and dismantle Conventional/ system formwork for all type of in situ and pre-cast RCC work, reading drawings, setting and layout. He should ensure trade specific compliance of environment, health, safety aspects and should engage and supervise the Helper Shuttering Carpenter under him for all relevant tasks.

Concrete Placers, Concrete Finishers and Related Workers; erect reinforced concrete frameworks and structures, make forms for moulding concrete, reinforce concrete surfaces, cement openings in walls or casings for wells, finish and repair cement surfaces.

Plasterer; plasters walls, ceilings and other surface of structures with cement, lime, mud or other mortar using hand trowel, level etc. Mixes sand, cement, lime brick powder etc. in required proportion adding water to it to prepare plastering mortar. Wets structure to be plastered with water to ensure proper adherence; spreads plaster with trowel to give preliminary coating. Levels and smoothens primary coat of plaster with straight edge, shapes borders to guide second coating and scratches surface of primary coat to provide bond for subsequent coating. Plasters area to be covered with primary coat and allows it to set for some time ensuring that it does not get dry before final coating. Applies thin layer of finish plastering coat over surface, makes out corners and angles to suit it and smoothens plastered area with straight edge and trowel. Directs and supervises sprinkling of water for curing during plastering and watches drying and final outcome of surface. May undertake ornamental plastering.

Stone Mason; Stone Setter/Stone Fixer builds stone walls, pillars and other structures by sizing and setting dressed or undressed stones. Receives instructions regarding nature and type of work to be done. Cuts stones to required size prior to setting by chipping with chisel and other cutting tools and gets them dressed or dresses them if necessary. Gets mortar prepared by labourers and spreads it with trowel bit by bit over area where stones are to be fixed. Fixes stones manually one by one in position and sets them by tapping with hammer. Checks vertical and horizontal alignments of set stones with plumb bob, ensures correct setting by alterations if necessary and fills in gaps in between stone slabs with stone chips and mortar. Removes excess mortar with trowel to smoothen joints and stones to raise structure as required. May dismantle masonry and reset girders if necessary. May do plastering, repairing and ornamental work. May lay stones on leveled ground to construct floors pavements, streets, etc. May erect scaffolding for construction work.

Tile Setter; Tile Layer fits and sets tiles to walls, floors and ceilings of buildings according to specified design using cement or other mortar and hand tools. Receives instructions regarding specifications, layout and material to be used. Soaks tiles in water to prepare them for setting. Applies mortar or cement coat over wall with trowel and lays tiles aligned in rows according to pattern. Checks alignment of tiles laid with straight edge, levelling hoard, spirit level etc., makes adjustments if necessary and taps them with trowel handle to get them set firmly. Sprinkles dry cement over freshly laid concrete for laying floor tiles and ensures proper bond between cement and tiles while laying. Cuts and shapes tiles for corner pieces, fills gaps with cement as necessary and ensures proper joining setting and alignment. May erect scaffolding for setting ceiling tiles.

Reference NCO-2015:

(i) 7112.0200 - Bricklayer, Construction
(ii) 9313.0301 - Helper Mason
(iii) 7112.0201 - Plumbing Mason
(iv) 7112.0400 - Paviour
(v) 7112.0601 - Assistant Mason
(vi) 7115.0201 - Assistant Shuttering Carpenter
(vii) 7114.9900 - Concrete Placers, Concrete Finishers and Related workers
(viii) 7123.0100 - Plasterer
(ix) 7112.0100 - Stone Mason
(x) 7122.0100- Tile Setter

Reference NOS: -- IES/N9441, CON/N0144, CON/N0144, CON/N0143, CON/N0111, CON/N0113, IES/N9442, IES/N9443, IES/N444, IES/N09445, IES/N9446, IES/N9447, IES/N9448, IES/N9449, IES/N9450, IES/N9451, IES/N9452, IES/N9453.

4. GENERAL INFORMATION

Name of the Trade	**MASON (BUILDING CONSTRUCTOR)**
Trade Code	DGT/1035
NCO - 2015	7112.0200, 9313.0301, 7112.0201, 7112.0400, 7112.0601, 7115.0201, 7114.9900, 7123.0100, 7112.0100, 7122.0100
NOS Covered	IES/N9441,CON/N0144, CON/N0144,CON/N0143, CON/N0111, CON/N0113, IES/N9442, IES/N9443, IES/N444, IES/N09445, IES/N9446, IES/N9447, IES/N9448, IES/N9449, IES/N9450,IES/N9451, IES/N9452, IES/N9453,
NSQF Level	Level-3
Duration of Craftsmen Training	One year (1200 hours + 150 hours OJT/Group Project)
Entry Qualification	Passed 8th class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, CP, LC, DW, AA, LV, DEAF, AUTISM, SLD, MD
Unit Strength (No. of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	80 Sq. m
Power Norms	4 KW
Instructors Qualification for:	
(i) Mason (Building Constructor) Trade	B.Voc/Degree in civil engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in civil engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the trade of Mason (Building Constructor) with three years' experience in the relevant field. **Essential Qualification:**

	Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***NOTE: - Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
(ii) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
(iii) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOME (TRADE SPECIFIC)

1. Perform wood work with carpenter's tools following safety precautions. NOS:IES/N9441
2. Plan and organize the work to make masonry brick wall as per drawing and specification applying different types of tools, materials and check for dimensional accuracy. NOS:CON/N0144
3. Construct wall leaving space for door & window opening. NOS:CON/N0144
4. Perform R.C.C casting, rod cutting in different sizes, bending, binding & placing. Mixing & compaction of Concrete with different proportions. NOS:IES/N9442
5. Perform Construction of cavity wall. NOS:IES/N9443
6. Perform Laying out of building plan, diagonal check-up, fixing up of excavation lines. NOS:CON/N0143
7. Perform Wall & ceiling plastering with application of mortar, smoothening the surface by using of screeds & floats. NOS:CON/N0111
8. Make different types of floor with determination and formation of Slope. NOS:IES/N9444
9. Lay drain pipe, jointing, fittings & fixing of W.C. pan, urinals, gully trap. Construction of manhole etc. NOS:IES/N9445
10. Construct septic tank. NOS:IES/N9446
11. Perform fixing & fittings of wash basin, flushing cistern, sink, vent pipe, etc. NOS:IES/N9447
12. Construct stone wall with cutting, chamfering, bevelled etc. NOS:CON/N0113
13. Lay marble on floor & stair with marking, cutting &complete setting. NOS:IES/N9448
14. Construct circular brick wall & hollow block walls. NOS:IES/N9449
15. Prepare & mix concrete, formwork, cutting & bending of bar, casting of roof slab, beams, lintels, stair, column etc. NOS:IES/N9450
16. Cut& set glazed tiles to walls. NOS:IES/N9451
17. Lay mosaic, terrazzo & tile flooring. NOS:IES/N9452
18. Perform Construction of R.C.C. & Brick stairs. NOS:IES/N9453
19. Read and apply engineering drawing for different application in the field of work.
20. Demonstrate basic mathematical concept and principles to perform practical operations.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Perform wood work with carpenter's tools following safety precautions. NOS:IES/N9441	Identify the woods and character.
	Identify the Carpenter's hand Tools.
	Prepare the job as per drawing.
	Observe safety procedure during wood cutting, sawing, chiselling, planning as per standard norms and procedures.
	Check and verify the job as per drawing
2. Plan and organize the work to make masonry brick wall as per drawing and specification applying different types of tools, materials and check for dimensional accuracy. NOS:CON/N0144	Identify mason's tools, instruments and equipment and Plan for marking and make this available for use in a timely manner.
	Select raw material and visual inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Perform basic handling of brick, rotating of bricks in one hand and as per specification to make the job.
	Make a simple construction of different type of Brick joints with mortar.
	Observe safety procedure during above operation as per standard norms and procedures.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
3. Construct wall leaving space for door & window opening. NOS:CON/N0144	Study drawing, Identify the door and window opening.
	Mark space for door & window.
	Make desired space for door & window during masonry work.
	Check the opening space as per Drawing.
4. Perform R.C.C casting, rod cutting in different sizes, bending, binding & placing. Mixing & compaction of Concrete with different proportions. NOS:IES/N9442	Read and interpret the drawing.
	Identify required Mason's hand tools.
	Cut rods as per size with cutting tools.
	Bend bar (rod) as per drawing with bar bending die.
	Check the measurement of bar as per drawing.
	Bind rods with proper hand tools as per drawing.
	Identify the equipment for mixing concrete.
	Mix up simple concrete as per specified ratio.
	Laying of concrete and compact as per procedure.

	Observe safety procedure during concreting.
	Check and verify the job as per drawing.
5. Perform Construction of cavity wall. NOS:IES/N9443	Identify different types of Mason's hand tools.
	Identify the Construction materials.
	Plan for cavity wall construction.
	Make a cavity wall in brick Masonry work.
	Check & verify the job as per drawing.
6. Perform Laying out of building plan, diagonal check-up, fixing up of excavation lines. NOS:CON/N0143	Identify different types of Mason's hand tools &equipment's for laying out.
	Set right angle on the ground following proper method.
	Laying out the building plan.
	Check the diagonal.
	Mark excavation lines as per Drawing.
	Check & verify the work as per drawing.
7. Perform wall& ceiling plastering with application of mortar, smoothening the surface by using of screeds & floats. NOS:CON/N0111	Identify different types of plastering tools.
	Make scaffolding as per requirement.
	Prepare mortar in specified proportions.
	Apply mortar on wall surface& ceiling.
	Make plaster work.
	Observe safety procedure during plaster.
8. Make different types of floor with determination and formation of Slope. NOS:IES/N9444	Identify different types of floors.
	Identify different types of tools required for flooring.
	Determine slope and make floor accordingly.
	Check and verify the job as per requirements.
9. Lay drain pipe, jointing, and fittings & fixing of W.C. pan, urinals, gully trap. Construction of manhole etc. NOS:IES/N9445	Plan for the desired work and identify tools, instrument and equipment for marking and make this available for use on a timely manner.
	Select and Prepare raw materials, fittings, etc. and visually inspect for defects.
	Mark the position to fix the fittings.
	Set up a W.C pan & urinals.
	Construct a gully trap, manhole.
	Observe safety points on above work as perstandard norms and guidelines.
10. Construct septic tank. NOS:IES/N9446	Read and interpret the drawing.
	Mark the position of septic tank for excavation.

	Construct Septic tank conforming PWD norms.
	Check bonding & waterproofing of tank walls.
	Perform lining field drains with bricks.
	Check and verify the work as per standard norms and guidelines.
11. Perform fixing& fittings of wash basin, flushing cistern, sink, vent pipe, etc. NOS:IES/N9447	Plan for the work and select the tools, instrument and equipment for the Fixing& fittings of wash basin, flushing cistern, sink, vent pipe, etc.
	Mark the position and fix fittings e.g. wash basin, flushing cistern, sink, vent pipe, etc. observing standard procedure and method.
	Check and verify the work as per standard norms and guidelines.
12. Construct stone wall with cutting, chamfering, bevelled etc. NOS:CON/N0113	Identify tools, instrument and equipment's for marking, cutting and make this available for use in a timely manner.
	Measure and cut stone & chamfer as required.
	Construct stone masonry wall.
	Check for finishing and dimensional accuracy as per standard procedure.
13. Lay marble on floor & stair with marking, cutting & complete setting. NOS:IES/N9448	Plan and identify tools and equipment for marking, cutting and make this available for use in a timely manner.
	Select raw materials and inspect visually for defect.
	Measure, mark and cut marble as required.
	Lay marble on floor and stair.
	Observe safety procedure during above work asper standard norms.
	Check for finishing and dimensional accuracy as per standard procedure.
14. Construct circular brick wall & hollow block walls. NOS:IES/N9449	Plan for the work and arrange materials, tools and equipment for circular / hollow brick work.
	Prepare bricks as required in circular / hollow brick wall.
	Construct circular / hollow block wall.
	Check for finishing and dimensional accuracy as per standard procedure.
15. Prepare& mix of concrete, formwork, cutting & bending of bar, casting of roof slab, beams, lintels, stair, column	Read and interpret the drawing.
	Make shuttering and formwork with proper support.
	Perform cutting & bending of bar & bind them as per measurement and drawing.

etc. NOS:IES/N9450	Perform leveling and check measurement criteria.
	Mix concrete and cast roof slab, beams, lintels, stair, column etc. as per measurement and drawing.
	Observe safety procedure during above work as per standard norms.
16. Cut& set of glazed tiles to walls. NOS:IES/N9451	Plan for the work and arrange for raw material and different types of plastering, pointing & tile setting tools.
	Prepare wall surface and mortar in specified proportions.
	Perform pointing to wall and apply mortar on wall surface.
	Marking & Cutting of glazed tiles as per requirement.
	Set glazed tiles to wall and fill joints.
	Check for finishing and dimensional accuracy.
17. Lay mosaic, terrazzo & tile flooring. NOS:IES/N9452	Plan for the work and arrange for raw material and different types of tile setting tools.
	Prepare floor surface and mortar in specified proportions.
	Perform leveling to floor applying mortar on floor surface.
	Marking & Cutting of floor tiles.
	Setting of tiles on floor.
	Check for finishing and dimensional accuracy
18. Perform Construction of R.C.C. & Brick stairs. NOS:IES/N9453	Read and interpret the drawing.
	Make shuttering and formwork with proper support.
	Perform cutting & bending of bar & bind them as per measurement and drawing.
	Perform leveling and check measurement criteria.
	Mix concrete and cast R.C.Cstair or perform construction of brick stair as per measurement and drawing.
	Observe safety procedure during above work as per standard norms.
19. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems
	Explain concept of basic science related to the field of study
20. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.

	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

7. TRADE SYLLABUS

SYLLABUSFOR MASON (BUILDING CONSTRUCTOR) TRADE			
Duration – One Year			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 76 Hrs; Professional Knowledge 14 Hrs	Perform wood work with carpenter's tools following safety precautions. (Mapped NOS: IES/N9441)	1. Familiarization with Institute, administrative setup of Institute. (3 hrs.) 2. Rules & resolutions of attendance with leave facility. (3 hrs.) 3. Importance of Trade training, instruments & equipment's used. (5 hrs.) 4. Importance of trade training, List of tools & Machinery used in the trade.(4 hrs.) 5. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (5 hrs.) 6. First Aid Method and basic training. (4 hrs.) 7. Safe disposal of waste materials like Pieces of wood, rod, stone, mud, etc. (2 hrs.) 8. Hazard identification and avoidance. (2 hrs.) 9. Safety signs for Danger, Warning, caution & personal safety message. (3hrs.) 10. Preventive measures	• Importance of safety and general precautions required for the trade. • Importance of the trade. • Types of work to be done by trainees in the institute. • Scope of a mason work. • Types of services has to plan. • Role of a mason, nature of job done by masons(07 hrs)

		for electrical accidents & steps to be taken in such accidents. (5 hrs.) 11. Use of Fire extinguishers. (9 hrs.) 12. Practice and understand precautions to be followed while working in mason jobs. (3 hrs.) 13. Safe use of tools and equipments used in the trade. (2 hrs.)	CHAPTER -3 VIDEO DEMO
		Carpenter works :- 14. Demonstrate uses of Carpenter's hand tools. (10 hrs.) 15. Centering work. Uses of nails, screws, nuts & bolts, hinges etc. (7 hrs.) 16. Perform centering & form work. (9 hrs.)	• Common types of wood- their description and use. • Carpenter's hand tools, their names and uses. • Carpentry joints and their uses. Use of nails, screws, dowels, etc.(7hrs)
Professional Skill 150 Hrs; Professional Knowledge 23 Hrs	Plan and organize the work to make masonry brick wall as per drawing and specification applying different types of tools, materials and check for dimensional accuracy. (Mapped NOS: CON/N0144)	17. Handling of brick, turning of brick for stretcher & header faces. (4 hrs.) 18. Cutting of brick with brick hammer as desire shape & size. (8 hrs.) 19. Shaping mortar, spreading on the bed joining bricks. (10 hrs.) 20. Preparation of various types of mortars according to the ratio of ingredients. (6 hrs.) 21. Building $4\frac{1}{2}$" straight wall about 6courses high with one end stepped and the other racked back. (24 hrs.)	• Technical terms used in brick masonry. Necessity of bonding bricks. Types of bond Types of mortars, different grades of sand for brick work & plastering. Grades of cement. • Brickwork-racking back & toothing. Differences between English & Flemish bonds. Details of English & Flemish bond for 1 and $1\frac{1}{2}$ brick walls. Precautions at quoins. • Cross wall-method of construction. Grouting of mortar, jointing and finishing of brickwork.

		22. Building $4\frac{1}{2}$" quoin wall with oneend stepped and the other racked back. Use of plumb rule. (26 hrs.) 23. Construct of 1 &1 ½ brick walljunctions in English & Flemishbonds. Racking out the joints &finishing it flush. (24 hrs.) 24. Construction of 1 brick thick walls inEnglish & Flemish garden bonds. (24 hrs.) 25. Construct of detached brick pillars with footings square & rectangular types. (24 hrs.)	Types of pointing & tools used. Details of bonding & special precautions at 'T', 'L' and cross junctions. Types of copings-weathering & throating. • Pillars: Necessity, types, relation between cross section & height. Details of reinforcement for square &rectangular pillars. • Types of cement, sand & lime. English &Flemish garden wall bonds. PWD specification on brickwork. • Foundation: Definition, purpose, types,important terms, causes of failure of foundations. (23 hrs)
Professional Skill 25 Hrs; Professional Knowledge 06 Hrs	Construct wall leaving space for door & window opening. (Mapped NOS: CON/N0144)	26. Form a door opening in a wallofEnglish bond. Bonding of jambs & reveals. (10 hrs.) 27. Form a window opening in awall in English bond. (7 hrs.) 28. Construction of sill with overSailingcourses. Use of gauge rodFixing door & window frames. (8 hrs.)	• Purpose of arch centering& form work. Different types of bricks &theirsizes.Characteristics of good bricks Sizes of mortar joints for different works. Stretcher & header (06 hrs)
Professional Skill 50 Hrs; Professional Knowledge 7 Hrs	Perform R.C.C casting, rod cutting in different sizes, bending, binding & placing. Mixing & compaction of Concrete with different proportions.	29. Demonstrate R.C.C, re-enforcement of different dia. With unit weight. Cutting, bending & binding of bar. (4 hrs.) 30. Perform Pre-casting a lintel-compacting, curing & setting the same in position. Check for equal	• RCC lintels: Materials required, • method of construction, precast lintels, • method of construction of formwork, details of reinforcement. • Arches: Purpose, technical terms & types. Setting out

	(Mapped NOS: IES/N9442)	bearing. (8 hrs.) 31. Spanning of opening by casting alintel in site. (10 hrs.) 32. Making of shuttering &supports with uprights and wedges. (7 hrs.) 33. Cutting, bending & placing ofreinforcement. (4 hrs.) 34. Mixing, placing & compacting concrete. (2 hrs.) 35. Spanning of opening with a semi-circular arch, making centering, cutting of templates for voussoirs & preparing voussoirs, setting uprights of arch. Construction of arch &removing centering. (15 hrs.)	an arch. (7 hrs)
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Perform Construction of cavity wall. (Mapped NOS: IES/N9443)	36. Construct cavity walls, setting out both leaves, provision of wall ties and use of cavity rods. (25 hrs.)	• Cavity wall: Technical terms, advantages,constructional details, precautions to be taken at the bottom of cavity. 4HRS
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	Perform Laying out of building plan, diagonal check-up, fixing up of excavation lines. (Mapped NOS: CON/N0143)	37. Setting out a building: Obtaining first,second, third & fourth lines, marking diagonals, setting out cross walls & offsets. (30 hrs.) 38. Marking excavation lines & fixingof plinth & floor levels. (20 hrs.)	• Steps in setting out & marking centre line, excavation line & other lines-use of deadman-checking accuracy & precautions. Windows & ventilators: Including steel windows & ventilators, fixtures &fastenings used.(10 hrs)
Professional Skill 70 Hrs;	Perform wall & ceiling plastering with application of	39. Plastering of walls-setting of spots-applying mortar-use of screeds	• Plastering: Tools used, necessity of screeds& their fixing,

Professional Knowledge 12 Hrs	mortar, smoothening the surface by using of screeds & floats. (Mapped NOS: CON/N0111)	&floats. (25 hrs.) 40. Fixing of screeds to soffits of door & window openings-reversing the screeds & squaring. (20 hrs.) 41. Plastering of ceiling: Application of mortar, strengthening and finishing (Improvise a roof with stone orconcrete slab for the purpose ofdemonstration). (25 hrs.)	• Steps in plastering. • Concrete: Ingredients, selection ofmaterials, various ratios of mix, their uses, measuring of materials for mixing. (12 hrs) VIDEO CHAPTER -5
Professional Skill 50 Hrs; Professional Knowledge 07Hrs	Make different types of floor with determination and formation of Slope. (Mapped NOS: IES/N9444)	42. Flooring practice: Determination and formation of slope, application of slurry for finishing, setting out of skirting, formation of spots for skirting. (30 hrs.) 43. Use of screeds, formation of curve at the junction of skirting & floor. (20 hrs.)	• Floors: Types, constructional details such as consolidation of bed, sand filling, concrete base & finishing. Granolithic flooring. Local Municipal byelaws. (07 hrs)
Professional Skill 100 Hrs; Professional Knowledge 20 Hrs	Lay drain pipe, jointing, fittings& fixing of W.C. pan, urinals, gully trap. Construction of manhole etc. (Mapped NOS: IES/N9445)	44. Drainage: Set out a drainage line including position of manhole& gully trap. (22hrs.) 45. Practice in setting up and reading of dumpy level. (16 hrs.) 46. Lay out drainage to required gradients with the help of dumpy level and/or boning rod and layingits surface with bricks. (26 hrs.) 47. Laying of concrete foundation for drainage pipes and jointing. Checking of alignment.	• Purpose of drainage, different systems, their advantages & disadvantages, method of collection, carriage & final disposal of wastage, various types of constructions required. Roofs: Classification, parts, trussed roof, covering materials. • House drainage system-normal layout of drainage. • Traps-gully, nahani, etc.-their description. • Purpose & method of

		Cutting the pipe to the required length. (10 hrs.) 48. Covering of drain pipe with concrete as per PWD specification. (4hrs.) 49. Laying out foundation concrete and construction of manhole. (12hrs.) 50. Method of providing footrests, Forming of drain and benching.(10 hrs.)	fixing sanitary fittings such as WC, urinal, washbasin, kitchen sink, etc. • Construction of surface drains and laying its surface with bricks. • Drainage pipes: Types, materials, sizes, gradient for different diameters, method of laying & jointing, importance of water tightness, concrete base and covering. (20 hrs)
Professional Skill 50 Hrs; Professional Knowledge 06 Hrs	Construct septic tank. (Mapped NOS: IES/N9446) Perform fixing& fittings of wash basin, flushing cistern, sink, vent pipe, etc. (Mapped NOS: IES/N9447)	51. Construct Septic tank conforming PWD norms, Bonding &waterproofing of tank walls, lining field drains with bricks. Shoring for deep trenches following proper Safety precautions. (30 hrs.) 52. Fix brackets for washbasin and flushing cistern. (06 hrs.) 53. Fix WC pan, kitchen &bathroom traps, sinks, etc. Fixing of vent pipe to walls.(14hrs.)	• Septic tank: Purpose, parts and method of construction. .(06 hrs) Chapter -6 video demo
Professional Skill 30 Hrs; Professional Knowledge 07Hrs	Lay marble on floor& stair with marking, cutting &complete setting. (Mapped NOS: IES/N9448)	54. Marble work: Method of cutting and setting on stair, floor, wall &pillar. (30 hrs.)	• Marble floor: types, constructional details..(07hrs)
Professional Skill 25 Hrs; Professional Knowledge 12 Hrs	Construct circular brick wall & hollow block walls. (Mapped NOS: IES/N9449)	55. Construct a $4\frac{1}{2}$" dia. X 9" thick circular brick wall 4 layers. (15 hrs.) 56. Construct circular gate pillars with Brick / stone/ tile/ concrete.	• Circular walls: Details of construction. Purpose-made bricks. • Setting out and construction of circular gate pillars with

		(10 hrs.)	brick/stone/tile/concrete. • Hollow block masonry: Laying of hollow blocks for walls & columns. • Use of structural clay tile for partition. • Precast concrete partition, metal lathe partition and concrete block partition.(12 hrs)
Professional Skill 64 Hrs; Professional Knowledge 15 Hrs	Prepare & mix of concrete, formwork, cutting & bending of bar, casting of roof slab, beams, lintels, stair, column etc. (Mapped NOS: IES/N9450)	57. Construct of roof with RCC slab and beam(64 hrs.)	• Introduction to RCC: Uses, materials, properties and formwork, bending of bars & construction. • Reference to ISI code. Reinforced brickwork. • Brief description of slabs, beams, lintels, stairs, columns, etc. • RCC work: Mixing of concrete. • Laying, compacting &Curing of concrete. • Thumb rule for percentage of reinforcement for lintels, slabs, beams & columns. • Necessity hook & cranking. Shear reinforcement. (15 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Cut & set glazed tiles to walls. (Mapped NOS: IES/N9451)	**Finishing works :** 58. External/internal wall finishing practice by plastering or Pointing. (10 hrs.) 59. Fixing cement concrete jelly.(2 hrs.) 60. Laying of glazed tiles.(08 hrs.) 61. Fixing the thread, filling between ends, plumbing, setting out a jamb, bonding.(3 hrs.)	• Method of finishing-factors to be kept in mind, PWD specification on the above. • Use of glazed tiles for wall facing, steps in fixing, precautions. • Construction & expansion joints-method of filling-repair of cracks.(07 hrs)

		62. Marking & cutting tiles.(2 hrs.)	
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Lay mosaic, terrazzo & tile flooring. (Mapped NOS: IES/N9452) Perform Construction of R.C.C. & Brick stairs. (Mapped NOS: IES/N9453)	63. Flooring: Mosaic, terrazzo, and tile flooring. (30 hrs.) 64. Laying out a stair on the ground.(20 hrs.)	• Stairs: Technical terms, relation between tread & rise, • Types of stairs, construction details of brick, stone & RCC stairs. • Spiral stairs with precast concrete steps. • Formwork & shuttering-their removal-precautions-PWD specifications.(14 hrs)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (Mapped NOS: IES/N9454)	**ENGINEERING DRAWING:** Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to thesketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Reading of dimension and Dimensioning Practice. Symbolic representation – • Different symbols used in the trades. Reading of Plan drawing	
Workshop Calculation Science: 36 Hrs.			
Professional Knowledge WCS- 36 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (Mapped NOS:	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division	

	IES/N9455)	Decimal fractions - Addition, subtraction, multilipication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and suare root Simple problems using calculator Applications of pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Precentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Introduction of iron and cast iron **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, celsius, fahrenheit, kelvin and conversion between scales oftemperature Co-efficient of linear expansion and related problems with assignments Thermal conductivity and insulators **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Trigonometry** Measurement of angles Trigonometrical ratios
<u>In plant training/ Project work</u> **Broad areas:** a) Install a W.C. pan.		

b) Construct of a circular brick wall c) Construct a manhole. d) Set glazed tiles on wall.

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately inwww.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

List of Tools and Equipment			
MASON (Building Constructor) (For batch of 24 Candidates)			
Sl. No.	**Name of the Tools& Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1	Bolster	4" (100mm)	24+1 Nos.
2	Pitching tool (mason)		24+1 Nos.
3	Chisel (mason) Hammer headed punch		24+1 Nos.
4	-do-	$^{1}/_{2}$" (12mm)	24+1 Nos.
5	-do-	1" (25mm)	24+1 Nos.
6	-do-	Cross cut type	24+1 Nos.
7	-do-	$^{3}/_{4}$" (18mm)	24+1 Nos.
8	-do-	$1^{1}/_{2}$" (35mm)	24+1 Nos.
9	Club hammer	$1^{1}/_{2}$" / 1pbs.	24+1 Nos.
10	Hammer (mason) brick	(600-800gm)	24+1 Nos.
11	Helmet		24+1 Nos.
12	Leather gloves		24+1 Nos.
13	Goggles		24+1 Nos.
14	Plumb level	36" (1m)	24+1 Nos.
15	Pins (Line)		24+1 Nos.
16	Plumb bob		24+1 Nos.
17	Steel square		24+1 Nos.
18	Plastering trowel-double		24+1 Nos.
19	Wooden float		24+1 Nos.
20	Trowel-brick	10" (25cm) long	24+1 Nos.
21	Trowel-pointing	6" (15cm)	24+1 Nos.
22	Tasla (tin) pan		24+1 Nos.
23	Wooden straight edge	4'	24+1 Nos.
24	Bucket		24+1 Nos.
B. TOOLS, MEASURING INSTRUMENTS AND GENERAL SHOP OUTFIT			
25.	Spade		12Nos.

26.	Shovel		12Nos.
27.	Measuring steel tape	15m	3Nos.
28.	Measuring tape	30m	2Nos.
29.	Ladder	2-4m	3Nos.
30.	Sledge hammer	4kg	3Nos.
31.	Drum	45gallons	3Nos.
32.	G.I. pipe	1" (25mm) dia.	200Nos.
33.	Hose pipe		60m
34.	G.I. pipe	$^1/_2$" (12mm) dia.	200Nos.
35.	Cellotax board		3Nos.
36.	Spirit level	6" (15cm)	24 Nos.
37.	Chop saw machine	200 watt	2 sets
38.	Spirit level	12" (30cm)	6 Nos.
39.	Screw driver		6 Nos.
40.	Pocket steel tape	6' long	20Nos.
41.	Pickaxe		6 Nos.
42.	Crowbar	1.5m long	3Nos.
43.	Scrapper		24 Nos.
44.	Snip straight	10" (25cm)	6 Nos.
45.	Carpenter tool kit of 20 sets		
	(a) Handsaw		1No.
	(b) Mortise chisel		1No.
	(c) Tenion saw		1No.
	(d) Firmer chisel		1No.
	(e) Mallet		1No.
	(f) Carpenter claw hammer		1No.
	(g) Hand brace with bits		1No.
	(h) Plane		1No.
46.	Wheel barrow		5Nos.
47.	Tubular scaffolding		As required
48.	Steel measuring boxes	(0.6 cft& 1.2 cft)	4 each
49.	Adjustable steel props		30Nos.
50.	Bending rods		3Nos.
51.	Bar bending die	one end 6mm and other 8mm	6 Nos.
52.	- Do -	one end 10mm and other 12mm	6 Nos.
53.	Dumpy level with stand & staff		3Nos.
54.	Spanner set		1No.

55.	Rammer		6 Nos.
56.	Steel shuttering	400 sq. m.	2 sets
57.	Bench grinder		2Nos.
58.	Drilling machine		2Nos.
59.	Steel lockers	with 8 drawers Metal rack (1800x1500x450mm)	3 Nos.
60.	Metal rack	1800X1500X450mm	1 No.
61.	Desk		1No.
62.	Stool		1 No.
63.	Black Board with glass		1 No.
64.	Fire Extinguisher		1 No.
65.	Fire Buckets with stand		1 No.
66.	Steel Almirah (large)		1 No.
67.	Instructor table and chair		1 No.
C. TOOLS & EQUIPMENT FORDRAWING HALL			
68.	Engineering Instrument Box		24+1 Nos.
69.	Protractor	15 cm full circular	24+1 Nos.
70.	Card board/ plastic metric scale set	A to H	24+1 Nos.
71.	Celluloid set square	45° & 60°	24+1 Nos.
72.	Drawing board	1250 x 900 mm	24+1 Nos.
73.	T square	1250 mm/ Mini drafter	24+1 Nos.
74.	Erasing shield small size		24+1 Nos.
75.	Architect's & builder's template		24+1 Nos.
76.	Drawing machine	(Horizontal type	24+1 Nos.
77.	French curve- set of 12		24+1 Nos.

Note:

1. *Internet facility is desired to be provided in the class room.*
2. *Dumpy level need not be provided, if the institute has Surveyor/Draughtsman Civil trade.*
3. *Sl. Nos. 25 to 34 need not be provided, if the institute has Surveyor/ Architecture/ Draughtsman Civil/ Draughtsman Mechanical/ other similar trades.*

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

CURRICULUM

FOR THE TRADE OF

TOOL AND DIE MAKER (PRESS TOOLS, JIGS & FIXTURES)

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENURESHIP
DIRECTORATE GENERAL OF TRAINING

CONTENTS

1. ACKNOWLEDGEMENT

The DGT sincerely express appreciation for the contribution of the Industry, State Directorate, Trade Experts and all others who contributed in revising the curriculum. Special acknowledgement to the following industries/organizations who have contributed valuable inputs in revising the curricula through their expert members:

1. Larsen & Toubro, Mumbai
2. Maruti India Ltd., Gurugram
3. Volkswagan Academy, Pune
4. OCL Ltd. (Dalmia Group), Odisha
5. Bharat Heavy Electricals Ltd., Ranipet, Tamil Nadu
6. TATA Motors, Pune
7. JBM Group, Chennai
8. MTAB Technology (P) Ltd., Chennai

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

Co-ordinator for the course: Sh. Nirmalya Nath., ADT

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Remarks
1.	Anil.V. Bhide, Manager(Trg)	NTTF, Peenya Campus, Bangalore	Expert
2.	G.N. Eswarappa, DDT	FTI, Bangalore	Expert
3.	N. Nath, ADT	CSTARI, Kolkata	Expert
4.	R. N. Manna, T.O.	CSTARI, Kolkata	Expert

2. BACKGROUND

2. 1. Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

2. 2. Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

2. 3. Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.

- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.

- Scope has been extended also to non-engineering occupations.

- Establishments have been permitted to outsource basic training in an institute of their choice.

- The burden of compliance on industry has been reduced significantly.

3. RATIONALE

(Need for Apprenticeship in **Tool and Die Maker – Press Tool, Jigs & Fixture** trade)

1. The greater degree of relevance of the training with latest advancements of the industry will enhance the employability opportunities
2. It will enhance the ability to study blueprints, sketches or other instructions to determine operational methods or sequences.
3. It will enhance the ability to visualize and compute dimensions, sizes, shapes, and tolerances of assemblies, based on specifications.
4. It will enhance the ability to fit and assemble machine tools, parts or fixtures using machine tools and hand tools.
5. It will enhance the ability to obtain required fixtures, cutting tools, measuring instruments and other items from tool needs.
6. It will enhance the ability to develop and design tools, fixtures, or other devices for production equipment.
7. It will enhance the ability to design jigs, fixtures, and templates for use as work aids in the fabrication of parts or products.
8. It will enhance the ability to set-up and operate press so it is capable of performing work assignments to the predetermined level of production and quality goals.
9. It will enhance the ability to set up and operate a hydraulic press or punch for routine established work.
10. It will enhance the ability to select correct tooling for metal press forming task with setup documents.
11. It will enhance the ability to load, install and correctly set up the tools required.
12. It will enhance the ability to lift work piece manually or with hoist, and positions and secures it on machine table in drilling jig or holding fixture.
13. It will enhance the ability to perform assigned work to time standards and quality expectations.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Tool Maker makes cutting and press tools, gauges, simple jigs, fixtures, etc. mainly for use in machines. Studies drawings, samples and other specifications of tool or gauge to be made. Selects required type of metal or alloy and marks it for various operations, using vernier height gauges, sine plate, Vee blocks, etc. Cuts, files, grinds, scrapes or otherwise shapes metal to specified dimensions frequently checking it while working with measuring instruments such as micrometer, vernier, gauges, face plate etc. as necessary. Anneals, shapes, hardens and tempers cutting tools ensuring correct cutting angles, clearances, etc. according to standard or prescribed specifications. Assembles part, finishes object. Checks accuracy with precision measuring instruments and shadow graph if necessary to ensure desired performance. Calibrates and adjusts tools and gauges where required and maintains them in good working order. Guides brazing of tips to stalks and finishes them to make tip tools. Is designated as GAUGE MAKER if engaged in making or reconditioning gauges. May repair and recondition tools for further use. May design tools, jigs and fixtures and braze and weld metal parts.

Jig and Fixture Maker makes and repairs jigs and fixtures (device for holding metal and guiding cutting tools) for mass production work. Studies drawing and checks dimensions and other specifications of sample to calculate working details. Collects material, gets surfaces finished by filing or machining and marks them off. Makes different parts of required jig or fixture by cutting, filing, machining, grinding, scraping, drilling, screwing, etc. and finishes them to required dimensions. Hardens and tempers necessary parts or gets them done ensuring that they do not get demoted. Assembles parts in proper sequence, fits hardened bushes or parts where specified to guide cutting tools and checks easy fixing and removing of part to be machined to ensure operational efficiency of jig or fixture made. Checks fitting of jig and fixture at each stage while assembling to conform to specifications. Tests completed jig or fixture by trial operations to ensure operational efficiency and accuracy in production work. May make adaptors, pullers etc. for specific purposes. May machine and grind jig and fixture parts himself.

Tool Setter, Press sets press tools (die and punch) in power and hand press for manufacture of sheet metal products. Examines sample or studies drawings and specifications of item for production. Selects appropriate pair of die and punch and examines them for sharpness, cutting angle, clearance, etc. Fits punch in punch holder of

machine and securely screws it in position. Places die on machine table and lowers punch to fit in die. Adjusts position of die in relation to punch. Clamps die securely on machine table with holders, plates, bolts and nuts and manually operate punch few times to ensure that it passes clearly through die set. Starts machine and feeds metal to cut or form trial pieces. Examines them for correctness in all respects, resets die if necessary, and hands press over to operator for production work. May grind press tools on surface grinder. May fit guide pin in die to avoid wastage of material. May fit die in bolster (holding device) before setting. May supervise operators.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Perform TPM (Total Production Management), TQM (Total Quality Management) and record keeping system.

Reference NCO:

i). **NCO-2004: 7222.20**
ii). **NCO-2004: 7222.30**
iii). **NCO-2004: 7223.20**
iv). **NCO-2004: 7222.50**
v). **NCO-2004: 8211.10**
vi). **NCO-2004: 8211.15**
vii). **NCO-2004: 8211.22**
viii). **NCO-2004: 8211.30**
ix). **NCO-2004: 8211.38**
x). **NCO-2004: 8211.55**
xi). **NCO-2004: 8211.70**

5. GENERAL INFORMATION

1. **Name of the Trade** : **TOOL AND DIE MAKER (PRESS TOOLS, JIGS AND FIXTURES)**

2. **N.C.O. Code No.** : **NCO-2004:** 7222.20, 7222.30, 7222.50, 8211.10, 8211.15, 8211.22, 8211.30, 8211.38, 8211.55, 8211.70

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):**2years

3.1 **For Freshers: -** Duration of Basic Training: -

a) Block –I : 3 months

b) Block – II : 3 months

Total duration of Basic Training: **6 months**

Duration of Practical Training (On -job Training): -

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: **18 months**

3.2 **For ITI Passed: -** Duration of Basic Training: - **NIL**

Duration of Practical Training (On -job Training): **12 months**

4. **Entry Qualification** : Passed 10th Class with Science and Mathematics under 10+2 system of Education or its equivalent

5. **Selection of Apprentices:** The apprentices will be selected as per Apprentices Act amended time to time.

6. **Rebate for ITI passed trainees** : i) **One year** in the trade of **TDM (Press Tools, Jig & Fixtures)/Machinist/TDM (Dies & Moulds)**

Note: Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.

6. COURSE STRUCTURE

Training duration details: -

Time (in months)	1-3	4-12	13-15	16-24
Basic Training	Block– I	-----	Block – II	------
Practical Training (On - job training)	----	Block – I	------	Block – II

Components of Training	Duration of Training in Months →																							
↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Basic Training Block - I																								
Practical Training Block - I																								
Basic Training Block - II																								
Practical Training Block - II																								

7. SYLLABUS

7.1 BASIC TRAINING
(BLOCK – I & II)
DURATION: 06 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **TOOL AND DIE MAKER (PRESS TOOLS, JIGS AND FIXTURES)**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 29.6 KW for Workshop
5) **Space Norms** : 130 Sq. m.
6) **Examination** : The internal assessment will be held on completion of each Block.
7) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

OR

ii) NTC/NAC in the trade of **Tool & Die Maker (Press Tools, Jigs and Fixtures)** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

8) **Tools, Equipments & Machinery required** : - As per Annexure – I

7.1.1 DETAIL SYLLABUS OF CORE SKILL

A. Block– I
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1.	**Engineering Drawing:** Introduction and its importance Different types of standards used in engineering drawing. Drawing Instruments: their uses Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.	**30**	**Units & Measurements-** FPS, CGS, MKS/SI unit, unit of length, Mass and time. Fundamentals and derived units Conversion of units and applied problems.	**20**
2.	Lines : types and applications in Drawing as per BIS SP:46-2003 Drawing geometrical object using all types of lines. **Drawing of Geometrical Figures:** Angle, Triangle, Square, Rectangle and Circle. **Letters: -** Lettering styles, Single stroke letters and numbers as per IS standard. Lettering practice		**Material Science** : properties - Physical & Mechanical, Types - Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals	
3.	**Dimensioning-** Types of dimension, elements of dimensions, Methods of indicating Values, Arrangement, Alignment and indication of dimensions. **Scales**:-Types use and construction. Representative factor of scale.		**Mass .Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density,	
4.	Method of presentation of Engineering Drawing - Pictorial View - Orthogonal View - Isometric view		**Speed and Velocity:** Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation. Average Velocity, Acceleration & Retardation. Related problems.	

			Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force	
5.	**Constructions: -** Draw proportionate free hand sketches of plane figures. Sketch horizontal, vertical and inclined line by free hand, Draw circles by free hand using square and radial line method, Draw arcs and ellipse by free hand		**Ratio & Proportion** : Simple calculation on related problems. **Percentage:** Introduction, Simple calculation.	
6.	Projections: Concept of axes plane and quadrant. Orthographic projections Method of first angle and third angle projections (definition and difference) Symbol of 1^{st} angle and 3^{rd} angle projection as per IS specification. Free hand Drawing of Orthographic projection from isometric/3D view of geometrical blocks		**Work, Power and Energy:** work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy. Meaning of H.P., I.H.P., B.H.P., and F.H.P. and CC and Torque.	

B. Block- II
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1.	**Screw :-** Its Types and Sizes, Screw thread, their standard forms as per BIS, external and internal thread.	**30**	**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	**20**
2.	**Rivets and Joints:-** Prepare a drawing sheet on rivets nomenclature and Joints.		**Heat & Temperature:** Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	
3.	Free hand Sketches for simple pipe line with general fittings.		**Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids - cube, cuboid, cylinder and Sphere. Surface area of solids -cube, cuboid, cylinder and Sphere. Volume of cut-out solids: hollow cylinders, frustum of cone, block section. Volume of simple solid blocks.	
4.	Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.		**Basic Electricity:** Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections - series, parallel, electric power, Horse power, energy, unit of electrical energy. Concept of earthling.	
5.	Simple exercises related to trade related symbols. Basic electrical and electronic symbols		**Simple machines** **Transmission of power: -** Transmission of power by belt, pulleys & gear drive. **Heat treatment process: -** Heat treatment and advantages.	

			Annealing, Normalizing, Hardening, Tempering.	
6.	Free hand sketch of trade related components / parts /cutting tool indicating angles.		**Trigonometry:** Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding the value of unknown sides and angles of a triangle by Trigonometrical method. Finding height and distance by trigonometry. Application of trigonometry in shop problems. (viz. taper angle calculation). Calculate the area of triangle by using trigonometry and application of Pythagoras theorem.	
7.			**Concept of pressure** - **Definition**:-Force, Pressure, and their units, atmospheric pressure, gauges used for measuring pressure, problems. Introduction to pneumatics & hydraulics systems.	
8.	**Simple exercises related to trade related Test Papers. Solution of NCVT test papers.**			

7.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I

Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	Safety: - its importance, classification, personal, general, workshop and job safety. Occupational health and safety. Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Preventive measures for electrical accidents & steps to be taken in such accidents. Importance of housekeeping & good shop floor practices. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Fire& safety: Use of Fire extinguishers.	Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Institute system including stores procedures. Introduction of First aid. Safety attitude development of the trainee by educating him to use Personal Protective Equipment (PPE). Response to emergencies eg; power failure, fire, and system failure. Accidents- Definition types and causes. First-Aid, nature and causes of injury and utilization of first-aid. Introduction to 5S concept & its application. Fire: - Types, causes and prevention methods. Fire Extinguisher, its types. Global warming its causes and remedies. Industrial Waste its types, sources and waste Management.
2.	Identification of tools & equipments as per desired specifications for marking & sawing(Hand tools , Fitting tools & Measuring tools) Uses of marking tools, Punch, Try square & basic measuring tools, caliper, steel rule. Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions, sawing different types of metals of different sections. Filing, Chipping & scraping flat surfaces and measure using different measuring instruments.	Introduction hacksaw cutting, marking, filling operation, need and application, types of files and their construction and usage Perpendicularity, parallelism. Hand tools and its importance, steel rule, Try square, chisel, surface gauge and care & maintenance, Hacksaw frame, blades. Classification and types of chisels, files & uses, vices - its constructions and uses. Hammers and its types. Related safety. Marking block, Steel rule, and calipers- different types and uses. Hacksaw blade, Hacksaw frame and its types. Drill bits- parts, Types & uses. Different measuring instruments and gauges

		used in shop floor, their construction and usage. Selection of Cutting parameters and work holding devices.
3.	Mounting and dismantling of different dills on machines and different practical exercises. Marking and Drilling holes on flat pieces. Tapping as per simple drawing. Exercise on use of pillar drill in drilling, counter sinking, counter boring. Spot facing and use of spot facing tools. Further practice of drilling of Radial drills. Practice of reaming on drilled holes.	Identification of different parts, accessories, attachments', operations and tools used in drilling machines. Introduction to Hand Taps & Dies and their types, applications, care and maintenance. Familiar with tap and drill size, Thread Terminology.
4.	Lathe: Holding of round job in an independent chuck and truing it. Holding the tool in a tool post, centering the job with the tool. Facing & drilling. Parallel turning between centers, parting off, chamfering using roughing, finishing and parting off tools. Holding the job in three jaw chuck truing, centering facing. Step turning undercutting, knurling drilling and boring.	Introduction to lathe. Its types, engine lathe construction, detail function of parts size and specification. Safety points to be observed while working on a lathe. Lathe tools their angles & uses. Driving mechanism, speed and feed mechanism & lathe accessories.
5.	Taper turning by swiveling compound rest, setting the compound rest to correct degree, checking the tool height, clamping the saddle for no longitudinal movement, checking up with precision instruments. Cutting V thread external and internal in a lathe. Checking up with screw pitch gauge. Cutting square thread external & internal on a lathe. Cutting square threads (right hand only) on a lathe-checking with thread gauge-grinding of tool and	Chucks-different types of job holding devices on lathe and advantages of each type. Mounting and dismounting of chucks. Taper introduction, types and uses. Calculations of tapers. Measurement of taper by sine bar and slip gauges. Different thread forms their related dimensions and calculations screw cutting in a lathe.

	setting in correct position.	
6.	Introduction to milling machine, demonstration on working principle, setting of job, setting of cutter in arbor, setting of vice on table. Safety points to be observed while working on a milling machine. Sequence of milling six faces of a solid block. Checking the accuracy with the help of try-square scribing block and vernier height gauge. Step milling using side and face cutter checking with micrometer.	Milling machine importance of milling machine, types and specification of milling machine, driving and feed mechanism of milling machine. Classification & different types of milling cutters & their use. Parts and nomenclature. Vernier height gauge construction, graduations vernier setting & reading, vernier bevel protractor, construction graduation setting and reading. Care and maintenance of vernier height gauge and bevel protractor.
7.	Straddle and gang milling operations including up-milling and down milling. Milling concave and convex surfaces. Introduction to indexing head types, setting and aligning of indexing head with reference to job on milling machine. Milling square and hexagonal job by simple indexing method.	Different milling operations plain-face, angular, form, slot, gang and straddle milling etc. Up and down milling. Different types of milling attachments and their uses. Indexing-introduction & types. Indexing head-constructional details, function of indexing plates and the sector arms. Calculation for various types of indexing.
8.	Milling dovetail and 'T'slots both male & female matching each other. Milling of spur gear. Introduction to grinding machine surface grinder, cylindrical grinder. Driving and feed mechanism, job holding devices mounting of wheels. Different practical exercises with different accuracy levels. Wheel balancing & truing. Grinding of parallel and stepped jobs. Dressing of grinding wheels.	Introduction surface and cylindrical grinding machine, identification of different parts, accessories, attachments', operations and tools used in grinding machines. Selection of grinding wheels, balancing and mounting of grinding wheels. Types of Abrasives and their uses, Glazing and loading of wheels. Explain the importance and necessity of quality.
9-10	**Tool & Cutter Grinder:** Grinding of single point cutting tool blank.	**Tool & Cutter Grinder:** Description of tool and cutter grinding

	Grinding of plain and face milling cutter.	machine. Work (cutting tool) holding devices for tool & cutter grinder machine. Setting process of cutting tools and grinding wheel on tool & cutter grinding machine.
11-12	**Wire Cut** Machining practice / observation on Wire cut Machine.	**Wire Cut** Electrical discharge machining (EDM) - Introduction, principle of operation, advantages & disadvantages and its applications. Wire cut machine - introduction, principle of operation, advantages & disadvantages and its applications.
13.	**Revision & Internal Assessment**	

B. Block –II
Basic Training

Week No.	Professional Skills	Professional Knowledge
1-3.	**JIGS & FIXTURES:** Identify different elements of jigs and fixture. Manufacture simple parts as per drawing with different machining operations	**JIGS & FIXTURES:** Definition and application of jigs and fixtures. Explain the constructional features, different elements and working principles of jigs and fixture.
4-8	**PRESS TOOL:** Identify different parts of press and different elements of different press tools. Demonstrate about safety precautions followed during working on press machine. Manufacture and assembly of different press tools viz., Blanking die, piercing die and progressive die.	**PRESS TOOL:** Introduction of press machine, its types and application of press and press tools. Explain the constructional features and working principles of different types of press and press tools Extrusion process – Process overview, type of extrusion dies with sketches, advantages of different extrusion processes, manufacturing and Inspection of extrusion dies. Concept of Unitized tooling – advantages and limitations. Fine Blanking Technology – Tool Construction, type of Fine Blanking tools.
9	**Hydraulics & Pneumatics** Identification and familiarization of various types of hydraulic & pneumatic elements such as cylinder, valves, actuators and filters. Study of simple hydraulic & pneumatic circuits.	**Hydraulics & Pneumatics** Basic principles of hydraulic & pneumatic system. Advantages & disadvantages of hydraulic and pneumatic system. Theory of Pascal's law, Brahma's press, pressure & flow. Type of valves used in hydraulic and pneumatic system.
10-12	Program generation & Simulation (Turning, Milling and Machining of punch & dies) with CAD/CAM software. Inspection of machined punch and dies with measuring instruments.	Basic concept of CNC Machine and its different code (G and m code) for programming. Practice of simple programming. CAD (Theory)/ CAM Basic concepts of inspection of 3D surfaces (Finishing of punch and Die). Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time,

		productivity reports, job cards. Concept of TPM & TQM.
13.	**Revision & Internal Assessment**	

7.1.3 EMPLOYABILITY SKILLS

GENERAL INFORMATION

1)	**Name of the subject**	**:**	**EMPLOYABILITY SKILLS**
2)	**Applicability**	**:**	ATS- Mandatory for fresher only
3)	**Hours of Instruction**	**:**	**110 Hrs. (55 hrs. in each block)**
4)	**Examination**	**:**	The examination will be held at the end of two years Training by NCVT.
5)	**Instructor Qualification**	**:**	

i) MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.

7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

A. Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**15**
1	**Pronunciation :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading** Reading and understanding simple sentences about self, work and environment	
4	**Writing** Construction of simple sentences Writing simple English	
5	**Speaking / Spoken English** Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	I.T. Literacy	**15**
1	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**Computer Operating System** Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.	
3	**Word processing and Worksheet** Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets	
4.	**Computer Networking and INTERNET** Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks),	

	Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
	Communication Skill	**25**
1	**Introduction to Communication Skills** Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body - language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise	
2	**Listening Skills** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
3	**Motivational Training** Characteristics Essential to Achieving Success The Power of Positive Attitude Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning. Case study/Exercise	
4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
5	**Behavioral Skills** **Organizational Behavior** Problem Solving Confidence Building Attitude Decision making Case study/Exercise	

B. Block– II
Basic Training

Topic No.	Topic	Duration (in hours)
	Entrepreneurship skill	**15**
1	**Concept of Entrepreneurship** **Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	
2	**Project Preparation & Marketing analysis** Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	**Institutions Support** Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.	
4	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**Comparison with developed countries** Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.	
4	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**15**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	

2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	
3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	
9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**Welfare Acts** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
	Quality Tools	**10**
1	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2	**Quality Circles :** Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3	**Quality Management System :** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	

7.2 PRACTICAL TRAINING (ON-JOB TRAINING)
(BLOCK – I & II)
DURATION: 18 MONTHS (9 months in each block)

GENERAL INFORMATION

1) **Name of the Trade** : **TOOL AND DIE MAKER (PRESS TOOL, JIGS & FIXTURE)**

2) **Batch size** : a) Apprentice selection as per Apprenticeship guidelines.
b) Maximum 20 candidates in a group.

3) **Examination** : i) The internal assessment will be held on completion of each block
ii) NCVT exam will be conducted at the end of 2nd year.

4) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

OR

ii) NTC/NAC in the trade of **Tool & Die Maker (Press Tools, Jigs and Fixtures)** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

5) **Infrastructure for On-Job Training** : - As per Annexure – II

7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

A. BLOCK – I (09 months)

1. Safety and best practices/Basic Industrial Culture (5S, KAIZEN, etc.)
2. Prepare different types of documentation as per industrial need by different methods of recording information.
3. Produce finished components on a lathe & milling machine and check for accuracy. (Conventional/CNC machine)
4. Produce finished components on a surface and cylindrical grinding machines and check for accuracy.
5. Reading & understanding of Jigs & fixtures, drawing etc. Use of limits fits & tolerances.
6. Grind/ re-sharpen of single point and multipoint cutting tools. (different types of milling cutters) using Tool and cutter grinding machine
7. Material selection for the manufacture of different elements of Press Tool - Jigs and Fixtures and Gauges. Heat treatment - It's effects on functioning of different parts - different methods of heat treatment etc. Material Testing - hardness - tensile and compressive strength - crack - X-ray etc.
8. Manufacture different components using wire cut EDM.
9. Tool length measurement training with different types of tool holders like HSK63, BT40, BT30, BT50, HSK40 etc. automatic machine or with height gauge with dial indicator.
10. Practical exposure to working on Engraving machine.
11. Manufacture of forming tools like coining, embossing, hole flanging, planishing.

B. BLOCK – II (09 months)

1. Manufacture of different types of jigs and fixtures.
2. Manufacture and assembly of different press tools viz., Blanking die, piercing die and progressive die.
3. Manufacture and assemble different press tools viz., compound die, V bending die, and drawing die.
4. Identify and explain the function of cylinder, valve , actuator and filters in the machines available in work shop like hydraulic press, surface and cylindrical grinder
5. Process planning - machining sequence, cutting tools selection, cutting parameters, work holding devices.
6. Develop different elements of punches and dies using CAD/CAM software.
7. Measurement of surface finish. Measuring straightness, flatness circularity & roundness, cylindricity, profile of any line or surface, parallelism, perpendicular &squareness, angularity, position concentricity & coaxially symmetry.
8. Factors infusing surface quality. Grinding allowance, hardness requirement.Working on surface finishing processes like broaching, honing & lapping.
9. Hydraulic clamping, pneumatic clamping, vacuum clamping & magnetic clamping Indexing devices - linear indexing devices & rotary indexing devices. Template jigs & pot jigs-description of parts & function.

10. Accuracy & repeatability concept for jigs & fixtures. Automated jigs & fixture by use of pneumatics & hydraulics
11. Identify potential causes for non-conformities to quality assurance standards for different press tools, jigs and fixtures, ISO standards – Trouble shooting – Rectification of tools – Maintenance of tools – Simple hydraulic/ pneumatic circuits
12. Material selection for the manufacture of different elements of press tools, jigs and fixtures. Factors to be considered for the selection of material like Load, Heat Resistance, Machinability etc. Selection of material on the basis of manufacture aspects and processing aspects. Application of non-ferrous materials for the manufacture of press tools, jigs and fixtures. Fundamental designing of small tools. Heat treatment its effect on functioning of different parts – different methods of heat treatment etc.
13. Quality and Inspection of Tools - Stage inspection - Inspection of additional tooling like electrodes, templates, masters etc.. Use of profile projectors, tool maker's microscope, comparators - Three co-ordinate measuring machine - surface measuring equipment etc. and documentation.
14. CNC machine operations and setting of CNC machines verification and simulation of CNC part programs. Work offsets and tool offsets used in the CNC machines.
15. Prepare part programme using G codes and M codes and machine simulation and manufacture different components on CNC machines.
16. Preventive maintenance of CNC machines.
17. Perform TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping system.

8. ASSESSMENT STANDARD

8.1 Assessment Guideline:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line with those demanded by the component/job.
- a fairly good level of neatness and consistency in the finish
- occasional support in completing the project/job.

b) Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- a good level of neatness and consistency in the finish
- little support in completing the project/job

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.

In this work there is evidence of:

- high skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST

(SUMMATIVE ASSESSMENT FOR TWO YEARS TRADE)

SUBJECTS	Marks	Sessional Marks	Full Marks	Pass Marks	Duration of Exam.
Practical	300	100	400	240	**08 hrs.**
Trade Theory	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50		50	17	2 hrs.
Grand Total	**550**	**150**	**700**	**-**	

Note: - The candidate pass in each subject conducted under all India trade test.

9. FURTHER LEARNING PATHWAYS

- On successful completion of the course trainees can opt for Diploma course (Lateral entry). [Applicable for candidates only who undergone ATS after CTS]
- On successful completion of the course trainees can opt for CITS course.

Employment opportunities:

On successful completion of this course, the candidates may be gainfully employed in the following industries:

1. Production & Manufacturing industries involved in manufacturing jigs & fixture.
2. Infrastructure and defence organisations
3. In public sector industries (Central and State) and private industries in India & abroad involved in manufacturing jigs & fixture.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: TOOL AND DIE MAKER (PRESS TOOL, JIGS & FIXTURE)

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A : TRAINEES TOOL KIT:

Sl. No.	Description of Tools	Quantity
1	Steel Rule 150 mm English and Metric combined	20 nos.
2	Engineer's Square 150 mm with knife edge	20 nos.
3	Hacksaw frame adjustable with pistol grip for 200-300 mm blade	20 nos.
4	Centre punch 100 mm	20 nos.
5	Prick punch 150 mm	20 nos.
6	File flat bastard 300 mm	20 nos.
7	File flat 2^{nd} cut 250 mm	20 nos.
8	File flat safe edge 200 mm	20 nos.
9	File triangular smooth 200 mm	20 nos.

B : Tools and Equipments:

Sl. No.	Name of Tools and Equipments	Quantity
1	Caliper inside spring type-150 mm	4 nos.
2	Caliper outside spring type-150 mm	4 nos
3	Divider spring type – 150 mm	4 nos.
4	Odd leg caliper firm joint 0- 150 mm	2 nos.
5	Screw driver – 150 mm	1 no.
6	Screw driver – 200 mm	1 no.
8	Centre gauge 55^0 and 60^0	2 nos.
9	Oil can 250 ml	1 no.
10	File flat smooth 200 mm	4 nos.
11	File flat smooth with safe edge 200 mm	4 nos.
12	File half round bastard 300 mm	4 nos.

13	File half round smooth 250 mm	4 nos.
14	File triangular bastard 250 mm	4 nos.
15	File triangular smooth 200 mm	4 nos.
16	File round bastard 250 mm	4 nos.
17	File square bastard 300 mm	4 nos.
18	File square smooth 250 mm	4 nos.
19	Knife edge file 150 mm	4 nos.
20	Needle file assorted (12 nos.) 150 mm	4 sets
21	File card	4 nos.
22	Scraper flat 250 mm	4 nos.
23	Hammer Ball Peen 0.5 kg with handle	4 nos.
24	Hammer Cross Peen 0.75 kg with handle	4 nos.
25	Chisel cold flat 18 x 150 mm	4 nos.
26	Chisel Cross Cut 10 x 3 x 200 mm	4 nos.
27	Chisel Half Round 10 x 250 mm	4 nos.
28	Chisel diamond point 10 x 200 mm	4 nos.
29	Scribing block universal 300 mm	2 nos.
30	Cast Iron Surface plate 300 x 300 mm	1 no.
31	Granite Surface plate 600 x 600 x 80 mm	1 no
32	Tap extractor 3 mm to 12 mm x 1.5 mm (ezzy out)	1 set
33	Screw extractor sizes 1 to 8	1 set
34	Taps and dies metric 5 mm to 12 mm complete set in a box	2 sets
35	Twist Drill with St. Shank Ø 5 to Ø 12 mm in steps of 0.5 mm	1 set
36	Twist Drill St. Shank Ø 8 mm to Ø 12 mm in steps of 2 mm	1 set
37	Taper shank drills Ø 6 mm to Ø 20 mm in steps of 1 mm	1 set
38	D.E spanners 3-4 , 6-8, 10-12, 13-14, 15-16, 18-19, 20-22, 24-26 (8 spanners)	2 sets
39	Letter punch 5 mm set	1 set
40	Number punch 5 mm set	1 set
41	Drill chuck 12 mm capacity with key	1 no.
42	Allen key metric 3 to 12 mm set	2 sets
43	Centre drills 3, 4,5 mm	2 each
44	Parallel hand reamer 6 mm to 12 mm in steps of 1 mm	1 set
45	Star dresser	2 nos.
46	Diamond dresser with holder	2 nos.
47	Safety goggles (Personal Protective Equipments)	4 nos.
48	Demagnetizer	1 no.
49	Snips 200 mm blade	1 no.
50	Workbench 240 cm x 120 cm x 75 cm with 150 mm vice (Each bench fitted with 4 vices)	4 nos.
51	Bench Vice 150 mm	16 nos.
52	Steel lockers for 16 trainees (Pigeon Cup Board)	2 nos.
53	Steel cupboard 180 cm x 60 cm x 45 cm	6 nos.
54	Metal rack 180 cm x 60 cm x 45 cm	1 nos.
55	Fire extinguisher	2 nos.
56	Fire buckets with stand	4 nos.
57	Feeler gauge 0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm (13 leaves)	1 set
58	Metric Screw pitch gauge-Range 0.4 -6 mm pitch 60^0 (21 leaves)	1 set
59	Radius gauge 1 - 3 mm by 0. 25 mm and 3.5-7mm by 0.5 mm (34	1 no.

	leaves)	
60	Vernier height gauge - Range 300 mm, with 0.02 mm least count	1 no.
61	Universal vernier caliper-Range 200 mm, with 0.02 mm least count	2 nos.
62	Dial vernier caliper 0-200 mm, with 0.02 mm least count	1 no.
63	Vernier caliper-Range 300 mm Vernier scale 0.02 mm	2 nos.
64	Vernier bevel protractor-Blade range 150 and 300 mm, dial 1^0 , least count 5' (min.) with head, Acute Angle attachment	1 no.
65	Outside micrometer 0-25 mm, with 0.01 mm least count	2 nos.
66	Outside micrometer 25-50 mm, with 0.01 mm least count	1 no.
67	Outside micrometer 50-75mm, with 0.01 mm least count	1 no.
68	Combination square sets-300 mm blade with square head, centre head, protractor head	1 set
69	Telescopic gauge range 8 -150 mm (6 pcs/set)	1 set
70	Sine bar 150 mm with stopper plate	1 no.
71	Sine table 200 mm length with magnetic bed	1 no.
72	Slip Gauge Box (workshop grade) -87 pieces per set	1 set
73	Gauge block accessories consisting holders, half round jaws, scriber point, centre point , triangular straight edge (14 pcs/set)	1 set
74	Central square – Size 400 x 250 mm blade	1 no.
75	V-Block-Approx. 32 x 32 x 41 mm with clamping capacity of 25 mm with clamps	2 pairs
76	V-Block-Approx 65x65x80 mm with clamping capacity of 50 mm with clamps	1 pairs
77	Magnetic V-Block 100x100x125 mm	2 pairs
78	Angle plate 150 x 150 x 200 mm	1 no.
79	Angle plate-adjustable 250x250x300 mm	1no.
80	Inside micrometer – Range 50-63 mm with std extension rods upto 200mm..	1 set
81	Depth micrometer – Range 0-25 mm, accuracy 0.01 mm with std set of extension rod s.	1set.
82	Magnetic stand with magnetic base 60 x 47.5 mm and with universal swivel clamp, dial holding rod (150 mm) scriber	2 nos.
83	Dial test indicator-Lever type- Range 0-0.8 mm –Graduation 0.01mm, reading 0-50-0 with accessories	1 nos.
84	Dial test indicator – Plunger type-Range 0-10 mm , Graduation 0.01 mm, Reading 0-100 with revolution counter	1 nos.
85	Bore gauge with dial indicator (1 mm range, 0-0.01 mm graduation)-Range of bore gauge 18-150 mm	1 set
86	Straight edge-Single beveled-Size 150 mm and 250 mm	1 each
87	Tool makers clamp 50 mm & 75 mm	2 nos. each
88	C – clamp- 50 mm & 75 mm	2 nos. each

C : Cutting Tools:

Sl. No.	**Name of Tools and Equipments**	**Quantity**
1	Side and face milling cutter Ø 100 x 10 X Ø 25 mm	2 nos.
2	Side and face cutter Ø 80 x 10 X Ø 27 mm	2 nos.
3	Cylindrical milling cutter Ø 63 x 70 x Ø 27 mm	2 nos.
4	Slitting Saw cutter Ø 75 x 3 X Ø 27 mm	2 nos.

5	Slitting Saw cutter Ø 100 x 6 X Ø 27 mm	2 nos.
6	Single angle cutter Ø 75 x 16 x Ø 27mm - 60^0	2 nos.
7	Single angle cutter Ø 75 x 20 x Ø 27 - 45^0	2 nos
8	Equal angle cutter Ø75x 30 x Ø 27 - 90^0	2 nos
9	Shell End Mill Ø 50 x 36 x Ø 22 (preferably inserted tip type)	2 nos.
10	Shell End Mill Ø 75 mm x 50 x Ø 22 (preferably inserted tip type)	2 nos.
11	Parallel shank end mills Ø6, Ø10 and Ø 16 are (double fluted), Ø 20 mm & Ø 25mm (four fluted)	4 nos. each
12	'T' slot cutter with parallel shank- Ø 17.5 x 8 mm width x dia. of shank 8 mm	2 nos.
13	Concave Milling cutter Ø 63 x 6 radius x Ø 27 mm	1 nos.
14	Convex Milling cutter Ø 63 x 6 radius x Ø 27 mm	1 nos.
15	Disc type form milling cutter (involutes form -2 module, 20° pressure angle)	1 set
16	Tool holder (straight) to suit 6, 8 mm sq. bit size	2 nos. each
17	Parting tool holders to suit 3 and 4 mm thick tool blade.	2 nos.
18	Boring bars with holders to accommodate 4, 6 and 8 mm HSS tool bits	3 each
19	Knurling tool (straight & diamond)	2 nos. each
20	Tool bits, inserts, carbide tool bits, reamers, special counter bore, counter sink tools(CNC tooling setup)	As required

D : General Machinery & Installation:

(Note: The specifications given under "General Machinery & Installation" can be purchased to the nearest size according to the availability in the Indian Market.)

Sl. No.	Name of Tools and Equipments	Qty.
1.	Sensitive drilling machine - capacity 12 mm Motorized –with drill chuck and key etc.	1No.
2.	Pillar/column type Drilling machine – 25 mm capacity-motorized with drill chuck & key etc.	1No.
3.	Radial Drill machine to drill up to 32 mm diameter.	1No.
4.	Power hacksaw machine to accommodate 21" or more length blade.	1no.
5.	Double ended Pedestal Grinder with 178 mm wheels(one fine and one rough wheel)	1 no.
6.	SS and SC centre lathe (all geared) with centre height 150 mm and centre distance 1000 mm along with 3 jaws, 4 jaw chuck, auto feed system, taper turning attachment, coolant pump, safety guard, dog carriers, face plate and machine light arrangement.	3 sets.
7.	Shearing machine (lever type)hand operated complete with 300 mm blade length	1 no.
8.	Welding Equipment (**It is not required if Welding Trade is available in the Institute**) Latest welding kits in Die making	2 set.

	(i) Transformer welding set 300 amps-continuous welding current with all accessories and electrode holder	1 set
	(ii) Welding cable to carry 400 amps 50 meter with flexible rubber cover.	12 nos.
	(iii) Lugs for cable	2 nos.
	(iv) Earth clamps	1 set
	(v) Arc welding table (all metal top) 122cm x 12 cm x 60 cm with positioner	1 no.
	(vi) Oxy-acetylene gas welding set-equipment with hoses, regulator and other accessories	1 set
	(vii) Gas welding table with positioner	6 nos.
	(viii) Welding torch tips of different sizes	1 no
	(ix) Gas lighter	2 nos.
	(x) Trolley for gas cylinders	2 pairs
	(xi) Chipping hammer	2 nos.
	(xii) Gloves (Leather)	1 set
	(xiii) Leather apron	2 nos.
	(xiv) Welding torches 5 to 10 nozzles	4 pair
	(xv) Spindle key for cylinder valve	2 nos.
	(xvi) Welding goggles	10 sets
	(xvii) Welding helmets with coloured glass	2 nos.
	(xviii) Tip cleaner	1 no.
9.	Universal Milling Machine -	2 no
	Longitudinal traverse 700 - 800 mm Cross traverse 300 - 400 mm Vertical traverse 200 - 350 mm Swivel of table on either side 45^0 Speed range rpm 30 to 1800 With universal dividing head, circular table, long arbors, slab arbor, slotting attachment, vertical indexing head, etc.	
10.	Horizontal and Vertical milling machine	2 Nos. each
	Table Length x width 1350x310 mm Longitudinal traverse 700 - 800 mm Cross traverse 200 - 265 mm Vertical traverse 300 - 400 mm Speed range rpm 20 to 1800	
11.	Hydraulic Surface Grinding Machine	2 Nos.
	Table Clamping area 600 x 178 mm Grinding area 400 x 200 mm Distance table-centre of spindle 400 - 500 mm Table speed 1-25 m/min. With standard accessories like dust extractor with water separator, balancing device, table-mounted Radius-tangent wheel dresser, wheel flanges, etc.	
12.	Tool and Cutter Grinder	1No.
	Largest diameter of cutter that can be ground 10-100 mm Max. admit between centers 230 mm Max. length of cutting edges ground 120 mm With standard equipment like adaptor bushes, cutter head holder assembly, adaptors, extension spindle, flanges fro grinding wheel, etc.	
13.	Universal cylindrical Grinding Machine	1No.

	Max. dia ground (effective) 250 mm Max. grinding length 300 mm Height of centre 130 mm Max. distance between centers 340 mm With special accessories like face plate, steady, radius and face dressers, find hand feed attachment etc.	
14.	Pantograph / **E**ngraving 3D machine	1set.
	Working area (rectangle) 320 x 145 mm Max. height of work 380 mm **Work table traverse:** Longitudinal x Transverse 160 x300 mm Work clamping area 360x200 mm With attachment like index head, roll engraving attachment, type template holders, circular table, raised and sunk letters etc.	
15.	Fly press 5 ton capacity	1No.
16.	Muffle furnace – heating chamber 300 x 300 x 450 mm for 1050^0 C Quenching tank-600 x600 x 600 mm	1No.
17.	Rockwell hardness testing machine with standard accessories	1No.
18.	Wire EDM with CAM software	1 No.
19.	CAD/CAM software(Standard/latest available in the market)	4 set
20.	Desktop computers with latest configuration suitable for CAD/CAM software with necessary furniture	5 sets
21.	Spark Erosion EDM (Optional)	1No.
22.	CNC vertical milling machine (Optional)	1 no
23.	CNC lathe (optional)	1 no
24.	Co-ordinate measuring machine (Optional)	01
25.	Profile projector (Optional)	01
26.	Unit height master (Optional)	01
27.	Polishing kits (Optional)	1 set
28.	Hydraulic press 16T with all safety measures (Optional)	01

Note: Any institute not having the optional machines may tie up with an industry having the above machine for exposure.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: TOOL AND DIE MAKER (PRESS TOOL, JIGS & FIXTURE)

LIST OF TOOLS& EQUIPMENTS FOR 20 APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Draughtsman drawing instrument box	20 Nos.
2.	Set square celluloid 45^0 (250 X 1.5 mm)	20 Nos.
3.	Set square celluloid 30^0-60^0 (250 X 1.5 mm)	20 Nos.
4.	Mini drafter	20 Nos.
5.	Drawing board (700mm x500 mm) IS: 1444	20 Nos.

B : FURNITURE REQUIRED

Sl. No.	Name of the items	Quantity (indicative)
1	Drawing Board	20 Nos.
2	Models : Solid & cut section	as required
3	Drawing Table for trainees	as required
4	Stool for trainees	as required
5	Cupboard (big)	01
6	White Board (size: 8ft. x 4ft.)	01
7	Trainer's Table	01
8	Trainer's Chair	01

ANNEXURE – II

INFRASTRUCTURE FOR ON-JOB TRAINING

TRADE: TOOL AND DIE MAKER (PRESS TOOL, JIGS & FIXTURE)

For Batch of 20 APPRENTICES

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (i.e. 9 months + 9 months) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

ANNEXURE-III

GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

TURNER

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

TURNER

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL – 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

Kolkata – 700 091

www.cstaricalcutta.gov.in

CONTENTS

1. COURSE INFORMATION

During the two years duration a candidate is trained on subjects Professional Skill, Professional Knowledge and Employability Skills related to job role. In addition to this a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The practical part starts with basic fitting & turning and executes complex turning operation both in conventional lathe and CNC turn centre at the end of the course. The broad components covered under Professional Skill subject are as below:

FIRST YEAR: The practical part starts with basic fitting & different turning including setting of different shaped job on different chucks. The different turning operations – Plain, Facing, Drilling, Boring (counter and stepped) Grooving, Parallel turning, stepped turning, Parting, Chamfering, U-cut, Reaming, Internal recess & Knurling. The skills on grinding of different cutting tools viz., V tool, side cutting, parting and thread cutting (both LH & RH) are also imparted. During this period the testing alignment of lathe by checking different parameters viz., axial slip of main spindle, true running of head stock, parallelism of main spindle and alignment of both the centres are also covered. The observation of all safety aspects is mandatory during execution any task. The safety aspects cover components like OSH&E, PPE, Fire extinguisher, First Aid and in addition 5S being taught.

This section covers setting of different components (Form tool, Compound slide, Tail stock offset, taper turning attachment) & parameters (feed, speed, depth of cut) of lathe for taper/ angular turning of jobs. Different boring operations (plain, stepped and eccentric) are also undertaken to gain the skill in producing components involving such operations. Different thread cutting (BSW, Metric, Square, ACME, Buttress) by setting machining parameters are being taught in the practical. The use different accessories of lathe (Driving Plate, Steady rest, dog carrier and different centres) are also part of the practical training. During this period the basic maintenance and preventive maintenance of lathe and grinding machine are also covered.

SECOND YEAR: On achieving above mentioned skill sets the candidate is engaged in producing different precision of engineering component with an appropriate accuracy (±0.02mm). The machining of different irregular shaped job using different lathe accessories and also producing different utility items viz., Crank Shaft (single throw), Stub arbor, etc. are covered to enhance their competency and perform the job as per practical requirement. The machining of different components along with assembly of such components (male & female) by performing different turning activities is also covered. The accuracy achieved is of an accuracy of ± 0.02 mm outside and ±0.05mm for inside turning.

A dedicated time of 13 weeks devoted for CNC operations which involve setting both job and tools and operating the CNC turn centre to produce components as per drawing by preparing part programmes. The candidate gets enough training both on multi-media-based CNC simulated and on actual intermediate production based CNC machine. The candidate is also imparted training on process plan to produce components by performing special operation on lathe viz., worm shaft cutting and also producing different engineering components viz., drill chuck, collet chuck, screw jack, box nut etc., to develop competency in producing components which is tangible and significant in work and industry ready for executing such work as per demand.

Professional Knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition, components like cutting tools and its specification, method of brazing and soldering, calculation involving gear ratio and gearing, and tool life, lubrication and functions, jigs and fixtures, interchangeability, quality control procedure and technical English are also covered under theory part.

Total three projects need to be completed by the candidates in a group. In addition to above components the core skills components e.g. Employability skill is also covered. This core skill is essential skill which is necessary to perform the job in any given situation.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for strengthening vocational training.

Turner trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Trade Certificate (NTC) by DGT having worldwide recognition.

Candidates need broadly to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and machining work.
- Check the job/components as per drawing for functioning, identify and rectify errors in job/components.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National

Apprenticeship certificate (NAC).

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal)during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per guideline. The pattern and marking structure are being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile

as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%..

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	

For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Turner; Lathe Operator makes metal articles to required specifications using lathe and cutting tools. Studies drawings and other specifications of parts to be made. Selects metal, holds it in chuck, fixture on lathe as required, centres it by manipulating chuck jaws or otherwise using dial indicator or marking block and securely tightens it in position. Selects correct cutting tool, grinds it if necessary and holds it tight in tool post at correct height. Sets feed and speed and starts machine. Manipulates hand wheels or starts automatic controls to guide cutting tool into or along metal. Controls flow of coolant (cutting lubricant) on edge of tool. Arranges gears in machine to obtain required pitch for screw cutting. Calculates tapers and sets machine for taper turning, controls lathe during operation by means of hand wheels and levers and frequently checks progress of cutting with measuring instruments such as calipers and rule, micrometers, etc. Stops machine, removes completed part and checks it further with instruments to ensure accuracy. Repeats operations if necessary. Cleans and oils machine. Demonstrate the setting &operation of CNC turning machine and produce components as per drawing by preparing part programmes. May be designated as Turner according to nature of work done. May improvise devices and make simple adjustments to machine. May recondition lathe tools.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Tool Maker: Tool Maker makes cutting and press tools, gauges, simple jigs, fixtures, etc. mainly for use in machines. Studies drawings, samples and other specifications of tool or gauge to be made. Selects required type of metal or alloy and marks it for various operations, using Vernier height gauges, sine plate, vee blocks, etc. Cuts, files, grinds, scrapes or otherwise shapes metal to specified dimensions frequently checking it while working with measuring instruments such as micrometre, Vernier, gauges, face plate etc. as necessary. Anneals, shapes, hardens and tempers cutting tools ensuring correct cutting angles, clearances, etc. according to standard or prescribed specifications. Assembles part, finishes object. Checks accuracy with precision measuring instruments and shadow graph if necessary to ensure desired performance. Calibrates and adjusts tools and gauges where required and maintains them in good working order. Guides brazing of tips to stalks and finishes them to make tip tools. Is designated as GAUGE MAKER if engaged in making or reconditioning gauges. May repair and recondition tools for further use. May design tools, jigs and fixtures and braze and weld metal parts.

Jig and Fixture Marker: Jig and Fixture Maker makes and repairs jigs and fixtures (device for holding metal and guiding cutting tools) for mass production work. Studies drawing and checks dimensions and other specifications of sample to calculate working details. Collects material,

gets surfaces finished by filing or machining and marks them off. Makes different parts of required jig or fixture by cutting, filing, machining, grinding, scraping, drilling, screwing, etc. and finishes them to required dimensions. Hardens and tempers necessary parts or gets them done ensuring that they do not get demored. Assembles parts in proper sequence, fits hardened bushes or parts where specified to guide cutting tools and checks easy fixing and removing of part to be machined to ensure operational efficiency of jig or fixture made. Checks fitting of jig and fixture at each stage while assembling to conform to specifications. Tests completed jig or fixture by trial operations to ensure operational efficiency and accuracy in production work. May make adaptors, pullers etc. for specific purposes. May machine and grind jig and fixture parts.

Die Maker: Die Maker; Die Fitter; Press Tool Fitter makes metal dies to prescribed dimension for punching, cutting, forging and forming of metal or synthetic components for mass production. Studies drawing and specifications of dies to be made. Selects required type of metal or rough cast metal block. Machines or grinds one surface and marks it with template or otherwise to indicate dimensions and other working details. Cuts shapes, drill holes and mills metal according to marking on various machines. Checks dimensions while working with gauges and other measuring tools. Finishes made die (punch) by filing to required dimension and fits female to it. Files cutting angle and clearance accurately in female die and checks for sizes. Drills holes and cuts thread in female die for driving guide pin and fitting guide plates. Gets male and female dies tempered and grinds them to finish ensuring correct shear, cutting angle, clearances, etc. Sets finished dies in press and cuts or forms some trial pieces to ensure accuracy and correct production. May shape female die block to required angle for fitting it in bolster. May repair used dies and grind them to desired finish. May operate lathe, milling and shaping machines and harden and temper dies.

Grinder, General: Grinder General grinds and smoothens metal surfaces to specified accuracy using one or more type of grinding machine. Examines drawings and other specifications of part to be ground. Selects grinding wheel of appropriate size, shape and abrasive quality and fastens it on spindle of machine. Mounts metal part accurately in position on machine using chucks, jigs, fixtures or between centres of head and tail stock of machine as required and sets it accurately either parallel or at angle in relation to grinding wheel as specified using appropriate devices and instruments necessary. Adjusts machine table, guides, stops and other controls to determine direction and limit of metal and grinding wheel movements. Selects grinding wheel speed and starts machine for grinding. Manipulates hand wheel or sets and starts automatic controls to bring grinding wheel in contact with work. Checks progress of grinding with measuring instruments and gauges for accuracy. May balance dress or change grinding wheel, stone or abrasive. May oil and clean machine.

May be designated as Turner according to nature of work done

Turner

Reference NCO 2015:

(i) 7223.0601 – Turner
(ii) 7222.0200 – Tool Maker
(iii) 7222.0300 – Jig & Fixture Maker
(iv) 7222.0200 – Presstool Maker
(v) 7222.0500 – Die & Mould
(vi) 7224.0100 - Grinder, General

Reference NOS:

i) CSC/NO304
ii) CSC/NO110
iii) CSC/NO115
iv) CSC/N9401
v) CSC/N9402

Name of the Trade	**TURNER**
Trade Code	DGT/1013
NCO - 2015	7223.0601, 7222.0200, 7222.0300, 7222.0200, 7222.0500, 7224.0100
NOS Covered	CSC/NO304, CSC/NO110, CSC/NO115, CSC/N9401, CSC/N9402
NSQF Level	Level – 4
Duration of Craftsmen Training	Two years (2400 hours+300 hours OJT/ Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	110 Sq.m.
Power Norms	18.5 KW
Instructors Qualification for	
1. Turner Trade	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. OR 3 years Diploma in Mechanical Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. OR NTC/NAC passed in the trade of "Turner" or TDM (PT & JF) or TDM (Dies & Moulds) with three years'experience in the relevant field. **<u>Essential Qualification:</u>** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***NOTE:- Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
2. Workshop Calculation &	B.Voc/Degree in Engineering from AICTE/UGC recognized

Science	Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are reflection of total competencies of a trainee and assessment will be carried out as per assessment criteria.

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

FIRST YEAR:

1. Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy following safety precautions. [Basic Fitting Operation – Marking, Hack sawing, filing, drilling, taping etc.] (NOS:CSC/N0304)
2. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square](NOS: CSC/N0110)
3. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. [Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling. (NOS: CSC/N0110)
4. Test the alignment of lathe by checking different parameters and adjust the tool post. [Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.] (NOS: CSC/N0110)
5. Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. [Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.] (NOS: CSC/N0110)
6. Set the different machining parameter & tools to prepare job by performing different boring operations. [Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric] (NOS: CSC/N0110)
7. Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components. [Different thread: - BSW, Metric, Square, ACME, Buttress.] (NOS: CSC/N0110)
8. Set the different machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. [Different machining parameters: - Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and different centres.] (NOS: CSC/N0110)
9. Plan and perform basic maintenance of lathe & grinding machine and examine their functionality. (NOS: CSC/N0110)
10. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)

11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)

SECOND YEAR:

12. Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. [Appropriate accuracy - ±0.02mm/ (MT - 3) (proof turning); Different turning operation – Plain turning, taper turning, boring threading, knurling, grooving, chamfering etc.] (NOS: CSC/N0110)
13. Set & Produce components on irregular shaped job using different lathe accessories. [Different Lathe accessories: - Face plate, angle plate] (NOS: CSC/N0110)
14. Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. [Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.] (NOS: CSC/N0110)
15. Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. [Different boring operation – eccentric boring, stepped boring; appropriate accuracy - ±0.05mm] (NOS: CSC/N0110)
16. Calculate to set machine setting to produce different complex threaded component and check for functionality. [Different complex threaded component- Half nut, multi start threads (BSW, Metric & Square)] (NOS: CSC/N0110)
17. Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme. (NOS:CSC/NO115)
18. Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality. [Utility item: - screw jack/ vice spindle/ Box nut, marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, ACME, Metric), Thread on taper, different boring (Plain, stepped)] (NOS:CSC/NO115)
19. Make a process plan to produce components by performing special operations on lathe and check for accuracy. [Accuracy - ±0.02mm or proof machining & ±0.05mm bore; Special operation – Worm shaft cutting (shaft) boring, threading etc.] (NOS:CSC/NO115)
20. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)
21. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy following safety precautions. *[Basic Fitting Operation -Marking, Hack sawing, filing, drilling, taping etc.]* (NOS:CSC/N0304)	Plan & Identify tools, instruments and equipments for marking and make this available for use in a timely manner.
	Select raw material and visually inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Observe safety procedure during above operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
2. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square] (NOS:CSC/N0110)	Identify and acquaint with lathe machine operation with its components.
	Identify different work holding devices and acquaint with functional application of each device.
	Mount the appropriate work holding device and check for its functional usage to perform turning operations.
	Set the job on chuck as per shape.
	Set the lathe on appropriate speed & feed.
	Operate the lathe to demonstrate lathe operation, observing standard operating practice.
	Observe safety procedure during above operation as per standard norms and company guidelines.

3. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. [Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH),Appropriate accuracy: ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling. (NOS:CSC/N0110)	Identify cutting tool materials used on lathe machine as per the specification and their application.
	Plan and Grind cutting tools
	Measure the tool angles with gauge and Bevel protractor as per tool signature.
	Mount the job and set machine parameter.
	Perform turning operations viz., facing, Parallel Turning, Step Turning, chamfering, grooving, U -cut, parting, drilling, boring (counter & stepped),Reaming, internal recess and knurling to make component as per specification.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
4. Test the alignment of lathe by checking different parameters and adjust the tool post. [Different parameters– Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.] (NOS:CSC/N0110)	Plan for testing alignment of lathe
	Select appropriate items and tools for testing the alignment.
	Demonstrate possible solutions and agree tasks within the team.
	Perform testing of alignment and adjust the tool post as per instruction of machine manual/ standard testing procedure.
	Check for desired functionality.
	Record the different parameters in a standard format.
5. Set different components of machine& parameters to produce taper/ angular components and ensure proper assembly of the components. *[Different component of machine: - Form tool, Compound*	Plan and select appropriate method to produce taper/ angular components.
	Evaluate angles to set up the tool and machine component for machining.
	Demonstrate possible solutions and agree tasks within the team.
	Produce taper/ angular components as per standard operating procedure.
	Check accuracy/ correctness of job using appropriate gauge and

slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.] (NOS:CSC/N0110)	measuring instruments for their functional requirement.
	Assemble the components to ascertain functionality.
6. Set the different machining parameter & tools to prepare job by performing different boring operations. *[Different machine parameter- Feed, speed & depth of cut; Different boring operation– Plain, stepped & eccentric]* (NOS:CSC/N0110)	Plan for different boring (Plain, stepped & eccentric), Select appropriate tools and counterbalance while holding the work piece as per requirement.
	Set the different machining parameters as per requirement.
	Demonstrate possible solutions within the team.
	Set job and produce component following the standard operating procedure.
	Measure with instruments/gauges as per drawing.
	Comply with safety rules when performing the above operations.
	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
7. Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components. [Different thread: - BSW, Metric, Square, ACME, Buttress.] (NOS:CSC/N0110)	Plan and select appropriate method to produce threaded components.
	Plan and prepare thread cutting tool in compliance to standard thread parameters.
	Produce components as per drawing.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement and suit to male /female part.
	Test the proper assembly of the threaded components.
8. Set the different machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. [Different machining parameters: -	Identify different lathe accessories of lathe machine as per functional application.
	Mount appropriate lathe accessories to set up a job for machining.
	Observe safety/ precaution during mounting the accessories.
	Check for the alignment of accessories to machine as per standard procedure.
	Set the machining parameter and produce the component applying technique/ machine.

Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and different centres.] (NOS:CSC/N0110)	Check the accuracy of the component using instruments.
9. Plan and perform basic maintenance of lathe & grinding machine and examine their functionality. (NOS:CSC/N0110)	Plan for periodic and preventive maintenance of lathe/ grinding machine.
	Select appropriate items and tools for maintenance.
	Demonstrate possible solutions and agree tasks within the team.
	Perform maintenance as per schedule of machine manual.
	Check for desired functionality.
10. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	Read & interpret the information on drawing and apply in executing practical work.
	Read & analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawing with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)	Solve different mathematical problems.
	Explain concept of basic science related to the field of study.
SECOND YEAR	
12. Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. [Appropriate accuracy	Plan and select appropriate method to produce components.
	Grind form cutting tool.
	Set the machine parameters.
	Produce components by performing different turning operations as per standard operating procedure and as per drawing.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.

- ±0.02mm/ (MT - 3) (proof turning); Different turning operation – Plain turning, taper turning, boring threading, knurling, grooving, chamfering etc.] (NOS:CSC/N0110)	
13. Set & Produce components on irregular shaped job using different lathe accessories. [Different Lathe accessories: - Face plate, angle plate] (NOS:CSC/N0110)	Plan and select appropriate method to produce irregular shaped components with internal taper turning.
	Work out different parameters to set up the tool for machining.
	Set the lathe accessories and mount the job.
	Produce components as per standard operating procedure by using appropriate tools.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
14. Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. [Different utility component/ item – Crank shaft (single throw), stub arbour with accessories *etc.]* (NOS:CSC/N0110)	Select appropriate tools and plan for turning and counterbalance while holding the work piece as per requirement.
	Comply with safety rules when performing the above operations.
	Demonstrate possible solutions within the team.
	Set the lathe attachment as per requirement and produce component observing standard operating procedure.
	Measure with instruments/gauges as per drawing.
15. Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. [Different boring operation – eccentric boring, stepped boring;	Plan for different boring (Plain, stepped & eccentric) and counterbalance while holding the work piece as per requirement and select appropriate tools.
	Set the different machining parameters as per requirement.
	Demonstrate possible solutions within the team.
	Set job and produce component following the standard operating procedure.
	Measure with instruments/gauges as per drawing.
	Comply with safety rules when performing the above operations.

appropriate accuracy - ±0.05mm] (NOS:CSC/N0110)	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
16. Calculate to set machine setting to produce different complex threaded component and check for functionality. [Different complex threaded component- Half nut, multi start threads (BSW, Metric & Square)] (NOS:CSC/N0110)	Plan and select appropriate method to produce components with multi start threading.
	Prepare appropriate tool for generating required thread form.
	Calculate and set machine
	Mount the job and turn multi start thread (male and female).
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	Match the male & female component for checking for functionality
17. Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme. (NOS: CSC/N0115)	Plan and prepare part programme as per drawing, simulate for it's correctness with appropriate software.
	Prepare tooling layout and select tools as required
	Demonstrate possible solution within the team.
	Set selected tools on to the machine
	Test/Dry run the part programme on the machine
	Set up the job and machine the component as per standard operating procedure involving parallel, step, taper, drilling, boring, radius, grooving and threading operations, etc.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	Observe safety/ precaution during machining.
	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
18. Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and	Plan and select tools and materials for the part components and make this available for use in a timely manner.
	Produce part components as per drawing
	Check for accuracy of all the part components and suitability to the higher assembly.
	Assemble all the part components as per the guidelines given in the drawing.

check functionality. [Utility item: - screw jack/ vice spindle/ Box nut, marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, ACME, Metric), Thread on taper, different boring (Plain, stepped)] (NOS: CSC/N0115)	Check for functionality of the screw jack, vice spindle/ Box nut, marking block, drill chuck, collet chuck etc., as per standard operating procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
19. Make a process plan to produce components by performing special operations on lathe and check for accuracy. [Accuracy - ±0.02 mm or proof machining & ±0.05 mm bore; Special operation – Worm shaft cutting (shaft) boring, threading etc.] (NOS: CSC/N0115)	Plan and select appropriate method to produce components with worm gear cutting.
	Prepare appropriate tool for producing required worm shaft.
	Set the job and turn worm shaft, match for accurate fitting with female gauge.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
20. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	Read & interpret the information on drawing and apply in executing practical work.
	Read & analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawing with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
21. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of	Solve different mathematical problems.
	Explain concept of basic science related to the field of study.

study. (NOS: CSC/N9402)	

SYLLABUS FOR TURNER TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 145 Hrs.; Professional Knowledge 30 Hrs.	Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy following safety precautions.*[Basic Fitting Operation – Marking, Hack sawing, filing, drilling, taping etc.]* (Mapped NOS:CSC/N0304)	1. Importance of trade training, List of tools & Machinery used in the trade. (1 hr.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (5 hrs.) 3. First Aid Method and basic training. (2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hrs.) 5. Hazard identification and avoidance. (2 hrs.) 6. Safety signs for Danger, Warning, caution & personal safety message. (1 hr.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (2 hrs.) 8. Use of Fire extinguishers. (5 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs.	All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft Skills: its importance and Job area after completion of training. Importance of safety and general precautions observed in the in the industry/shop floor. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Response to emergencies e.g.; power failure, fire, and system failure. **Importance of housekeeping & good shop floor practices.** Introduction to 5S concept & its application. **Occupational Safety & Health**: Health, Safety and Environment guidelines, legislations & regulations as applicable. (02 Hrs.)

		(2 hrs.) 10. Safe use of tools and equipments used in the trade. (1 hr.)	
		11. Identification of tools &equipments as per desired specifications for marking & sawing (Hand tools, Fitting tools & Measuring tools) (2 hrs.) 12. Selection of material as per application Visual inspection of raw material for rusting, scaling, corrosion etc. (1 hr.) 13. Marking out lines, gripping suitably in vice jaws, hack sawing to given dimensions, sawing different types of metals of different sections. (10 hrs.) 14. Practice on hammering, marking out, chipping, chisel grinding. (6 hrs.)	Measurement, line standard and end standard, steel rule-different types, graduation and limitation. Hammer and chisel-materials, types and uses. Prick punch and scriber. (05 Hrs.)
		15. Filing practice on plain surfaces, right angle by filing. (45 hrs.) 16. Use of calipers and scale measurement. (3 hrs.)	Vice – types and uses, Files-different types of uses, cut, grade, shape, materials etc. Try square-different types, parts, material used etc. Calipers-types and uses (firm joint). (10 Hrs.)
		17. Filing at right angle, marking & hack sawing. (25 hrs.)	Vee – block, scribing block, straight edge and its uses. Hacksaw-their types & uses. (05 Hrs.)
		18. Marking operation on flat & round job. (8 hrs.) 19. Drilling operation: Drill on flat, square bar and round	Center punch- materials, construction & material uses. Drill machine-different parts. Hacksaw blades- sizes, different

		bar of different material (Sensitive drill machine). (10hrs.)	Parts. Hacksaw blades-sizes, different pitch for different materials. Nomenclature of drill. (04 Hrs.)
		20. Different threading (BSW, BSP, BA, Metric, UNC, UNF) with the help of taps and dies both external & internal (including pipes) using collet chuck. (10 hrs.) 21. Extraction of broken tap. (2 hrs.)	Surface plate its necessity and use. Tap - different types (Taper 2nd and bottoming) care while tapping. Dies different types and uses. Calculation involved to find Out drill size (Metric and Inch). (04 Hrs.)
Professional Skill 40 Hrs.; Professional Knowledge 08 Hrs.	Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. *[Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square]* (Mapped NOS: CSC/N0110)	22. Identify & function of different parts of lathe. Practice on operation of lathe (dry/idle run). (15 hrs.) 23. Setting lathe on different speed and feed. (5 hrs.)	Getting to know the lathe with its main components, lever positions and various lubrication points as well. Definition of machine & machine tool and its classification. History and gradual development of lathe. (04 Hrs.)
		24. Mounting of chuck on machine spindle and unloading –3-jaw chuck & 4-jaw chuck. (10 hrs.) 25. Setting practice on round & square/ hexagonal bar. (3 hrs.) 26. Dismantling and assembling of 3 jaw and 4 jaw chucks. (7 hrs.)	Classification of lathe in Function and construction of different parts of Lathe. (04 Hrs.)
Professional Skill 210 Hrs.; Professional Knowledge 45 Hrs.	Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning	27. Turning of round stock and square/hexagonal as per availability on 4-jaw independent chuck. (15 hrs.) 28. Turning of round stock on 3-jaw self centering chuck.	Types of lathe drivers, merit and demerit. Description in details-head stock- cone pulley type- all geared type- construction & function. Tumbler gear set. Reducing speed-necessary &

	operations. *[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling.* (Mapped NOS: CSC/N0110)	(10hrs.)	uses. Back Gear Unit –its construction use. (05Hrs.)
		29. Grinding of R.H. and L.H., V-tool, side cutting tools, parting tool. (10 hrs.) 30. Checking of angles with angle gauge / bevel protractor. (1 hr.) 31. Grinding of "V" tools for threading of Metric 60-degree threads. (9 hrs.)	Lathe cutting tool-different types, shapes and different angles (clearances and rake), specification of lathe tools. (05 Hrs.)
		32. Facing operation to correct length (5 hrs.) 33. Centre drilling and drilling operation to required size. (05 hrs.) 34. Make square block by turning using 4-jaw chuck and perform drilling, boring and grooving operation. (10 hrs.)	Combination drill- appropriate selection of size from chart of combination drill. Drill, chuck- its uses. Lathe accessories, chuck independent, self-centering, collet, magnetic etc., its function, construction and uses. (05 Hrs.)
		35. Parallel turning, step turning, parting, grooving, chamfering practice. (38 hrs.) 36. Measurement with scale and outside caliper to ± 0.5 mm. accuracy. (2 hrs.)	Vernier caliper-its construction, principle graduation and reading, least count etc. Digital vernier caliper. Outside micrometer –different parts, principle, graduation, reading, construction. Digital micrometer. Cutting speed, feed depth of cut, calculation involved-speed feed R.P.M. etc. recommended for different materials. (10 Hrs.)
		37. Step turning within ± 0.06 mm with different shoulder, U/cut on outside diameter. (15 hrs.)	Different types of micrometer, Outside micrometer. Vernier scale graduation and reading. Sources of error with

		38. Drilling on Lathe-step drilling, drill grinding practice. (10 hrs.)	micrometer & how to avoid them. Use of digital measuring instruments. (05Hrs.)
		39. Boring practice-Plain. Counter& step, internal recessing. (20 hrs.) 40. Reaming in lathe using solid and adjustable reamer. (15 hrs.) 41. Make bore by trepanning (10 hrs.) 42. Drill grinding. (5 hrs.)	Drills-different parts, types, size etc., different cutting angles, cutting speed for different material. Boring tool. Counter - sinking and Counter boring. Letter and number drill, core drill etc. Reamers-types and uses. Lubricant and coolant-types, necessity, system of distribution, selection of coolant for different material: Handling and care. (07 Hrs.)
		43. Turning practice-between centres on mandrel (Gear blanks). (15 hrs.) 44. Fitting of dissimilar materials- M.S. in brass, aluminium, in cast iron etc. (10 hrs.) 45. Knurling practice in lathe (Diamond, straight, helical & square). (5hrs.)	Knurling meaning, necessity, types, grade, cutting speed for knurling. Lathe mandrel- different types and their uses. Concept of interchangeability, Limit, Fit and tolerance as per BIS: 919-unilateral and bilateral system of limit, Fits- different types, symbols for holes and shafts. Hole basis & shaft basis etc. Representation of Tolerance in drawing. (08 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	Test the alignment of lathe by checking different parameters and adjust the tool post. *[Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main*	46. Checking alignment of lathe centres such as Levelling, axial slip of main spindle, true running of head stock centre, parallelism of the main spindle to saddle movement, alignment both the centres. (20 hrs.) 47. Adjustment of tool post. (3 hrs.) 48. Mounting job in between	Driving plate. Face plate & fixed & traveling steadies- construction and use. Transfer caliper-its construction and uses. Lathe centers-types and their uses. Lathe carrier- function types & uses. Mandrel – Different types and its use. Magnetic stand dial indicator, its used and care. (05 Hrs.)

	spindle, alignment of both the centres.] (Mapped NOS: CSC/N0110)	centres. (2 hrs.)	
Professional Skill 65 Hrs.; Professional Knowledge 10 Hrs.	Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. *[Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.]* (Mapped NOS: CSC/N0110)	49. Make taper turning by form tool and compound slide swivelling. (20 hrs.)	Taper – different methods of expressing tapers, different standard tapers. Method of taper turning, important dimensions of taper. Taper turning by swiveling compound slide, its calculation. (05 Hrs.)
		50. Male and female taper turning by taper turning attachment, offsetting tail stock. (22 hrs.) 51. Matching by Prussian Blue. (2 hrs.) 52. Checking taper by bevel protector and sine bar. (1 hr.) 53. Make MT3 lathe dead centre and check with female part. (Proof machining) (20 hrs.)	Bevel protector & Vernier bevel protractor-its function & reading. Method of taper angle measurement. Sine bar-types and use. Slip gauges-types, uses and selection. (5 Hrs.)
Professional Skill 65 Hrs.; Professional Knowledge 05 Hrs.	Set the different machining parameter & tools to prepare job by performing different boring operations. *[Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric]* (Mapped NOS: CSC/N0110)	55. Turning and boring practice on CI (preferable) or steel. (22 hrs.) 56. Eccentric marking practice. (2 hrs.) 57. Perform eccentric turning. (15 hrs.) 58. Use of Vernier height Gauge and V-block. (1 hr.) 59. Perform eccentric boring. (15 hrs.) 60. Make a simple eccentric with dia. of 22 mm and throw/offset of 5mm. (10 hrs.)	Basic process of soldering, welding and brazing. Vernier height gauge, function, description & uses, templates-its function and construction. Screw thread-definition, purpose & its different elements. Driving plate and lathe carrier and their usage. Fundamentals of thread cutting on lathe. Combination set-square head. Center head, protractor head-its function construction and uses. (5 Hrs.)

Professional Skill 210 Hrs.; Professional Knowledge 40 Hrs.	Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components. *[Different thread: - BSW, Metric, Square, ACME, Buttress.]* (Mapped NOS: CSC/N0110)	61. Screw thread cutting (B.S.W) external (including angular approach method) R/H & L/H, checking of thread by using screw thread gauge and thread plug gauge. (14 hrs.) 61. Screw thread cutting (B.S.W) internal R/H & L/H, checking of thread by using screw thread gauge and thread ring gauge. (14 hrs.) 62. Fitting of male & female threaded components (BSW) (4hrs.) 63. Prepare stud with nut (standard size). (10hrs.)	Different types of screw thread- their forms and elements. Application of each type of thread. Drive train. Chain gear formula calculation. Different methods of forming threads. Calculation involved in finding core dia., gear train (simple gearing) calculation. Calculations involving driver-driven, lead screw pitch and thread to be cut. (08 Hrs.)
		64. Grinding of "V" tools for threading of Metric 60-degree threads and check with gauge. (3 hrs.) 65. Screw thread cutting (External) metric thread-tool grinding. (10 hrs.) 66. Screw thread (Internal) metric & threading tool grinding. (14 hrs.) 67. Fitting of male and female thread components (Metric) (2 hrs.) 68. Make hexagonal bolt and nut (metric) and assemble. (10 hrs.)	Thread chasing dial function, construction and use. Calculation involving pitch related to ISO profile. Conventional chart for different profiles, metric, B.A., With worth, pipe etc. Calculation involving gear ratios and gearing (Simple & compound gearing). Screw thread micrometer and its use. (08 Hrs.)
		69. Cutting metric threads on inch lead screw and inch threads on Metric Lead Screw. (20 hrs.)	Calculation involving gear ratios metric threads cutting on inch L/S Lathe and vice-versa. (03Hrs.)
		70. Practice of negative rake tool on non-ferrous metal and thread cutting along with fitting with ferrous	Tool life, negative top rake-its application and performance with respect to positive top rake (03 Hrs.)

		metal. (21 hrs.)	
		71. Cutting Square thread (External) (11 hrs.) 72. Cutting Square thread (Internal). (18 hrs.) 73. Fitting of male and female Square threaded components. (2 hrs.) 74. Tool grinding for Square thread (both External & Internal). (2 hrs.) 75. Make square thread for screw jack (standard) for minimum 100mm length bar. (12 hrs.)	Calculation involving tool Thickness, core dia., pitch proportion, depth of cut etc. of sq. thread. (08 Hrs.)
		76. Acme threads cutting (male & female) & tool grinding. (08 hrs.) 77. Fitting of male and female threaded components. (7 hrs.) 78. Cut Acme thread over 25 mm dia. rod and within length of 100mm. (10 hrs.)	Calculation involved – depth, core dia., pitch proportion etc. of Acme thread. Calculation involved depth, core dia., pitch proportion, use of buttress thread. (05 Hrs.)
		79. Buttress threads cutting (male & female) & tool grinding. (11 hrs.) 80. Fitting of male & female threaded components. (2 hrs.) 81. Make carpentry vice lead screw. (5 hrs.)	Buttress thread cutting (male & female) & tool grinding(05 Hrs.)

Professional Skill 40 Hrs.; Professional Knowledge 08 Hrs.	Set the different Machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. *[Different machining parameters: -Speed, feed & depthof cut; Differentlathe accessories: -Driving Plate,Steady rest, dogcarrier and different centres.]* (Mapped NOS: CSC/N0110)	82. Make job using different lathe accessories viz., driving plate, steady rest, dog carrier and different centres. (25hrs.) 83. Make test mandrel (L=200mm) and counter bore at the end. (15 hrs.)	Different lathe accessories, their use and care. (8 Hrs.)
Professional Skill 40 Hrs.; Professional Knowledge 9 Hrs.	Plan and perform basic maintenance of lathe & grinding machine and examine their functionality. (Mapped NOS: CSC/N0110)	85. Balancing, mounting &dressing of grinding wheel (Pedestal). (10hrs.) 86. Periodical lubrication procedure on lathe. (10 hrs.) 87. Preventive maintenance of lathe. (20 hrs.)	Lubricant-function, types, sources of lubricant. Method of lubrication. Dial test indicator use for parallelism and concentricity etc. in respect of lathe work Grinding wheel abrasive, grit, grade, bond etc. (9 Hrs.)
Engineering Drawing: 40 Hrs.			
Professional Knowledge E.D. - 40 Hrs	Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	**ENGINEERING Drawing:** Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram.	

		• Lettering & Numbering – Single Stroke Dimensioning : • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation - • Different symbols used in the related trades. Concept and reading of Drawing in – • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) Reading of Job drawing of related trades –
Workshop Calculation & Science: 40 Hrs.		
Professional Knowledge WCS - 40 Hrs	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage. Percentage - Changing percentage to decimal and fraction. **Material Science :-** Types metals, types of ferrous and non ferrous metals. Physical and mechanical properties of metals. Introduction of iron and cast iron Difference between iron & steel, alloy steel and carbon steel. **Mass, Weight, Volume and Density :-** Mass, volume, density, weight and specific gravity, numericals realted to sections L, C O. **Work, Power and Energy ;** Work, power, energy, HP, IHP, BHP and efficiency. **Pressure :-** Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure.

		Basic Electricity – Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units. **Mensuration –** Area and perimeter of square, rectangle and parallelogram. Area and perimeter of Triangles. Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse. Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder. **Levers and Simple machines-** Lever & Simple machines - Lever and its types. **Trigonometry –** Measurement of angles. Trigonometrical ratios. Trigonometrical tables.
In-plant training / Project work **Broad area:** a) Drill extension socket b) conical brush c) V-belt pulley d) Tail Stock Centre (MT – 3) e) Taper ring gauge f) Sprocket g) Socket spanner		

SYLLABUS FOR TURNER TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 110 Hrs.; Professional Knowledge 30 Hrs.	Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. [Appropriate accuracy - ±0.02mm/ (MT - 3) (proof turning); Different turning operation – Plain turning, taper turning, boring threading, knurling, grooving, chamfering etc.] (Mapped NOS: CSC/N0110)	88. Form turning practice by hand. (8 hrs.) 89. Re-sharpening of form tools using bench grinder. (2 hrs.) 90. Tool machine handle turning by combination feed. (15 hrs.)	Form tools-function-types and uses, Template-purpose & use. Dial test indicator- construction & uses Calculation involving modified rake and clearance angles of lathe tool at above and below the center height. Subsequent effect of tool setting. Jig and fixture-definition, type and use. Chip breaker on tool-purpose and type (09 hrs.)
		91. Turn Morse taper plug (different number) and check with ring gauge / suitable MT sleeve. (20 hrs.) 92. Make revolving tail stock centre- Bush type (C-40). (Proof machining) (20 hrs.)	Cutting tool material-H.C.S., HSS, Tungsten. Carbide, Ceramic etc, - Constituents and their percentage. Tool life, quality of a cutting material. (13 hrs.)
		93. Make Morse taper sleeve and check by taper plug gauge. (25 hrs.)	Checking of taper with sin bar and roller-calculation involved (04 hrs.)
		94. Make mandrel/ plug gauge with an accuracy of ±0.02mm using tungsten carbide tools including throw-away tips. (20 hrs.)	Cutting speed, feed, turning time, depth of cut calculation, cutting speed chart (tungsten carbide tool) etc. Basic classification of tungsten carbide tips. (04 hrs.)
Professional Skill 40 Hrs.; Professional	Set & Produce components on irregular shaped job using different	95. Setting and turning operation involving face and angle plate (20 hrs.) 96. Make angle plate using face	Accessories used on face plate –their uses. Angle plate-its construction & use. Balancing-its necessity.

Knowledge 10 Hrs.	lathe accessories. [Different Lathe accessories: - Face plate, angle plate] (Mapped NOS: CSC/N0110)	plate. (20 hrs.)	Surface finish symbols used on working blueprints- I.S. system lapping, honing etc. (10 hrs.)
Professional Skill 110 Hrs.; Professional Knowledge 30 Hrs.	Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. [Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.] (Mapped NOS: CSC/N0110)	97. Holding and truing of Crankshaft – single throw (Desirable). (45 hrs.)	Preventive maintenance, its necessity, frequency of lubrication. Preventive maintenance schedule., TPM (Total Productive Maintenance), EHS (Environment, health, Safety) Marking table-construction and function. Angle plate-construction, eccentricity checking. (12 hrs.)
		98. Turning of long shaft using steady rest (within 0.1 mm). (20 hrs.)	Roller and revolving steadies, Necessary, construction, uses etc. (06 hrs.)
		99. Use of attachments on lathe for different operations. (20 hrs.) 100. Turning standard stub arbor with accessories collar, tie rod, lock nut. (25 hrs.)	Different types of attachments used in lathe. Various procedures of thread measurement thread screw pitch gauge. Screw thread micrometer, microscope etc. (12 hrs.)
Professional Skill 80 Hrs.; Professional Knowledge 18 Hrs.	Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. [Different boring operation – eccentric boring, stepped boring;	101. Perform eccentric boringand make male & female eccentric fitting. (15 hrs.) 102. Position boring using tool maker's button. (10 hrs.)	Tool maker's button and its parts, construction and uses, telescopic gauge its construction and uses. (05 hrs.)
		103. Boring and stepped boring (within ± 0.05 mm) (10hrs.) 104. Cutting of helical grooves in bearing and bushes (Oil groove) (10 hrs.)	Inside micrometer principle, construction graduation, reading, use etc. (Metric & Inch.) (05 hrs.)
		105. Turning & boring of split bearing – (using boring bar and fixture) (35 hrs.)	Care for holding split bearing. Fixture and its use in turning. (8 hrs.)

	appropriate accuracy - ±0.05mm] (Mapped NOS: CSC/N0110)		
Professional Skill 110 Hrs.; Professional Knowledge 28 Hrs.	Calculate to set machine setting to produce different complex threaded component and check for functionality. *[Different complex threaded component- Half nut, multi start threads (BSW, Metric & Square)]* (Mapped NOS: CSC/N0110)	106. Cutting thread of 8 and 11 TPI. (20 hrs.)	Calculation involving fractional threads. Odd & even threads. (04 hrs.)
		107. Multi start thread cutting (B.S.W.) external &internal. (25 hrs.)	Multiple thread function, use, different between pitch & lead, formulate to find out start, pitch, lead. Gear ratio etc. (04 hrs.)
		108. Multi start thread cutting (Metric) (External & internal). (20 hrs.)	Indexing of start - different methods tool shape for multi-start thread. Setting of a lathe calculation for required change wheel (06 hrs.)
		109. Multi-start thread cutting, square form (Male & Female). (25 hrs.)	Calculation involving shape of tool, change wheel, core dia etc. Calculation involving shape, size pitch, core dia. Etc. (05 hrs.)
		110. Make half nut as per standard lead screw. (20 hrs.)	Helix angle, leading angle & following angles. Thread dimensions-tool shape, gear, gear calculation, pitch, depth, lead etc. (09 hrs.)
Professional Skill 210 Hrs.; Professional Knowledge 62 Hrs.	Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme. (Mapped NOS:CSC/NO115)	111. Personal and CNC machine Safety: Safe handling of tools, equipment and CNC machine. (2 hrs.) 112. Identify CNC machine, CNC console. (3 hrs.) 113. Demonstration of CNC lathe machine and its parts bed, spindle motor and drive, chuck, tailstock, turret, axes motor and ball screws, guide ways, LM guides,	CNC technology basics: Difference between CNC and conventional lathes. Advantages and disadvantages of CNC machines over conventional machines. Machine model, control system and specification. Axes convention of CNC machine - Machine axes identification for CNC turn centre.

		console, controlswitches, coolant system, hydraulic system, chip conveyor, steady rest. (6 hrs.) 114. Working of parts explained using Multimedia based simulator for CNC parts shown on machine. (3 hrs.) 115. Identify machine over travel limits and emergency stop. (2 hrs.)	Importance of feedback devices for CNC control. Concept of Co-ordinate geometry, concept of machine axis. (05 hrs.)
		116. Conduct a preliminary check of the readiness of the CNC turning centre viz., cleanliness of machine, referencing – zero return, functioning of lubrication, coolant level, correct working of sub-system. (2 hrs.) 117. Identification of safety switches and interlocking of DIH modes. (1 hr.) 118. Machine starting & operating in Reference Point, JOG and Incremental Modes. (6 hrs.) 119. Check CNC part programming with simple exercises and using various programming codes and words. (05 hrs.) 120. Check the programme simulation on machine OR practice in simulation software in respective control system. (05 hrs.) 121. Absolute and incremental programming assignments and simulations. (05 hrs.) 122. Linear interpolation, and	Programming – sequence, formats, different codes and words. Co-ordinate system points and simulations. Work piece zero points and ISO/DIN G and M codes for CNC. Different types of programming techniques of CNC machine. Describe the stock removal cycle in CNC turning for OD / ID operation. L/H and R/H tool relation on speed. Describe CNC interpolation, open and close loop control systems. Co-ordinate systems and Points. Program execution in different modes like manual, single block and auto. Absolute and incremental programming. Canned cycles. Cutting parameters- cutting speed, feed rate, depth of cut, constant surface speed, limiting spindle speed, tool wear, tool life, relative effect of each cutting parameter on tool life.

		Circular interpolation assignments and simulations on software. (6 hrs.)	Selection of cutting parameters from a tool manufacturer's catalog for various operations. Process planning & sequencing, tool layout & selection and cutting parameters selection. Tool path study of machining operations Prepare various programs as per drawing. (15 hrs.)
		123. Perform Work and tool setting: - Job zero/work coordinate system and tool setup and live tool setup. (10 hrs.) 124. Carryout jaw adjustment according to Diameter and tooling setup on Turret. (10 hrs.) 125. CNC turning centre operation in various modes: JOG, EDIT, MDI, SINGLE BLOCK, AUTO. (10 hrs.) 126. Program entry. (2 hrs.) 127. Set the tool offsets, entry of tool nose radius and orientation. (8 hrs.) 128. Conduct work off set measurement, Tool off set measurement and entry in CNC Control. (8 hrs.) 129. Make Tool nose radius and tool orientation entry in CNC control. (5 hrs.) 130. Jaw removal and mounting on CNC Lathe. (5 hrs.) 131. Manual Data Input (MDI) and MPG mode operations and checking of zero offsets and tool offsets. (7 hrs.)	Tool Nose Radius Compensation (G41/42) and its importance (TNRC). Cutting tool materials, cutting tool geometry – insert types, holder types, insert cutting edge geometry. - Describe Tooling system for turning - Setting work and tool offsets. - Describe the tooling systems for CNC TURNING Centers. - Cutting tool materials for CNC Turning and its applications - ISO nomenclature for turning tool holders, boring tool holders, indexable inserts. - Tool holders and inserts for radial grooving, face grooving, threading, drilling.(17 hrs.)
		132. Program checking in dry	Prepare various part programs

		run, single block modes. (5 hrs.) 133. Checking finish size by over sizing through tool offsets. (5 hrs.) 134. Part program preparation, Simulation & Automatic Mode Execution for the exercise on Simple turning & Facing (step turning) (6 hrs.) 135. Part program preparation, Simulation & Automatic Mode Execution for the exercise on Turning with Radius / chamfer with TNRC. (6 hrs.) 136. Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the exercise on Blueprint programming contours with TNRC. (6 hrs.) 137. Machining parts on CNC lathe with parallel, taper, step, radius turning, grooving & threading. (10 hrs.) 138. Carryout Drilling /Boring cycles in CNC Turning. (12 hrs.) *(First 60 % of the practice ison CNC machine simulator, followed by 40 % on machine.)*	as per drawing & check using CNC simulator. Processes and Tool selection related to grooving, drilling, boring & threading. (10 hrs.)
		139. Geometry Wear Correction. Geometry andwear offset correction. (4 hrs.) 140. Produce components on CNC Machine involving different turningoperations viz.,	- Describe Tapping on CNC turning. - Programming for Grooving/Threading on OD/ID in CNC Turning. - Trouble shooting in CNC lathe machine

		• Stock removal cycle OD • Drilling / boring cycles • Stock removal cycle ID • Carryout threading in different pitches. (12 hrs.) 141. Produce components by involving turning operation and part programme exercises of CNC turning viz., • Grooving and thread cutting OD • Grooving and thread cutting ID • Threading cycle OD • Sub programs with repetition • Using Sub Programs & Cycles in the Main Program. (12 hrs.) 142. Part off: Part Prog. (3 hrs.) 143. Produce job involving profile turning, threading on taper, boring, etc. operations. (15 hrs.) 144. Demo on M/C on bar feeding system. (simulation/ video) (1 hr.) 145. DNC system setup. (Optional) 146. Run the machine on DNC mode. (Optional) 147. CAM programme execution. (Optional) 148. Data Input-Output on CNC machine. (2 hrs.)	- Identify Factors affecting turned part quality/ productivity. - Parting off operation explanation. - Bar feeding system through bar feeder. - Input and Output of Data. - DNC system. Interlacing with PC. - Use of CAM Programme. (Optional) (15 hrs.)
Professional Skill 80 Hrs.;	Manufacture and assemble components to	149. Thread on taper surface (Vee form). (40 hrs.)	Setting of tools for taper threads-calculation of taper setting and thread depth.

Professional Knowledge 20 Hrs.	produce utility items by performing different operations & observing principle of interchangeability and check functionality. *[Utility* item: - screw jack/ vice spindle/ Box nut, marking block, drill chuck, collet chuck etc.; different operations: threading (Square, BSW, ACME, Metric), Thread on taper, different boring (Plain, stepped)] (Mapped NOS:CSC/NO115)		Heat treatment – meaning & procedure hardening, tempering, carbonizing etc. Different types of metal used in engineering application. (8 hrs.)
		150. Manufacturing & Assembly of Screw jack/vice/Box nut by performing different lathe operation. (To use earlier produce screw jack). (20 hrs.)	Interchangeability meaning, procedure for adoption, quality control procedure for quality production. (06hrs.)
		151. Prepare different types of documentation as per industrial need by different methods of recording information. (4 hrs.) 152. Turn Bevel gear blank. (16 hrs.)	Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs in required formats of industry, estimation, cycle time, productivity reports, job cards. (06 hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 28 Hrs.	Make a process plan to produce components by performing special operations on lathe and check for accuracy. *[Accuracy - ±0.02mm or proof machining & ±0.05mm bore; Special operation – Worm shaft cutting (shaft) boring, threading etc.]* (Mapped NOS:CSC/NO115)	153. Read a part drawing, make a process plan for turning operation and make arbor with clamping nut (hexagonal). (40hrs.)	Terms used in part drawings and interpretation of drawings – tolerances, geometrical symbols - cylindricity, parallelism, etc. (11 hrs.)
		154. Practice of special operations on lathes - worm gear cutting. (Shaft) (20 hrs.)	Automatic lathe-its main parts, types diff. Tools used-circular tool etc. (09 hrs.)
		155. Boring on lathe using soft jaws to make bush with collar (standard) on nonferrous metal andcheck with dial bore gauge to accuracy of +/- 0.05 mm. (25hrs.)	Related theory and calculation. (8 hrs.)

		156.Make Arbor support bush. (Proof Machining) (15hrs.)	
Engineering Dearing: 40 Hrs.			
Professional Knowledge E.D.- 40 Hrs	Read and apply drawing for different application in the field of work. (NOS: CSC/N9401)	**ENGINEERING DRAWING: (40 Hrs)** Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc. (06 Hrs) Reading of foundation drawing. (06 Hrs) Reading of Rivets and rivetted joints, welded joints. (06 Hrs) Reading of drawing of pipes and pipe joints. (06 Hrs) Reading of Job Drawing, Sectional View & Assembly view. (16 Hrs)	
Workshop Calculation & Science: 34 Hrs.			
Professional Knowledge WCS- 34 Hrs	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9401)	**WORKSHOP CALCULATION & SCIENCE:** **Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction. Friction – Lubrication. Friction - Co- efficient of friction, application and effects of friction in workshop practice. **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application. **Area of cut out regular surfaces and area of irregular surfaces.** Area of cut out regular surfaces - circle, segment and sector of circle. Related problems of area of cut out regular surfaces - circle, segment and sector of circle. Area of irregular surfaces and application related to shop problems. **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus. Elasticity - Ultimate stress and working stress. **Heat Treatment** Heat treatment and advantages. (Only basic) **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade. Estimation and costing - Problems on estimation and costing.	

In-plant training/ Project work (Any Project to be done on CNC machine)

a) Taper Sunk
b) Socket with Split Collet
c) Screw Jack
d) Spindle with Hub
e) Morse Taper Eccentric
f) Crank Shaft with Taper Sleeve

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in / dgt.gov.in

LIST OF TOOLS AND EQUIPMENT			
Turner Trade (CTS) (For batch of 20 candidates)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-10 is required additionally)			
1	Caliper outside spring joint	150 mm	(20 +1) nos.
2	Caliper inside spring joint	150 mm	(20 +1) nos.
3	Caliper odd-leg firm joint	150 mm	(20 +1) nos.
4	Steel Rule	150 mm, Graduated both in Metric and English Unit	(20 +1) nos.
5	Scriber	150mm x 3 mm	(20 +1) nos.
6	Hammer ball peen	250 gm with handle	(20 +1) nos.
7	Centre punch	100 mm	(20 +1) nos.
8	Prick punch	100 mm	(20 +1) nos.
9	Divider spring joint	150 mm	(20 +1) nos.
10	Safety goggles clear glass (Good quality)		(20 +1) nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
11	Surface Plate - Granite	1000 x 1000 mm with Stand and Cover	1 no.
12	Work bench	240 x 120x 90cm high	1 no.
13	Marking table (CI)	120 x 120 cm	1 no
14	Bench vice	125 mm jaw	6 nos.
15	V-Block	150X100X100 mm with Clamp (Hardened & Ground)	1 pair each
16	Universal Surface gauge	250 mm arm	2 nos.
17	Hammer ball peen	750 gm with handle	6 nos.
18	Chisel cold flat	20 x 150 mm	6 nos.
19	Hammer copper/brass	500 gm with handle	12 nos.
20	Hacksaw fixed	200 mm (Pistol grip)	6 nos.
21	File flat	300 mm rough	6 nos.
22	File flat	250 mm 2nd cut	6 nos.
23	File flat	250 mm smooth	6 nos.
24	File half round	250 mm 2nd cut	6 nos.
25	File round	250 mm smooth	6 nos.
26	File half round	150 mm smooth	2 Sets

27	Knurling tool revolving head	(Rough, med, fine) diamond and straight	2 Sets
28	Combination set	300 mm (Complete Set)	6 nos.
29	Screwdriver	10 X 200 mm	1 set
30	Spanner double ended	6 mm to 21 mm	2 nos.
31	Spanner adjustable	200 mm	---
32	Pliers flat nose	150 mm side cutting	15 nos.
33	Caliper transfer inside	150 mm	3 nos.
34	Micrometer Outside	0 to 25 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 sets
35	Micrometer Outside	25 to 50 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
36	Micrometer Outside	50to 75 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 sets
37	Micrometer Inside	up to 25 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
38	Micrometer Inside	up to 25 to 50 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
39	Depth Gauge Micrometer	0 to 150 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
40	Vernier Caliper Outside, Inside and Depth	200 mm /8 inches with metric & inch scale (L.C. = 0.02mm) with NABL Accredited lab. Certificate	6 nos.
41	Dial Vernier Caliper with metric	200 mm, Least Count 0.05 mm with NABL Accredited lab. Certificate	6 nos.
42	Vernier Bevel Protractor	300 mm blade with NABL Accredited lab. Certificate	6 nos.
43	Vernier Micrometer	0 - 25 mm o/s LC 0.001mm with NABL Accredited lab. Certificate	2 nos.

44	Vernier Micrometer	25 - 50 mm, outside Least Count 0.001mm with NABL Accredited lab. Certificate	2 sets
45	Gauge Feeler	Thickness - 0.05 mm to 0.3 mm by 0.05 **and** 0.4 mm to 1 mm by 0.1 mm - 13 leaves	1 each
46	Gauge - Radius Set	1 mm to 25 mm by 0.5 mm	6 nos.
47	Centre Gauge	com. 60°, 55° and 29°	2 sets
48	Screw Pitch Gauge	Whitworth & Metric each (0.25 to 6mm)	2 sets
49	Drill Angle Gauge	45°,60°,90°	2 sets
50	Universal Dial Test Indicator - Plunger Type	Range 0 - 10 mm, Graduation 0.01 mm complete with Clamping Devices and Magnetic Stand	2 sets
51	Vernier Height Gauge	0 - 300 mm, LC = 0.02 mm with NABL Accredited lab. Certificate	1 set
52	Try Square	150 blades	4 nos.
53	Magnifying Glass	75 mm with magnifying factor 10X	4 nos.
54	Plain Ring and Plug Gauge	(12,16,20,25,30,32,36,40,45,50 mm)	1 set each
55	Wheel Dresser Hunting on-type with star cutter	Standard	1 No.
56	Wheel Dresser Diamond	(inserted-0.75 or 1 Carat)	2 nos.
57	Screw Thread micrometer interchangeable	(0-25 mm)	1 no.
58	Morse Taper Plug & Ring Gauge	No. 0 to 7 MT	1 set
59	Sine Bar with centers	200 mm	2 nos.
60	Slip Gauge metric set	(87 pieces in a Box) with workshop grade	2 nos.
61	Morse Taper	Sleeves No. 0-1, 1-2, 2-3, 3-4, 4-5.	1 set

62	Twist Drill	straight shank 3 to 12 mm by 1 mm	1 No.
63	Drill Twist Set	Taper Shank - 14 mm to 20 mm by 1 mm	1 set (Box)
64	Drill Chuck	12 mm cap with key	2 Sets.
65	Tap & Die	B.A. No. 0 to 10 in a box	2 nos.
66	Tap and Die Set	Metric - 3 to 24 mm	2 Sets
67	Tap & Die	B.S.F. up to 1 inch	2 Sets.
68	Tap & Die	B.S.W. up to 1 inch	2 Sets.
69	Reamer machine	straight flute 6 to 25 mm	1 Set.
70	Reamer Adjustable	10 to 20 mm	1 set.
71	Tool Holder RH & straight for mm square tool bit	Standard	1 no.
72	Parting Tool Holder with H.S.S. blade	Standard	12 nos.
73	Tool Bits	12 X 150 mm sq. assorted shaped	15 nos.
74	Boring Tool holder	6 mm sq. tool bit	15 nos.
75	Steel Rule	300 mm with Metric and Inch	15 nos.
76	Oil Can	½ pint (pressure feed system)	06 nos.
77	Dog Carrier	25, 50 and 75 mm	12 nos.
78	Angle Plate	Adjustable - 150 X 175 X 250 mm	02 nos.
79	Spirit Level	0.05 mm / 200 mm	2 nos.
80	Tool Maker's button	Standard	1 set
81	Combination Drill / Centre Drill	A3, A4 & A5	1 set
82	Oil Stone	12 mm sq. x 100 long fine	12 nos.
83	Tap Wrench (adjustable)	M6,M8,M10,M12	09 nos.
84	Die and Wrench	ϕ6,ϕ8,ϕ10,ϕ12	2 nos.
85	Tool Bit assorted sizes on holder		10 nos.
86	Machine Vice - Swivel Base	100 mm Jaw opening	01 no.
87	Chalk Board on mobile stand	4X4 Feet	1 no.
88	Spare Grinding Wheel Ajax type for carbide tool	As per M/C Bore Dia	1 no.
89	Almirah	1980x 910 x 480 mm	2 no.
90	St. Locker with drawer (Pigeonholes)	6 Or 8 Compartment	1 no.
91	Desk	3'X 2'X 3'	1 no.
92	Stool	2.5 Feet	4 nos.
93	Angle Gauge for tool grinding	Standard	6 nos.

94	Hand Chaser	M-12 & M-16 (External)	2 nos.
95	Hand Chaser	M-12 & M-16 (Internal)	2 nos.
96	Revolving Center (to suit Lathe tailstock)	Standard	6 nos.
97	Tool Cemented carbide assorted shaped (External) for steel turning	set of 12 nos.	1 No.
98	Thread Plug Gauge	M-20 & M-21	1 set
99	Thread Ring Gauge	M-20 & M-21	1 no.
100	Machine Chaser	M-12 TO M-21 (Std. Series) to suit on	1 set
101	Coventry Die head	Optional	2 nos.
102	Gauge Drill Grinding	Standard	1 No.
103	Magnetic Chuck	150 mm dia.(Circulartype)	1 set.
104	Lathe Mandrels (Diff. Types)	Optional	1 no.
105	Coventry Type Die Head (Self-opening)	Optional	1 no.
106	Collapsible Tap with attachment	Optional	2 nos.
107	Fire Extinguisher and buckets		2 nos. each
108	Bore dial gauge stems	12 to 35 mm, 35 to 65 mm., dial gauge indicator of 0.01 accuracy.	1 set each
C : MACHINERIES AND EQUIPMENTS			
109	Lathe S.S. & S.C. (All geared head stock) with minimum specification as: (With D.R.O. Z & Y Axis)	150 mm center height, to admit 750 mm between centers. Machine to be motorized and supplied with coolant installation, 4-jaw Independent chuck 150 mm, 3-jaw self-centering chuck 150 mm, fixed steady, traveling steady, face plate, driving plate, 4-way tool post, quick change gear box for Metric or British threads, live and dead centers with taper attachments, Motor Capacity - 5.5 KW. Or Higher Specification	5 nos.

110	Lathe S.S & S.C.(all geared type) with minimum specification as:	150 mm. Center height, 1000 mm between centers, gap bed machine to be motorized and supplied with coolant installation, 4-jaw independent chuck 250 mm , 3-jaw self-centering chuck 200 mm fixed steady, face plate, driving plate, 4-way tool post, quick change gear box for Metric/British threads, live and dead centers with taper attachments, Motor Capacity -5.5 KW Or Higher Specification	1 no.
111.	Lathe tool room S.S. & S.C. (all geared type) with minimum specification as (With D.R.O. Z & Y Axis)	150 mm center height, 1000 mm between centers. Machine to be motorized and supplied with coolant installation, 4-jaw independent chuck 250 mm, 3-jaw self-centering chuck 150 mm fixed steady, traveling steady, face plate, driving plate, 1-way tool post, draw in type collets set up to 25 mm, 0.5 mm, relieving attachments, Motor Capacity -5.5 KW Or Higher specification.	1 no.
112	Grinding machine pedestal type	D.E. 200 mm dia. Wheel with wheel guard and vision, Motor Capacity -0.75 KW	1 no.
113	Drill machine pillar type-motorized	up to 12 mm. Cap, Motor Capacity -0.75 KW	1 no.
114	Power saw machine – hydraulic feed system	400 mm. Blade size, Motor Capacity -0.75 KW	1 no.
D: LIST OF ADDITIONAL MACHINES, TOOLS & EQUIPMENT FOR CNC TURN CENTRE:			
115	CNC lathe/CNC turn Centre	[specification as per Annex-A & A (I)] Or Higher Specification	As per Annex-A & A (I)
116	a) Simulator b) Desktop Computers	[specification as per Annex-A & A (I)] Or Higher Specification	As per Annex-A & A (I)

117	Tool holders	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
118	LCD projector / large screen TV	As per Requirement	1 no.
119.	Digimatic Electronic Vernier Caliper	200 mm	2 nos.
120	Digimatic electronic outside Micrometer	(0 to 25 mm & 25 to 50 mm) LC 0.001 mm.	1 no. each

NOTE: -

1. *No additional items are required to be provided to the batch working in the second and third shift except the items under trainee's toolkit.*
2. *Institute having centralized computer lab may use the existing infrastructure to impart simulation training & in that case not required to procure item no. 118b.*
3. *Preferably all tools must be hardened, toughened and grounded.*
4. *Internet facility is desired to be provided in the classroom.*

Annexure – A

CNC Lab						
Space and Power Requirement						
1	Space Required (in Sq. Meter):		40 (For below 8(4+4) units) 65 (For above 8(4+4) units)			
2	Power Required (in KW):		6 (For below 4(2+2) units) 12.5(For 4(2+2) & above units)			
CNC Lab Infrastructure						
SNo.	**Name of Item**	**Category**	**Quantity**		**Unit**	**Remark**
			4 (2+2) units & Above	**Below 4 (2+2) units**		
3	CNC turn Centre [specification as per Annex-A (I)]	Machine	1	NIL	Number	**Refer Instructions**
4	Multimedia based simulator for CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based) (12 trainees + 1faculty) ***With help of this software the trainees should be able to Write, Edit, Verify & Simulate***	Software	10	10.	users	
5	Desktop Computers compatible to run simulation software with LAN facility	Machine	10	10	Number	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card:

						Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch.) Licensed Operating System and Antivirus compatible with trade related software.
6	Printer - (Laser/ Inkjet)	Machine	1	1	Number	Optional
7	Air Conditioner	Machine	As required	As required	Number	Optional
8	UPS	Machine	As required	As required	Number	Optional

Instructions	
a)	**For units less than 4(2+2), ITI can enter into MoU with Facilitator who will provide the Training to Trainees admitted and undergoing training in above Trades.** The Facilitator should be Government ITI, Engineering/ Polytechnic College, Recognized Training Institute, Industry, Private ITI (Facilitators are arranged in descending preference order). The Facilitator should have all the above training infrastructure. (Including CNC Machines and Multimedia software for CNC). If any of the facility is not available with facilitator then the same should be provided in the ITI. The facilities of CNC should be made available to ITI trainees at the time of examination. This clause should be part of MoU to be signed. The training provider must be within the range of 15 Km or within city whichever is less.
b)	**NOTE: -** "*It is on the discretion of the ITI that it may procure CNC simulation software with extra features in addition to the specification defined against CNC simulator*".

Annexure –A (I)

Detailed specification for 2 axis CNC Lathe / Turning centre			
1	**MACHINE CAPACITY**	**Units**	**Size**
a	Swing over bed	mm	350 or higher
b	Turning diameter	mm	135 or higher
c	Distance between centres	mm	250 or higher
d	Maximum Turning Length	mm	200 or higher
e	Slant angle (bed or saddle)	degrees	30 to horizontal or higher
f	Cast Iron grade for bed and saddle		Grade 25 or equivalent
g	Machine weight net	kg	1500 or higher
2	**SPINDLE**		
a	Spindle nose		A2-4 / A2-5
b	Bore through Spindle	mm	35 or higher
c	Maximum spindle speed	RPM	4000 or higher
d	Spindle power, continuous	kW	3.7 or higher
e	Minimum spindle speed @ full power	RPM	1200 or lower
f	Type of drive		AC servo spindle motor (digital)
g	Chuck size	mm	135 or higher
h	Chuck type		3-jaw hydraulic, Hydraulic Power operated
i	Spindle bearing class		P4 class
j	Front Bearing Dia. (ID)	mm	60 or higher
3	**AXES**		
a	X - axis Travel	mm	100 or higher
b	Z - axis Travel	mm	200 or higher
c	Programmable feed rate- X & Z	mm/min	10 - 10000
d	Minimum programmable command - X & Z	mm	0.001
e	Rapid traverse - X & Z	m/min	20 or higher
f	Type of drive - X & Z		AC servo motor
g	Motor torque - Z axis	Nm	3 or higher
h	Motor torque - X axis	Nm	3 or higher with brake
i	Ball screw - Z & X axes (diameter x pitch)	mm	25 x 10 or higher
j	Ball screw finish - Z & X axes		Hardened and Ground
k	Ball screw class- Z & X axes		Pre-loaded with C3 or better
l	Guideway type - Z & X axes		Antifriction linear motion guideway
m	Guideway size - Z & X axes	mm	25 or higher
n	Guideway precision - Z & X axes		P class
4	**TURRET**		

a	Bi-Directional Tool Turret		Electromechanical/Servo/Hydraulic
b	No. of Tools	Nos.	8 or higher
c	Tool shank size	mm	20 x 20 or higher
d	Maximum boring bar diameter	mm	25 or higher
5	**TAIL STOCK**		
a	Quill Diameter	mm	65 or higher
b	Quill Stroke	mm	70 or higher
c	Quill Taper		MT-4 or higher
d	Quill actuation		Hydraulic
e	Tail stock base travel manual	mm	150 or higher
f	Thrust (Adjustable)	Kgf	300 or higher
6	**COOLANT/LUBRICATION/HYDRAULIC**		
a	Coolant tank Capacity	Litres	100 or higher
b	Coolant pump motor	kW	0.37
c	Coolant pump out put	LPM	20 or higher
d	Lubrication type		Automatic centralized lubrication
e	Lubrication tank capacity	Litres	3 or higher
f	Hydraulic pump discharge	LPM	8 or higher
g	Hydraulic tank capacity	Litres	30 or higher
h	Hydraulic system pressure maximum	Bar	30 or higher
7	**ACCURACY as per ISO 230-2**		
a	Positioning accuracy X & Z axes	mm	0.012
b	Repeatability X & Z axes	mm	± 0.007
c	Geometrical Alignment		ISO 13041-Part 1
d	Accuracy of finish test piece		ISO 13041-Part 6
8	**CNC SYSTEM**		
a	Control System	FANUC /Siemens	
b	System resolution	0.001 mm	
c	Motors & Drives	Compatible with CNC controllers mentioned above	
d	Tool number display	On machine operator panel	
e	Machine control panel	Feed rate, spindle speed override knob	
f	MPG (Manual pulse generator)	On machine operator panel	
g	CNC features	Graphic Simulation, Programming help, Tool Offsets, MDI,	
		Absolute/ Incremental Positioning, Pitch error compensation	
9	**POWER SOURCE**		
a	Mains supply (± 10 %)	415 V, 3 Ph., 50Hz	
b	Total connected load requirement	Approx. 15 kVA	
10	**STANDARD EQUIPMENT**		
a	Voltage Stabilizer	15 kVA	
b	Air conditioning unit for electrical	1 No.	

	cabinet		
	Backup CD for PLC Ladder Logic	1 No.	
d	Machine lighting	1 No.	
e	Levelling pads and jacking screws	4 No.	
f	Operation manual	1 No.	
g	Maintenance manual	1 No.	
h	Installation kit	1 No.	
i	Maintenance tool kit	1 No.	
j	6 rack trolley (Size 25"x22"x45") with lock	1 No.	
k	Machine guarding with safety compliance	1 No.	
11	**MAKES OF CRITICAL MACHINE TOOL COMPONENTS**		
a	Linear Motion Guideways	HIWIN/THK/PMI/STAR	
b	Ball Screws	HIWIN/THK/TSUBAKI/PMI/STAR/HMT/NSK	
c	Spindle Bearings	RHP/NSK/FAG/SKF/NRB	
d	Turret	PRAGATI/BARUFFALDI/SAUTER/DUPLOMATIC	
e	Hydraulic Chuck & Cylinder	GMT/KITAGAWA/AIRTECH/PRAGATI/ROHM	
f	Hydraulic Power Pack	YUKEN/FLUID/REXROTH	
g	Panel AC	WERNER FINLEY/RITTAL/LEXTECNOID	
h	Stabilizer	NEEL/SERVOMAX/CONSUL/FARMAX/EQUIVALENT	
i	Lubrication	CENLUBE/DROPCO/EQUIVALENT	
j	Coolant Pump	RAJAMANE/GRUNDFOS	
k	Cutting tools and holders	SANDVIK/TAEGUTEC/KENNAMETAL/SECO/ISCAR/MITSUBISHI	

12 Cutting tools & tool holders	**Quantity**		**Inserts**	**Quantity**	
	1 year	**3 years**		**1 year**	**3 years**
1. External turning holder, insert type, MWLNL	2	4	WNMG	20	40
2. External turning holder, insert type, MVJNL	2	4	VNMG	10	20
3. External turning holder, insert type, PDJNR	2	4	DNMG	10	20
4. Threading Holder - External, LH	2	4	0.5 to 2	10	30
5. Threading Holder - Internal, LH	2	4	0.5 to 2	10	30
6. Grooving Holder External, LH	2	4	3 mm	10	30
7. Grooving Holder Internal, LH	2	4	3 mm	10	30
8. Parting off Holder for insert width 2 mm, LH	2	4	2 mm	10	30
9. Boring holder SCLCL for minimum bore dia. 12 mm	2	4	WCMT	20	60
10. Boring holder SCLCL for minimum bore dia. 16 mm	2	4	CCMT	20	60
11. Internal grooving holder LH, for minimum bore dia. 12 mm.	2	4	2 mm	10	30
12. Internal threading holder LH, for minimum bore dia. 12 mm	2	4	w mm	10	30

13. Insert drill 12.7 mm	2	4	Suitable	10 sets	30 sets
14. Reducing sleeves for internal holders - Dia 12 and 16 mm	1 set	2 sets			
15. Centre drill HSS A 2.5 x 6.3	2	6			
16. Twist drill HSS straight shank, dia 6,8,10,12 mm	2 Sets	6 sets			
17. Collets suitable for the above drills	1 Set	2 sets			
18. Collet Holder	2	4			
19. Boring bar holder	3	3			

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

FITTER

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

FITTER

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship
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CONTENTS

1. COURSE INFORMATION

During the two-year duration a candidate is trained on subjects Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Science & Calculation and Employability Skill related to job role. In addition to this a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The practical part starts with basic fitting with tolerance level ± 0.5mm and finally to ± 0.02mm and angular tolerance from 1° to 10' at the end of the course. The broad components covered under Professional Skill subject are as below:

FIRST YEAR: The practical part starts with basic fitting in the beginning and the candidate also imparted training on allied trades viz., Sheet Metal, Welding (Gas & Arc) which leads to multi-skilling. In the basic fitting the skills imparted are sawing, filing, marking, chipping, measurement, riveting, soldering, brazing, drilling and observation of all safety aspects is mandatory. The accuracy achieved is of±0.25 mm. The safety aspects cover components like OSH&E, PPE, Fire extinguisher, First Aid and in addition 5S being taught.

Different drilling operations (through, blind, angular), reaming, offhand grinding, tapping, dieing, different fits viz., sliding fit, etc., scraping, fastening (nuts & bolts, riveting, studs, screws, etc.,). The accuracy achieved is of± 0.04 mm and angular accuracy to 30minutes. Different turning operations on lathe (step, grooving, chamfering, drilling, boring, knurling & threading), simple repair, overhauling and lubrication work on machine are being taught in the practical.

SECOND YEAR: Power tool operation, different complex assembling and fitting, fastening, lapping, making gauges, pipe works and pipe joints, Dismantling, overhauling& assembling valves are covered. The accuracy achieved is of an accuracy of ± 0.02 mm & 10 minutes.

Making & using drill jigs, making of critical components, repair & maintenance of power transmission system, making of template &complex gauges, identify different Pneumatic & hydraulic components and circuit construction, repair & maintenance of machinery like lathe, drill, grinding, bench drilling, Inspection of Machine tools, Accuracy testing of Machine tools and erection of simple machines are being performed as part of practical training.

Professional Knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition components like Physical properties of engineering materials, Interchangeability, Method of expressing tolerance as per BIS Fits,

different types of iron, properties and uses, special files, honing, Metallurgical and metal working processes such as Heat treatment, the various coatings used to protect metals, different bearing, working material with finished surface as aluminium, duralumin and stainless steel, topics related to non-ferrous metals, Method of lubrication are also covered under theory part.

Total two projects need to be completed by the candidates in a group. In addition to above components the core skills components viz., Workshop calculation & science, Engineering drawing, employability skills are also covered. These core skills are essential skills which are necessary to perform the job in any given situation.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development &Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

Fitter trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skills, knowledge and life skills. After passing out of the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.

- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment (Internal)** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning

outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure are being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects are 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% accuracy achieved while

procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Fitter General; Sizes metal parts to close tolerances and fits and assembles them using hand tools for production or repairs of machines, or other metal products. Studies drawings to understand specification of different parts, fittings or assembles to be made and their functions. They select materials, appropriate tool and equipments to carry out their work. Holds the work in Vice, Cuts and shapes required parts to dimensions and specifications by processes of sawing, chipping, filing, grinding, drilling holes, screw cutting, scrapping etc., using hand tools for making specimens or finished components. Measures object while working using foot rules, calipers, micrometer, gauges etc. and checks for correct filing with square. Gets half-finished object marked or marks it himself using face plate, marking block scriber, vernier, height gauges, vee-blocks, angle plate, sine plate, slip gauges, combination set, etc. depending on accuracies required, to indicate guide lines for finished sizes, holes to be drilled and pitch centres, threads to be cut and other working details as specified in drawing or sample. Clamps object securely in correct position in vice and files it to required dimensions according to punch marks and guide lines frequently measuring it with calipers, micrometre, vernier, gauges etc, makes holes with drill, cuts threads with taps and dies ensuring that they are square or at required angle to base. Measures finished article with dial indicator, micrometre, vernier, height gauges, screw gauges, plug gauges, sine bar, slip gauge, etc according to prescribed accuracies. May make parts separately and assemble those with screws, rivets, pins, etc. as specified so as to make complete unit according to drawing. Dismantles or removes worn out, broken or defective parts using hand tools or power tools and replaces them by repaired or new ones. Performs repairing and maintenance work (including preventive maintenance) of simple machines, dismantles and replaces different components to construct circuit of Pneumatics and Hydraulics. Tests completed article/ assembly to ensure correct performance. May do simple turning of parts on machines and perform welding, brazing, and like operations. May explain heat treatment processes viz., annealing, hardening, tempering etc. May specialize in particular type of machine or product and be designated accordingly. May suggest alterations.

In addition, Fitter have the ability to visualize the job, good coordination, mechanical attitude, manual dexterity and perform work related mathematical calculations.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

May be designated as FITTER General according to nature of work done.

Reference NCO 2015:

i) 7233.0100 –Fitter, General
ii) 7233.0200 – Fitter, Bench

Reference NOS:

i) CSC/N0304,
ii) CSC/N0301,
iii) CSC/N0110

4. GENERAL INFORMATION

Name of the Trade	**FITTER**
Trade Code	DGT/1002
NCO - 2015	7233.0100, 7233.0200
NOS Covered	CSC/N0304, CSC/N0301, CSC/N0110
NSQF Level	Level – 5
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	88 Sq.m
Power Norms	3.51 KW
Instructors Qualification for	
1. Fitter Trade	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical Engineeringfrom AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Fitter" With three years' experience in the relevant field. **<u>Essential Qualification</u>:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT.

	Note:-Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.
2. Workshop Calculation & Science	.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability

	Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1LEARNING OUTCOMES (TRADE SPECIFIC)

FIRST YEAR:

1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. *[Basic fitting operation – Marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]* CSC/N0304
2. Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting. CSC/N03001
3. Join metal components by riveting observing standard procedure. CSC/N0304
4. Join metal component by arc welding observing standard procedure. CSC/N0304
5. Cut and join metal component by gas (oxyacetylene) CSC/N0304
6. Produce components by different operations and check accuracy using appropriate measuring instruments. [Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer] CSC/N0304
7. Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [Different Fit – Sliding, Angular, Step fit, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.] CSC/N0304
8. Produce components involving different operations on lathe observing standard procedure and check for accuracy. [Different Operations – facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)] CSC/N0110
9. Plan & perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe]
10. Read and apply engineering drawing for different application in the field of work.
11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.

SECOND YEAR:

12. Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality. [Different Mating Surfaces – Dovetail fitting, Radius fitting, Combined fitting; Different surface finishing operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] CSC/N0304
13. Make different gauges by using standard tools & equipment and checks for specified accuracy. [Different Gauges – Snap gauge, Gap gauge; Specified Accuracy - ±0.02mm] CSC/N0304
14. Apply a range of skills to execute pipe joints, dismantle and assemble valves & fittings with pipes and test for leakages. [Range of skills – Cutting, Threading, Flaring, Bending and Joining] CSC/N0304
15. Make drill jig & produce components on drill machine by using jigs and check for correctness. CSC/N0304
16. Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. [Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.] CSC/N0304
17. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]
18. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.
19. Plan & perform basic day to day preventive maintenance, repairing and check functionality. [Simple Machines – Drill Machine, Power Saw and Lathe] CSC/N0304
20. Plan, erect simple machine and test machine tool accuracy. [Simple Machines – Drill Machine, Power Saw and Lathe]
21. Read and apply engineering drawing for different application in the field of work.
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. *[Basic fitting operation – marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]* CSC/N0304	Plan & Identify tools, instruments and equipment for marking and make this available for use in a timely manner.
	Select raw material and visual inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Observe safety procedure during above operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
2. Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting. CSC/N0301	Identify Hand Tools for Sheet Metal work, Soldering, Brazing & riveting and make these available for use in a timely manner.
	Mark and develop various forms as per drawing using sheet metals.
	Make of simple items with sheet metal as per drawing.
	Prepare the job for Soldering, Brazing &riveting.
	Identify different type of rivets and use as per requirement.
	Identify tools for drilling and use these tools.
	Mark according to drawing.
	Drill through holes on the job.
	Solder, Braze and Rivet to prepare a job as per given drawing / sample following standard practices.
	Observe safety procedure during riveting as per standard norms and company guidelines.
3. Join metal components by	Identify Tools and equipments for riveting and make these

riveting observing standard procedure. CSC/N0304	available for use in a timely manner.
	Prepare the job for lap and butt joint.
	Identify different type of rivets and use as per requirement.
	Identify tools for drilling and use these tools.
	Mark according to drawing.
	Drill through holes on the job.
	Rivet to prepare a job as per given drawing / sample following standard practices.
	Observe safety procedure during riveting as per standard norms and company guidelines.
4. Join metal component by arc welding observing standard procedure. CSC/N0304	Identify different components/parts of arc welding machine, collect desired information and set each components/parts as per standard procedure.
	Observe safety/ precaution during operation.
	Select appropriate material & plan for arc welding.
	Weld metal parts / mechanical components as per specification observing standard procedure.
	Check joined part portion to ascertain proper welding.
5. Cut and join metal component by gas (oxyacetylene). CSC/N0304	Identify different components/parts of Gas (oxyacetylene) machine, collect desired information and set each components/parts as per standard procedure.
	Observe safety/ precaution during operation.
	Select appropriate material & plan for gas cutting & joining operation.
	Cut & join metal parts / mechanical components as per specification observing standard procedure.
	Check cut portion/ joined part to ascertain proper welding.
6. Produce components by different operations and check accuracy using appropriate measuring instruments.*[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]* CSC/N0304	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Produce component by observing standard procedure.
	Check the dimensions of the produced components to ensure dimensions are within prescribed limit.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
7. Make different fit of	Recognize general concept of Limits, Fits and tolerance

components for assembling as per required tolerance observing principle of interchangeability and check for functionality. *[Different Fit – Sliding, Angular, Step fit, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.]* CSC/N0304	necessary for fitting applications and functional application of these parameters.
	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Set up workplace/ assembly location with due consideration to operational stipulation
	Plan work in compliance with standard safety norms and collecting desired information.
	Demonstrate possible solutions and agree tasks within the team.
	Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts.
	Assemble components applying a range of skills to ensure proper fit.
	Check functionality of components.
8. Produce components involving different operations on lathe observing standard procedure and check for accuracy. *[Different Operations – facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)]* CSC/N01110	Ascertain basic working principles and safety aspect of lathe machine.
	Understand functional application of different levers, stoppers, adjustment etc.
	Identify different lubrication points and lubricants, their usage for application in lathe machine as per machine manual.
	Identify different work and tool holding devices and collect information for functional application of each device.
	Mount the work and tool holding devices with required alignment and check for its functional usage to perform lathe operations.
	Solve problem by applying basic methods, tools, materials and information during setting.
	Observe safety procedure during mounting as per standard norms.
	Produce components observing standard procedure.
	Check accuracy/ correctness of job using appropriate equipment/gauge.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
9. Plan&perform simple repair, *overhauling* of different machines and	Ascertain and select tools and materials for the repair, overhauling and make this available for use in a timely manner.

check for functionality. *[Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe]*	Plan work in compliance with standard safety norms.
	Demonstrate possible solutions and agree tasks within the team.
	Select specific parts to be repaired and ascertain for appropriate material and estimated time.
	Repair, overhaul and assemble the parts in the machine with the help of blueprint.
	Check for functionality of part and ascertain faults of the part/ machine in case of improper function.
	Rectify faults of assembly.
10. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
12. Make &assemble components of different mating *surfaces* as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality. *[Different Mating Surfaces – Dovetail fitting, Radius fitting, Combined fitting; Different surface finishing operations – Scraping, Lapping and Honing; Different fastening*	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard and collecting necessary information.
	Set up workplace/ assembly location with due consideration to operational stipulation
	Demonstrate possible solutions and agree tasks within the team.
	Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines.
	Perform scraping and lapping of components to obtain required surface finish of different mating surface.
	Comply with safety rules when performing the above operations.
	Check tolerance and accuracy of components as defined

components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] CSC/N0304	with appropriate instruments observing standard procedure.
	Assemble different components using different fastening components, tools and check the functionality.
13. Make different gauges by using standard tools & equipment and checks for specified accuracy. *[Different Gauges – Snap gauge, Gap gauge; Specified Accuracy - ±0.02mm]* CSC/N0304	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Produce gauge by observing appropriate method and as per specification of drawing.
	Perform Lapping of gauge to obtain required finish as per drawing.
	Check tolerance and specified accuracy of gauge with appropriate measuring instruments as per drawing.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
14. Apply a range of skills to execute pipe joints, dismantle and assemble valves & fittings with pipes and test for leakages.*[Range of skills – Cutting, Threading, Flaring, Bending and Joining]* CSC/N0304	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan to Dismantle and assemble valves and pipe fittings.
	Dismantle valves and fittings in pipes applying range of skills andcheck for defect as per standard procedure.
	Demonstrate possible solutions in case of defect and agree tasks within the team for repair or replacement.
	Assemble valves and various pipe fittings using range of skills and observing standard procedure.
	Test for leakage and appropriate functioning of valves.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
15. Make drill jig & produce components on drill machine by using jigs and check for correctness. CSC/N0304	Set up workplace/ assembly location with due consideration to operational stipulation
	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Collect information related to standard procedure, methods and tools to make drill jigs.
	Mark the components as per drawing.

	Make drill jigs by turning, drilling, reaming, filing, taping, etc.
	Test the functionality of jig.
	Select suitable jigs for drilling considering desired result and collecting necessary information.
	Produce component by using jig observing standard procedure and check the correctness of the job.
	Comply with safety rules when performing the above operations.
16. Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. *[Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]* CSC/N0304	Select and ascertain tools and materials for the job and make this available for use in a timely manner.
	Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information.
	Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes.
	Check the accuracy of the repaired components with appropriate gauge & instruments.
	Assemble the repaired mechanical components observing standard procedure.
	Comply with safety rules when performing the above operations.
	Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc.
	Check for functionality of power transmission system or any assembly as per standard parameters.
17. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. *[Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]*	Select and ascertain tools for the job and make this available for use in a timely manner.
	Identify different pneumatics and hydraulics components.
	Plan to dismantle and replace pneumatics & hydraulics circuit as per drawing and collecting necessary information.
	Perform dismantling and replacing of different components with accuracy applying range of skills and standard operating procedure.
	Assemble different components.
	Check functionality of the components.
18. Construct circuit of pneumatics and hydraulics	Select and ascertain tools for the job and make this available for use in a timely manner.

observing standard operating procedure& safety aspect.	Plan to construct pneumatics & hydraulics circuit as per drawing and collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team for constructing circuit.
	Construct circuit of pneumatics and hydraulics observing standard procedure.
	Comply with safety rules when performing the above operations.
	Check different parameters and functionality of the system.
19. Plan & perform basic day *to* day preventive maintenance, repairing and check functionality. *[Simple Machines – Drill Machine, Power Saw and Lathe]* CSC/N0304	Ascertain preventive maintenance/repair procedure as per manual of machine and select appropriate tools & equipment for undertaking job.
	Interpret construction, alignment and assembly of different parts of machine.
	Plan to carry out the preventive maintenance/repair task with appropriate accuracy of simple machine by collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team.
	Perform preventive maintenance/dismantle, repair parts and assemble sub-assemblies of simple machine as per layout plan and standard procedure.
	Put the machine in operation complying Standard operating procedure.
	Check for proper functioning of repaired machine and other parameters of simple machine as per manual after erection.
	Dispose unsalvageable materials as per standard procedures.
20. Plan, erect simple machine and test machine tool accuracy. *[Simple Machines – Drill Machine, Power Saw and Lathe]*	Ascertain erection procedure as per manual of machine and select appropriate tools & equipment for undertaking job.
	Interpret construction, alignment and assembly of different parts of machine.
	Set up workplace/ assembly location with due consideration to operational stipulation
	Plan to carry out the erection of simple machine by collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team.
	Erect simple machine as per layout plan and standard

	procedure.
	Put the machine in operation complying Standard operating procedure.
	Check alignment of erected machine and other parameters of simple machine as per manual after erection.
	Dispose unsalvageable materials as per standard procedures.
21. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR FITTER TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) with Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 212 Hrs; Professional Knowledge 37Hrs	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. *[Basic fitting operation – marking, Hacks awing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]* (Mapped NOS: CSC/N0304)	1. Importance of trade training, List of tools & Machinery used in the trade. (1 hr.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (5 hrs.) 3. First Aid Method and basic training. (2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hrs.) 5. Hazard identification and avoidance. (2 hrs.) 6. Safety signs for Danger, Warning, caution & personal safety message. (1 hrs.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (2 hrs.) 8. Use of Fire extinguishers. (7 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (2 hrs.) 10. Safe use of tools and equipments used in the trade. (1 hrs.)	All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft Skills, its importance and Job area after completion of training. Importance of safety and general precautions observed in the in the industry/shop floor. Introduction of First aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g.; power failure, fire, and system failure. **Importance of housekeeping & good shop floor practices.** Introduction to 5S concept & its application. **Occupational Safety & Health**: Health, Safety and Environment guidelines, legislations &regulations as applicable. Basic understanding on Hot work, confined space work and material handling equipment. (04 hrs.)

		11. Identification of tools &equipment as per desired specifications for marking & sawing. (4 hrs.) 12. Selection of material as per application. (1 hrs.) 13. Visual inspection of raw material for rusting, scaling, corrosion etc. (1 hrs.) 14. Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions. (9 hrs.) 15. Sawing different types of metals of different sections. (6 hrs.)	Linear measurements- its units, dividers, calipers, hermaphrodite, centre punch, dot punch, prick punch their description and uses of different types of hammers. Description, use and care of 'V' Blocks, marking off table. Measuring standards (English, Metric Units), angular measurements. (04 hrs.)
		16. Filing Channel, Parallel. (5 hrs.) 17. Filing- Flat and square (Rough finish), (08 hrs.) 18. Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule. (5 hrs.) 19. Marking practice with dividers, odd leg calipers and steel rule (circles, ARCs, parallel lines). (4 hrs.)	Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification, description, types and their uses, method of using hacksaws. Files- specifications, description, materials, grades, cuts, file elements, uses. Types of files, care and maintenance of files. Measuring standards (English, Metric Units), angular measurements. (04 hrs.)
		20. Marking off straight lines and ARCs using scribing block and dividers. (4 hrs.) 21. Chipping flat surfaces along a marked line. (9 hrs.) 22. Marking, filing, filing square and check using tri square. (9 hrs.)	Marking off and layout tools, dividers, scribing block, - description, classification, material, care & maintenance. Try square, ordinary depth gauge, protractor- description, uses and cares. Uses, care & maintenance of cold chisels- materials, types, cutting angles. (04 hrs.)
		23. Marking according to simple blueprints for locating, position of holes,	Marking media, marking blue, Prussian blue, red lead, chalk and their special application,

		scribing lines on chalked surfaces with marking tools. (8 hrs.) 24. Finding centre of round bar with the help of 'V' block and marking block. (2 hrs.) 25. Joining straight line to an ARC. (08 hrs.)	description. Use, care and maintenance of scribing block. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance. (03 hrs.)
		26. Chipping, Chamfering, Chip slots & oils grooves (Straight). (08 hrs.) 27. Filing flat, square, and parallel to an accuracy of 0.5mm. (07 hrs.) 28. Chip curve along a line-mark out, keyways at various angles & cut keyways. (1 hrs.) 29. Sharpening of Chisel. (2 hrs.) 30. File thin metal to an accuracy of 0.5 mm. (3 hrs.)	Physical properties of engineering metal: colour, weight, structure, and conductivity, magnetic, fusibility, specific gravity. Mechanical properties: ductility, malleability hardness, brittleness, toughness, tenacity, and elasticity. (04 hrs.)
		31. Saw along a straight line, curved line, on different sections of metal. (12 hrs.) 32. Straight saw on thick section, M.S. angle and pipes. (8 hrs.)	Power Saw, band saw, Circular saw machines used for metal cutting. (03 hrs.)
		33. File steps and finish with smooth file to accuracy of ± 0.25 mm. (12 hrs.) 34. File and saw on M.S. Square and pipe. (10 hrs.)	Micrometer- outside and inside – principle, constructional features, parts graduation, reading, use and care. Micrometer depth gauge, parts, graduation, reading, use and care. Digital micrometer. (03 hrs.)
		35. File radius along a marked line (Convex & concave) & match. (12 hrs.) 36. Chip sheet metal (shearing). (3 hrs.) 37. Chip step and file. (3 hrs.)	Vernier calipers, principle, construction, graduations, reading, use and care. Vernier bevel protractor, construction, graduations, reading, use and care, dial Vernier Caliper, Digital Vernier caliper.

			Vernier height gauge: material construction, parts, graduations (English & Metric) uses, care and maintenance. (03 hrs.)
		38. Mark off and drill through holes. (5 hrs.) 39. Drill and tap on M.S. flat. (8 hrs.) 40. Punch letter and number (letter punch and number punch) (3 hrs.) 41. Practice use of different punches. (5 hrs.)	Drilling processes: common type (bench type, pillar type, radial type), gang and multiple drilling machine. Determination of tap drill size. (03 hrs.)
Professional Skill 97Hrs; Professional Knowledge 21Hrs	Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting. (Mapped NOS: CSC/N0301)	42. Marking of straight lines, circles, profiles and various geometrical shapes and cutting the sheets with snips. (12 hrs.) 43. Marking out of simple development (5 hrs.) 44. Marking out for flaps for soldering and sweating. (4 hrs.)	Safety precautions to be observed in a sheet metal workshop, sheet and sizes, Commercial sizes and various types of metal sheets, coated sheets and their uses as per BIS specifications. Shearing machine- description, parts and uses. (05 hrs.)
		45. Make various joints: wiring, hemming, soldering and brazing, form locked, grooved and knocked up single hem straight and curved edges form double hemming. (22 hrs.) 46. Punch holes-using hollow and solid punches. (5 hrs.) 47. Do lap and butt joints. (12 hrs.)	Marking and measuring tools, wing compass, tin man's square tools, snips, types and uses. Tin man's hammers and mallets type-sheet metal tools, types, specifications, uses. Trammel- description, parts, uses. Hand grooves- specifications and uses. Sheet and wire gauge. (07 hrs.)
		48. Bend sheet metal into various curvature form, wired edges- straight and curves. Fold sheet metal at angle using stakes. (6 hrs.) 49. Make simple Square container with wired edge and fix handle. (13 hrs.)	Stakes-bench types, parts, their uses. Various types of metal joints, their selection and application, tolerance for various joints, their selection& application. Wired edges. (04 hrs.)

		50. Make square tray with square soldered corner. (11 hrs.) 51. Practice in soft soldering and silver soldering. (7 hrs.)	Solder and soldering: Introduction-types of solder and flux. Composition of various types of solders and their heating media of soldering iron. Method of soldering, selection and application-joints. Hard solder-Introduction, types and method of brazing. (05 hrs.)
Professional Skill 19Hrs; Professional Knowledge 03Hrs	Join metal components by riveting observing standard procedure. (Mapped NOS: CSC/N0304)	52. Make riveted lap and butt joint. (6 hrs.) 53. Make funnel as per development and solder joints. (8 hrs.) 54. Drill for riveting. (1 hr.) 55. Riveting with as many types of rivet as available, use of counter sunk head rivets. (4 hrs.)	Various rivets shape and form of heads, importance of correct head size. Rivets-Tin man's rivets types, sizes, and selection for various works. Riveting tools, dolly snaps description and uses. Method of riveting, The spacing of rivets. Flash riveting, use of correct tools, compare hot and cold riveting. (03 hrs.)
Professional Skill 21Hrs; Professional Knowledge 04Hrs	Join metal component by arc welding observing standard procedure. (Mapped NOS: CSC/N0304)	56. Welding - Striking and maintaining ARC, laying Straight-line bead. (21 hrs.)	Safety-importance of safety and general precautions observed in a welding shop. Precautions in electric and gas welding. (Before, during, after) Introduction to safety equipment and their uses. Machines and accessories, welding transformer, welding generators. (04 hrs.)
Professional Skill 64Hrs; Professional Knowledge 16Hrs	Cut and join metal component by gas (oxy-acetylene) (Mapped NOS: CSC/N0304)	57. Making butt joint and joint-gas and ARC. (12 hrs.) 58. Do setting up of flames, fusion runs with and without filler rod, and gas. (8 hrs.)	Welding hand tools: Hammers, welding description, types and uses, description, principle, method of operating, carbon dioxide welding. H.P. welding equipment: description, principle, method of operating L.P. welding equipment: description, principle, method of operating. Types of Joints-

			Butt and fillet as per BIS SP: 46-1988 specifications. Gases and gas cylinder description, kinds, main difference and uses. (05 hrs.)
		59. Make butt weld and corner, fillet in ARC welding (22 hrs.)	Setting up parameters for ARC welding machines-selection of Welding electrodes. Care to be taken in keeping electrode. (05 hrs.)
		60. Gas cutting of MS plates (22 hrs.)	Oxygen acetylene cutting-machine description, parts, uses, method of handling, cutting torch-description, parts, function and uses. (06 hrs.)
Professional Skill 143Hrs; Professional Knowledge 26Hrs	Produce components by different operations and check accuracy using appropriate measuring instruments.*[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]* (Mapped NOS: CSC/N0304)	61. Mark off and drill through holes. (04 hrs.) 62. Drill on M.S. flat. (1 hrs.) 63. File radius and profile to suit gauge. (10 hrs.) 64. Sharpening of Drills. (1 hrs.) 65. Practice use of angular measuring instrument. (04 hrs.)	Drill- material, types, (Taper shank, straight shank) parts and sizes. Drill angle-cutting angle for different materials, cutting speed feed. R.P.M. for different materials. Drill holding devices- material, construction and their uses. (04 hrs.)
		66. Counter sink, counter bore and ream split fit (three piece fitting). (04 hrs.) 67. Drill through hole and blind holes. (2 hrs.) 68. Form internal threads with taps to standard size (through holes and blind holes). (3 hrs.) 69. Prepare studs and bolt. (13 hrs.)	Counter sink, counter bore and spot facing-tools and nomenclature, Reamer-material, types (Hand and machine reamer), kinds, parts and their uses, determining hole size (or reaming), Reaming procedure. Screw threads: terminology, parts, types and their uses. Screw pitch gauge: material parts and uses. Taps British standard (B.S.W., B.S.F., B.A. & B.S.P.) and metric /BIS (coarse and fine) material, parts (shank body, flute, cutting edge). (03 hrs.)

		70. Form external threads with dies to standard size. (08 hrs.) 71. Prepare nuts and match with bolts. (15 hrs.)	Tap wrench: material, parts, types (solid &adjustable types) and their uses removal of broken tap, studs (tap stud extractor). Dies: British standard, metric and BIS standard, material, parts, types, Method of using dies. Die stock: material, parts and uses. (06 hrs.)
		72. File and make Step fit, angular fit, angle, surfaces (Bevel gauge accuracy 1 degree). (12 hrs.) 73. Make simple open and sliding fits. (08 hrs.)	Drill troubles: causes and remedy. Equality of lips, correct clearance, dead centre, length of lips. Drill kinds: Fraction, metric, letters and numbers, grinding of drill. (04 hrs.)
		74. Enlarge hole and increase internal dia. (2 hrs.) 75. File cylindrical surfaces. (5 hrs.) 76. Make open fitting of curved profiles. (15 hrs.)	Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing. Selection of grinding wheels. Bench grinder parts and use. (04 hrs.)
		77. Correction of drill location by binding previously drilled hole. (04 hrs.) 78. Make inside square fit. (16 hrs.)	Gauges- Introduction, necessity, types. Limit gauge: Ring gauge, snap gauge, plug gauge, description and uses. Description and uses of gauge-types (feeler, screw, pitch, radius, wire gauge). (05 hrs.)
Professional Skill 126Hrs; Professional Knowledge 28Hrs	Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. *[Different Fit – Sliding, Angular, Step fit, 'T' fit, Square fit*	79. Make sliding 'T' fit. (21 hrs.)	Interchange ability: Necessity in Engg, field definition, BIS. Definition, types of limit, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero line, tolerance zone Different standard systems of fits and limits. British standard system, BIS system. (05 hrs.)
		80. File fit- combined, open	Method of expressing

	and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.] (Mapped NOS: CSC/N0304)	angular and sliding sides. (08 hrs.) 81. File internal angles 30minutes accuracy open, angular fit. (12 hrs.)	tolerance as per BIS Fits: Definition, types, description of each with sketch. Vernier height gauge: material construction, parts, graduations (English & Metric) uses, care and maintenance. (04 hrs.)
		82. Make sliding fit with angles other than 90° (21 hrs.)	Pig Iron: types of pig Iron, properties and uses. Cast Iron: types, properties and usesWroughtiron:- properties and uses. Steel: plain carbon steels, types, properties and uses. Non-ferrous metals (copper, aluminium, tin, lead, zinc) properties and uses. (05 hrs.)
		83. Scrap on flat surfaces, curved surfaces and parallel surfaces and test. (04 hrs.) 84. Make & assemble, sliding flats, plain surfaces. (12 hrs.) 85. Check for blue match of bearing surfaces- both flat and curved surfaces by wit worth method. (5 hrs.)	Simple scraper- flat, half round, triangular and hook scraper and their uses. Blue matching of scraped surfaces (flat and curved bearing surfaces). Testing scraped surfaces: ordinary surfaces without a master plate. (04 hrs.)
		86. File and fit combined radius and angular surface (accuracy ± 0.5 mm), angular and radius fit. (15 hrs.) 87. Locate accurate holes & make accurate hole for stud fit. (2 hrs.) 88. Fasten mechanical components / sub-assemblies together using screws, bolts and collars using hand tools. (5 hrs.)	Vernier micrometer, material, parts, graduation, use, care and maintenance. Calibration of measuring instruments. Introduction to mechanical fasteners and its uses. Screw thread micrometer: Construction, graduation and use. (05 hrs.)

		89. Make sliding fits assembly with parallel and angular mating surface. (± 0.04 mm)(21 hrs.)	Dial test indicator, construction, parts, material, graduation, Method of use, care and maintenance. Digital dial indicator. Comparators-measurement of quality in the cylinder bores. (05 hrs.)
Professional Skill 95 Hrs; Professional Knowledge 15 Hrs	Produce components involving different operations on lathe observing standard procedure and check for accuracy. *[Different Operations – facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)]* (Mapped NOS: CSC/N0110)	90. Lathe operations- 91. True job on four jaw chuck using knife tool. (5 hrs.) 92. Face both the ends for holding between centres. (06 hrs.) 93. Using roughing tool parallel turn ± 0.1 mm. (06 hrs.) 94. Measure the diameter using outside caliper and steel rule.(1 hr.)	Safely precautions to be observed while working on a lathe, Lathe specifications, and constructional features. Lathe main parts descriptions- bed, head stock, carriage, tail stock, feeding and thread cutting mechanisms. Holding of job between centres, works with catch plate, dog, simple description of a facing and roughing tool and their applications. (04 hrs.)
		95. Holding job in three jaw chuck. (2 hrs.) 96. Perform the facing, plain turn, step turn, parting, deburr, chamfer-corner, roundthe ends, and use form tools. (08 hrs.) 97. Shoulder turn: square, filleted, beveled undercut shoulder, turning-filleted under cut, square beveled. (08 hrs.) 98. Sharpening of -Single point Tools. (1 hr.)	Lathe cutting tools-Nomenclature of single point & multipoint cutting tools, Tool selection based on different requirements and necessity of correct grinding, solid and tipped, throw away type tools, cutting speed and feed and comparison for H.S.S., carbide tools. Use of coolants and lubricants. (03 hrs.)
		99. Cut grooves- square, round, 'V' groove. (08 hrs.) 100. Knurl the job. (1 hr.) 101. Bore holes –spot face, pilot drill, enlarge hole using boring tools. (9 hrs.)	Chucks and chucking the independent four-jaw chuck. Reversible features of jaws, the back plate, Method of clearing the thread of the chuck-mounting and dismounting, chucks, chucking true, face plate, drilling - method of holding drills in the tail stock, Boring tools and

			enlargement of holes. (02 hrs.)
		102. Turn taper (internal and external). (10 hrs.) 103. Turn taper pins. (5 hrs.) 104. Turn standard tapers to suit with gauge. (5 hrs.)	General turning operations-parallel or straight, turning. Stepped turning, grooving, and shape of tools for the above operations. Appropriate method of holding the tool on tool post or tool rest, Knurling: - tools description, grade, uses, speed and feed, coolant for knurling, speed, feed calculation. Taper – definition, use and method of expressing tapers. Standard tapers-taper, calculations Morse taper. (03 hrs.)
		105. Practice threading using taps, dies on lathe by hand. (2 hrs.) 106. Make external 'V' thread. (8 hrs.) 107. Prepare a nut and match with the bolt. (10 hrs.)	Screw thread definition – uses and application. Square, worm, buttress, acme (nonstandard-screw threads), Principle of cutting screw thread in centre lathe – principle of chasing the screw thread – use of centre gauge, setting tool for cutting internal and external threads, use of screw pitch gauge for checking the screw thread. (03 hrs.)
Professional Skill 63 Hrs; Professional Knowledge 12Hrs	Plan & perform simple repair, overhauling of different machines and check for functionality. *[Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe]*	108. Simple repair work: Simple assembly of machine parts from blueprints. (10 hrs.) 109. Rectify possible assembly faults during assembly. (14 hrs.) 110. Perform the routine maintenance with check list (08 hrs.) 111. Monitor machine as per routine checklist (3 hrs.) 112. Read pressure gauge, temperature gauge, oil level (1 hr.)	**Maintenance** -Total productive maintenance -Autonomous maintenance -Routine maintenance -Maintenance schedule -Retrieval of data from machine manuals Preventive maintenance-objective and function of Preventive maintenance, section inspection. Visual and detailed, lubrication survey, system of symbol and colour coding. Revision, simple estimation of materials, use of

		113. Set pressure in pneumatic system (2 hrs.)	handbooks and reference table. Possible causes for assembly failures and remedies. Installation, maintenance and overhaul of machinery and engineering equipment (10 hrs.)
		114. Assemble simple fitting using dowel pins and tap screw assembly using torque wrench. (15 hrs.)	Assembling techniques such as aligning, bending, fixing, mechanical jointing, threaded jointing, sealing, and torqueing. Dowel pins: material, construction, types, accuracy and uses. (02 hrs.)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**Engineering Drawing:** Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the freehand sketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. Dimensioning • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definitionand difference) Reading of Job drawing of related trades.	
WORKSHOP CALCULATION & SCIENCE: 38 Hrs.			

Professional Knowledge WCS- 38 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, ~~molecule, atom, how electricity is produced~~, electric current AC,DC their comparison, voltage, resistance and their units **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels

		Levers and Simple machines Simple machines - Effort and load, mechanical advantage, velocity ratio, efficiency of machine, relationship between efficiency, velocity ratio and mechanical advantage **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
In-plant training / Project work		

SYLLABUS FOR FITTER TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) with Indicative hrs.**	**Professional Knowledge (Trade Theory)**
Professional Skill 255Hrs; Professional Knowledge 70Hrs	Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality. *[Different Mating Surfaces – Dovetail fitting, Radius fitting, Combined fitting; Different surface finishing operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.]* (Mapped NOS: CSC/N0304)	115. Make 'H' fitting. (13 hrs.) 116. Power tools: Practice operation of power tool for fastening. (5 hrs.) 117. Tightening of bolt/ screw with specified torque. (2 hrs.) 118. Selection of right tool as for Tightening or loosening of screw/bolt as per accessibility. (1 hr.)	Screws: material, designation, specifications, Property classes (e.g. 9.8 on screw head), Tools for tightening/ loosening of screw or bolts, Torque wrench, screw joint calculation uses. Power tools: its constructional features, uses & maintenance. (06 hrs.)
		119. Assembly sliding for using keys, dowel pin and screw, ± 0.02 mm accuracy on plain surface and testing of sliding fitting job. (13 hrs.) 120. File & fit angular mating surface within an accuracy of ± 0.02 mm & 10 minutes angular fitting. (12 hrs.)	Locking device: Nuts- types (lock nut castle nut, slotted nuts, swam nut, grooved nut) Description and use. Various types of keys, allowable clearances & tapers, types, uses of key pullers. (06 hrs.)
		121. Drill through and blind holes at an angle using swivel table of drilling machine. (09 hrs.) 122. Precision drilling, reaming and tapping and Test-Job. (12 hrs.)	Special files: types (pillar, Dread naught, Barrow, warding) description & their uses. (07 hrs.)
		123. Make Dovetailed fitting and radius fitting. (18hrs.)	Templates and Radius/fillet gauge, feeler gauge, hole gauge, and their uses, care and maintenance. (05 hrs.)

		124. File and fit, combined fit with straight, angular surface with ± 0.02 mm accuracy and check adherence to specification and quality standards using equipment like Vernier-calipers, micrometresetc.(18 hrs.)	Slip gauge: Necessity of using, classification & accuracy, set of blocks (English and Metric). Details of slip gauge. Metric sets 46: 103: 112. Wringing and building up of slip gauge and care and maintenance. (06 hrs.)
		125. Drilling and reaming, small dia. holes to accuracy & correct location for fitting. (4 hrs.) 126. Perform drilling using 'V' block and a clamp. (1 hrs.) 127. Make male and female fitting parts, drill and ream holes not less than 12.7 mm. (18 hrs.)	Application of slip gauges for measuring, Sine Bar-Principle, application & specification. Procedure to check adherence to specification and quality standards. (05 hrs.)
		128. Make Sliding Diamond fitting. (22 hrs.) 129. Lap flat surfaces using lapping plate. (5 hrs.)	Lapping: Application of lapping, material for lapping tools, lapping abrasives, charging of lapping tool. Surface finish importance, equipment for testing-terms relation to surface finish. Equipment for tasting surfaces quality – dimensional tolerances of surface finish. (06 hrs.)
		130. Prepare Stepped keyed fitting and test job. (16 hrs.) 131. Lapping holes and cylindrical surfaces. (5 hrs.)	Honing: Application of honing, material for honing, tools shapes, grades, honing abrasives. Frosting- its aim and the methods of performance. (05 hrs.)

		132. Dovetail and Dowel pin assembly. (16 hrs.) 133. Scrape cylindrical bore. (5 hrs.)	Metallurgical and metal working processes such as Heat treatment, various heat treatment methods - normalizing, annealing, hardening and tempering, purpose of each method, tempering colour chart. (06 hrs.)
		134. Scrapping cylindrical bore and to make a fit-(12 hrs.) 135. Scrapping cylindrical taper bore and check taper angle with sine bar. (08 hrs.)	Annealing and normalizing, Case hardening and carburising and its methods, process of carburising (solid, liquid and gas). (07 hrs.)
		136. Make a cotter jib assembly. (20 hrs.)	Tapers on keys and cotters permissible by various standards. (06 hrs.)
		137. Hand reams and fit taper pin. (12 hrs.) 138. Drilling and reaming holes in correct location, fitting dowel pins, stud, and bolts. (08 hrs.)	The various coatings used to protect metals, protection coat by heat and electrical deposit treatments. Treatments to provide a pleasing finish such as chromium silver plating, nickel plating and galvanizing. (05hrs.)
Professional Skill 113Hrs; Professional Knowledge 30Hrs	Make different gauges by using standard tools & equipment and checks for specified accuracy. *[Different Gauges – Snap gauge, Gap gauge; Specified Accuracy - ±0.02mm]* (Mapped NOS:CSC/N0304)	139. Making a snap gauge for checking a dia. of 10 ± 0.02 mm. (20 hrs.)	Gauges and types of gauge commonly used in gauging finished product-Method of selective assembly 'Go' system of gauges, hole plug basis of standardization. (06 hrs.)
		140. Scrape external angular mating surface and check angle with sine bar. (15 hrs.) 141. Scrape on internal surface and check. (10 hrs.)	Bearing-Introduction, classification (Journal and Thrust), Description of each, ball bearing: Single row, double row, description of each, and advantages of double row. (06 hrs.)
		142. Practice in dovetail fitting assembly and dowel pins	Roller and needle bearings: Types of roller bearing.

		and cap screws assembly. (16 hrs.) 143. Industrial visit. (5 hrs.)	Description & use of each. Method of fitting ball and roller bearings (06 hrs.)
		144. Preparation of gap gauges. (12 hrs.) 145. Perform lapping of gauges (hand lapping only) (10 hrs.)	Bearing metals – types, composition and uses. Synthetic materials for bearing: The plastic laminate materials, their properties and uses in bearings such as phenolic, Teflon polyamide (nylon). (06hrs.)
		146. Preparation of drill gauges. (10 hrs.) 147. File and fit straight and angular surfaces internally. (13 hrs.) 148. Identify different ferrous metals by spark test (2 hrs.)	The importance of keeping the work free from rust and corrosion. (06 hrs.)
Professional Skill 62 Hrs.; Professional Knowledge 18Hrs	Apply a range of skills to execute pipe joints, dismantle and assemble valves & fittings with pipes and test for leakages.*[Range of skills – Cutting, Threading, Flaring, Bending and Joining]* (Mapped NOS:CSC/N0304)	149. Flaring of pipes and pipe joints. (02 hrs.) 150. Cutting & Threading of pipe length. (3 hrs.) 151. Fitting of pipes as per sketch observing conditions used for pipe work. (10 hrs.) 152. Bending of pipes- cold and hot. (06 hrs.)	Pipes and pipe fitting- commonly used pipes. Pipe schedule and standard sizes. Pipe bending methods. Use of bending fixture, pipe threads- Std. Pipe threads Die and Tap, pipe vices. (06 hrs.)
		153. Dismantling & assembling – globe valves, sluice valves, stop cocks, seat valves and non-return valve. (20 hrs.)	Use of tools such as pipe cutters, pipe wrenches, pipe dies, and tap, pipe bending machine etc. (06 hrs.)
		154. Fit & assemble pipes, valves and test for leakage & functionality of valves. (18 hrs.) 155. Visual inspection for visual defects e.g. dents, surface finish. (1 hr.) 156. Measuring, checking and	Standard pipefitting- Methods of fitting or replacing the above fitting, repairs and erection on rainwater drainage pipes and household taps and pipe work. Inspection & Quality control

		recording in control chart. (2 hrs.)	-Basic SPC -Visual Inspection. (06 hrs.)
Professional Skill 24 Hrs.; Professional Knowledge 06 Hrs.	Make drill jig & produce components on drill machine by using jigs and check for correctness. (Mapped NOS:CSC/N0304)	157. Make a simple drilling jig. (20 hrs.) 158. Use simple jigs and fixtures for drilling. (04 hrs.)	Drilling jig-constructional features, types and uses. Fixtures-Constructional features, types and uses. (06 hrs.)
Professional Skill 152Hrs. Professional Knowledge 43 Hrs.	Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. *[Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]* (Mapped NOS:CSC/N0304)	159. Marking out for angular outlines, filing and fitting the inserts into gaps. (06 hrs.) 160. Exercises on finished material such as aluminium/ brass/ copper / stainless steel, marking out, cutting to size, drilling, tapping etc. without damage to surface of finished articles. (09 hrs.)	Aluminum and its alloys. Uses, advantages and disadvantages, weight and strength as compared with steel. Non-ferrous metals such as brass, phosphor bronze, gunmetal, copper, aluminum etc. Their composition and purposes, where and why used, advantages for specific purposes, surface wearing properties of bronze and brass. (04 hrs.)
		161. Making an adjustable spanner: - Marking out as per Blueprint, drilling, cutting, straight and curve filing, threading, cutting slot and cutting internal threads with taps. (16 hrs.)	Power transmission elements. The object of belts, their sizes and specifications, materials of which the belts are made, selection of the type of belts with the consideration of weather, load and tension methods of joining leather belts. (04 hrs.)
		162. Dismantling and mounting of pulleys. (12 hrs.) 163. Making & replacing damaged keys. (12 hrs.) 164. Dismounting, repairing damaged gears and mounting and check for workability. (16 hrs.) 165. Repair & replacement of belts and check for workability. (12 hrs.)	Vee belts and their advantages and disadvantages, use of commercial belts, dressing and resin creep and slipping, calculation. Power transmissions-coupling types-flange coupling,-Hooks coupling-universal coupling and their different uses. Pulleys-types-solid, split and

			'V' belt pulleys, standard calculation for determining size crowning of faces-loose and fast pulleys-jockey pulley. Types of drives-open and cross belt drives. The geometrical explanation of the belt drivers at an angle. Clutch: Type, positive clutch (straight tooth type, angular tooth type). Chains, wire ropes and clutches for power transmission. Their types and brief description. (15 hrs.)
		166. Making of template/gauge to check involute profile. (17 hrs.)	Power transmission –by gears, most common form spur gear, set names of some essential parts of the set-The pitch circles, Diametral pitch, velocity ratio of a gear set. (05 hrs.)
		167. Repair of broken gear tooth by stud and repair broker gear teeth by dovetail. (17 hrs.)	Helical gear, herring bone gears, bevel gearing, spiral bevel gearing, hypoid gearing, pinion and rack, worm gearing, velocity ratio of worm gearing. Repair of gear teeth by building up and dovetail method. (05 hrs.)
		168. Make hexagonal slide fitting. (16 hrs.) 169. Prepare different types of documentation as per industrial need by different methods of recording information. (04 hrs.)	Method or fixing geared wheels for various purpose drives. General cause of the wear and tear of the toothed wheels and their remedies, method of fitting spiral gears, helical gears, bevel gears, worm and worm wheels in relation to required drive. Care and maintenance of gears. (05 hrs.)
		170. Marking out on the round sections for geometrical	Fluid power, Pneumatics, Hydraulics, and their

		shaped fittings such as spline with 3 or 4 teeth. Finishing and fitting to size, checking up the faces for universality. (15 hrs.)	comparison, Overview of a pneumatic system, Boyle's law. Overview of an industrial hydraulic system, Applications, Pascal's Law. (05 hrs.)
Professional Skill 21Hrs; Professional Knowledge 07Hrs	Identify, dismantle, replace and assemble different pneumatics and hydraulics components. *[Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]*	171. Identify pneumatic components – Compressor, pressure gauge, Filter-Regulator-Lubricator (FRL) unit, and Different types of valves and actuators. (2 hrs.) 172. Dismantle, replace, and assemble FRL unit. (5 hrs.) 173. Demonstrate knowledge of safety procedures in pneumatic systems and personal Protective Equipment (PPE). (2 hrs.) 174. Identify the parts of a pneumatic cylinder.(1 hrs.) 175. Dismantle and assemble a pneumatic cylinder.(6 hrs.) 176. Construct a circuit for the direction & speed control of a small-bore single-acting (s/a) pneumatic cylinder. (5 hrs.)	Compressed air generation and conditioning, Air compressors, Pressure regulation, Dryers, Air receiver, Conductors and fittings, FRL unit, Applications of pneumatics, Hazards & safety precautions in pneumatic systems. Pneumatic actuators:- Types, Basic operation, Force, Stroke length, Single-acting and double-acting cylinders. (07 hrs.)
Professional Skill 20Hrs; Professional Knowledge 07Hrs	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.	177. Construct a control circuit for the control of a d/a pneumatic cylinder with momentary input signals. (4 hrs.) 178. Construct a circuit for the direct & indirect control of a d/a pneumatic cylinder with a single & double solenoid valve. (08 hrs.)	Pneumatic valves:- Classification, Symbols of pneumatic components, 3/2-way valves (NO & NC types) (manually-actuated & pneumatically-actuated) & 5/2-way valves, Check valves, Flow control valves, One-way flow control valve Pneumatic valves: Roller

		179. Dismantling &assembling of solenoid valves. (08hrs.)	valve, Shuttle valve, Two-pressure valve Electro-pneumatics: Introduction, 3/2-way single solenoid valve, 5/2-way single solenoid valve, 5/2-way double solenoid valve, Control components - Pushbuttons (NO & NC type) and Electromagnetic relay unit, Logic controls. (07 hrs.)
Professional Skill 20Hrs; Professional Knowledge 07Hrs	Identify, dismantle, replace and assemble different pneumatics and hydraulics components. *[Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]*	180. Demonstrate knowledge of safety procedures in hydraulic systems (Demo by video) (04 hrs.) 181. Identify hydraulic components – Pumps, Reservoir, Fluids, Pressure relief valve (PRV), Filters, different types of valves, actuators, and hoses (04 hrs.) 182. Inspect fluid levels, service reservoirs, clean/replace filters (04 hrs.) 183. Inspect hose for twist, kinks, and minimum bend radius, Inspect hose/tube fittings (04 hrs.) 184. Identify internal parts of hydraulic cylinders, pumps/motors (04 hrs.)	- Symbols of hydraulic components, Hydraulic oils –function, properties, and types, Contamination in oils and its control - Hydraulic Filters – types, constructional features, and their typical installation locations, cavitation, Hazards & safety precautions in hydraulic systems - Hydraulic reservoir & accessories, Pumps, Classification – Gear/vane/ piston types, Pressure relief valves – Direct acting and pilot-operated types - Pipes, tubing, Hoses and fittings – Constructional details, Minimum bend radius, routing tips for hoses. (07 hrs.)
Professional Skill 18 Hrs.; Professional Knowledge 05Hrs	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.	185. Construct a circuit for the control of a s/a hydraulic cylinder using a 3/2-way valve (Weight loaded d/a cylinder may be used as a s/a cylinder), 4/2- & 4/3-way valves. (8 hrs.) 186. Maintenance, troubleshooting, and safety aspects of	- Hydraulic cylinders –Types - Hydraulic motors –Types - Hydraulic valves: Classification, Directional Control valves – 2/2- and 3/2-way valves - Hydraulic valves: 4/2- and 4/3-way valves, Centre positions of 4/3-way valves - Hydraulic valves: Check

		pneumatic and hydraulic systems (The practical for this component may demonstrated by video). (10 hrs.)	valves and Pilot-operated check valves, Load holding function - Flow control valves: Types, Speed control methods – meter-in and meter-out - Preventive maintenance & troubleshooting of pneumatic & hydraulic systems, System malfunctions due to contamination, leakage, friction, improper mountings, cavitation, and proper sampling of hydraulic oils. (05 hrs.)
Professional Skill 80Hrs; Professional Knowledge 23Hrs	Plan & perform basic day to day preventive maintenance, repairing and check functionality. *[Simple Machines – Drill Machine, Power Saw and Lathe]* (Mapped NOS:CSC/N0304)	187. Dismantle, overhauling & assemble cross-slide & hand-slide of lathe carriage. (20 hrs.)	Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards. (05 hrs.)
		188. Simple repair of machinery: - Making of packing gaskets. (04 hrs.) 189. Check washers, gasket, clutch, keys, jibs, cotter, Circlip, etc. and replace/repair if needed. (04 hrs.) 190. Use hollow punches, extractor, drifts, various types of hammers and spanners, etc. for repair work. (16 hrs.) 191. Dismantling, assembling of different types of bearing and check for functionality. (20 hrs.) 192. Perform routine check of machine and do replenish	Method of lubrication-gravity feed, force (pressure) feed, splash lubrication. Cutting lubricants and coolants: Soluble off soaps, suds-paraffin, soda water, common lubricating oils and their commercial names, selection of lubricants. Washers-Types and calculation of washer sizes. The making of joints and fitting packing. (18 hrs.)

		as per requirement. (15 hrs.)	
Professional Skill 75 Hrs; Professional Knowledge 16Hrs	Plan, erect simple machine and test machine tool accuracy. *[Simple Machines – Drill Machine, Power Saw and Lathe]*	193. Inspection of Machine tools such as alignment, levelling. (10 hrs.) 194. Accuracy testing of Machine tools such as geometrical parameters. (15 hrs.)	Lubrication and lubricants- purpose of using different types, description and uses of each type. Method of lubrication. A good lubricant, viscosity of the lubricant, Main property of lubricant. How a film of oil is formed in journal Bearings. (04 hrs.)
		195. Practicing, making various knots, correct loading of slings, correct and safe removal of parts. (5 hrs.) 196. Erect simple machines. (45 hrs.)	Foundation bolt: types (Lewis cotter bolt) description of each erection tools, pulley block, crowbar, spirit level, Plumb bob, wire rope, manila rope, wooden block. The use of lifting appliances, extractor presses and their use. Practical method of obtaining mechanical advantage. The slings and handling of heavy machinery, special precautions in the removal and replacement of heavy parts. (12 hrs.)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**<u>Engineering Drawing:</u>** • Reading of drawing of nuts, bolt, screw thread, different types oflocking devices e.g., Double nut, Castle nut, Pin, etc. • Reading of foundation drawing • Reading of Rivets and rivetted joints, welded joints • Reading of drawing of pipes and pipe joints Reading of Job Drawing, Sectional View & Assembly view	
WORKSHOP CALCULATION & SCIENCE: 28 Hrs.			
Professional Knowledge WCS- 28 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**<u>WORKSHOP CALCULATION & SCIENCE:</u>** **Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice	

		Centre of Gravity Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment** Heat treatment and advantages Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalising and case hardening **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing
In-plant training/ Project work		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

FITTER			
LIST OF TOOLS AND EQUIPMENT (For batch of 20candidates)			
S no.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-18 is required additionally)			
1.	Steel Rule with metric & British graduation	150 mm, Stainless steel	(20+1) Nos.
2.	Try Square.	150 mm blade	(20+1) Nos.
3.	Caliper inside spring type.	150 mm	(20+1) Nos.
4.	Caliper hermaphrodite spring type	150 mm	(20+1) Nos.
5.	Caliper outside spring type	150 mm	(20+1) Nos.
6.	Divider spring type	150 mm	(20+1) Nos.
7.	Scriber	150 mm	(20+1) Nos.
8.	Centre Punch	10 mm and Length - 120 mm	(20+1) Nos.
9.	Screw driver	150mm insulated flat type	(20+1) Nos.
10.	Chisel cold flat	20 mm X 150 mm High carbon steel	(20+1) Nos.
11.	Hammer ball peen with handle	450 grams (1 lb)	(20+1) Nos.
12.	Hammer ball peen with handle.	220 grams (1/2 lb)	(20+1) Nos.
13.	File flat - second cut	250 mm	(20+1) Nos.
14.	File flat smooth	250 mm.	(20+1) Nos.
15.	File half round second cut	150 mm.	(20+1) Nos.
16.	Hacksaw frame fixed type	300 mm	(20+1) Nos.
17.	Safety goggles.		(20+1) Nos.
18.	Dot punch	100 mm	(20+1) Nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT - For 2 (1+1) units no additional items are required			
INSTRUMENTS			
19.	Steel Rule Graduated both in Metric and English Unit	300 mm Stainless steel	4 nos.
20.	Straight edge steel	300 mm or above	2 nos.
21.	Spirit Level metal Type - 2	300 mm Basic Length Accuracy 0.1mm/Meter	1 no.
22.	Stud Extractor EZY - out	Set of 8	2 sets
23.	Combination Set	300 mm	2 nos.
24.	Micrometer outside.	0 - 25 mm	2 nos.
25.	Micrometer outside.	25 - 50 mm	2 nos.
26.	Micrometer outside.	50 - 75 mm	2 nos.

27.	Micrometer inside with extension rods.	Accuracy 0.01 mm with extension rods up to 150 mm	1 no.
28.	Vernier caliper	150 mm	4 nos.
29.	Vernier height gauges	0 - 300 mm with least count = 0.02 mm	1 no.
30.	Vernier bevel protractor Blade with Acute Angle Attachment	300 mm	1 no.
31.	Screw pitch gauge Metric	0.25 to 6 mm	1 no.
32.	Wire gauge, metric standard.		1 no.
GENERAL SHOP OUTFIT			
33.	Surface plate C.I/Granite with Stand and Cover	600 x 600 mm	1 no.
34.	Marking table (Mild steel)	900X900X900 mm	1 no.
35.	Universal scribing block.	220 mm	2 nos.
36.	V-Block pair with clamps	150 x 100 x 100 mm	2 nos.
37.	Angle plate	150 X 150 X 250 mm	2 nos.
38.	Punch letter set.	3 mm	1 no.
39.	Punch number set.	3 mm	1 no.
40.	Portable hand drill (Electric)	0 to 13 mm Capacity	1 no.
41.	Drill twist straight shank	3 mm to 12 mm by 0.5 mm H.S.S.	2 sets
42.	Drill twist Taper shank	8 mm to 20 mm by 0.5 mm H.S.S.	2 sets
43.	Taps and dies complete set in box.	Whitworth	1 no.
44.	Taps and dies complete set	5, 6, 8, 10 & 12mm set of 5	2 Sets
45.	File knife edge smooth	150 mm	4 nos.
46.	File feather edge smooth	150 mm	4 nos.
47.	File triangular smooth	200 mm	10 nos.
48.	File round second cut	200 mm	10 nos.
49.	File square second cut	250 mm	10 nos.
50.	Feeler gauge	Gauge Feeler / Thickness - 0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm - 13 leaves	1 set
51.	File triangular second cut.	200 mm	10 nos.
52.	File flat second cut safe edge.	300 mm	10 nos.
53.	File flat bastard	200 mm	10 nos.
54.	File flat bastard.	300 mm	10 nos.
55.	File Swiss type needle	Set of 12, Length = 150 mm	2 sets
56.	File half round second cut.	250 mm	10 nos.
57.	File half round bastard.	250 mm	10 nos.

58.	File round bastard.	250 mm	10 nos.
59.	File hand second cut.	150 mm	10 nos.
60.	File card./Wire Brush	3"x5" size, brass or steel wire	10 nos.
61.	Oil Can	250 ml	2 nos.
62.	Pliers combination insulated	150 mm	2 nos.
63.	Wooden handle forged Soldering Iron copper bit.	230V, 250 W, 350 gm	2 nos.
64.	Blow Lamp	0.5 litre	2 nos.
65.	Spanner- Double Ended	6x7, 8x9, 10x11, 12x13, 14x15, 16x17, 18x19, 20x22	1 set each
66.	Spanner adjustable	150 mm	2 nos.
67.	Interchangeable ratchet socket set	12 mm driver, sized10-32 mm set of 18 socket & attachments.	1 set
68.	Double Ended tubular Box spanner set with Tommy bar.	A/F 6-25 mm set of 10 Tommy Bar Dia. 6, 8, 10, 12, 14, 16	1 set
69.	Glass magnifying	75 mm	2 nos.
70.	Clamp toolmaker	5 cm and 7.5 cm set of 2.	2 nos.
71.	Clamp "C"	100 mm	2 nos.
72.	Clamp "C"	200 mm	2 nos.
73.	Hand Reamer set (Taper pin straight flute)	Nominal Dia. 6, 8, 10, 12, 16mm	1 set
74.	Machine Reamer parallel (Helical flute)	12 - 16mm set of 5.	1 no.
75.	Scraper flat	150 mm	10 nos.
76.	Scraper triangular	150 mm	10 nos.
77.	Scraper half round	150 mm	10 nos.
78.	Chisel cold crosscut& diamond point.	9 mm X 150 mm	10 each
79.	Chisel cold flat	9 mm X 100 mm	10 nos.
80.	Chisel cold round nose	9 mm X 100 mm	10 nos.
81.	Drill chuck with key	12 mm.	1 no.
82.	Pipe wrench	400 mm	1 no.
83.	Pipe vice	100 mm	1 no.
84.	Adjustable pipe die set BSP	cover pipe size 1" or 3/4"	1 Set
85.	Wheel dresser (One for 4 units) Star/Dresser with Holder	Length 150 mm, diamond point	1 no.
86.	Machine vice - Swivel Base	100 mm	1 no.
87.	Machine vice - Swivel Base	125 mm	1 no.
88.	Sleeve drill Morse	No. 0 - 1, 1 - 2, 2 - 3, 3 - 4, 4 - 5	1 Set

89.	Vice bench	150 mm	20 nos.
90.	Bench working.	2400 x 1200 x 900 mm	4 nos.
91.	Almirah.	1800 x 900 x 450 mm	2 nos.
92.	Lockers with 8 drawers (standard size).	One locker for each trainee	3 nos.
93.	Metal rack	1820 x 1820 x 450 cm	1 no.
94.	Instructor Table		
95.	Instructor Chair		
96.	Black board with easel.		
97.	Fire extinguisher (For 4 Units)	CO2 type, 3 kg capacity	
98.	Fire buckets.		
99.	Machine vice.	100mm	2 nos.
100.	Wing compass.	254 mm or 300 mm	2 nos.
101.	Hand hammer with handle.	1000 gm	1 nos.
102.	Torque wrench (Standard/Ratchet type)	14 to 68 Nm	1 no.
103.	Power tools for fastening	Capacity 10-18mm	1 No.
104.	Different Profile gauges (Plate type) - For demonstration	Metric standard	4 nos.
105.	Knurling tool (Diamond, straight & Diagonal)		1 each
106.	Indexable boring bar with inserts	1" shank	4 nos.
107.	Machine maintenance manual for Lathe, Pedestal grinder, Drill machine, Power saw		1
108.	Temperature gauge	Range 0 - 150°C	1 each
109.	Dowel pin (straight)	Dia. -1” Length -4" (Mat: Stainless Steel)	1 each
110.	Standard Tap screws	M3, M4, M5, M6, M8, M10, M12, M14, M16	1 each
111.	Lapping plate	Dia. -6"	2 each
112.	Medium carbon Heat treated alloy steel Metric Studs and bolts along with nuts (for display) of standard length (May be manufactured in-house)	M6, M8, M10, M12, M14, M16 (Standard)	2 each
113.	Caps screws	M6, M8, M10, M12	2 each
114.	Drill gauges	Letter drill gauge (A to Z), Number drill gauge (1 to 60), Metric drill gauge (1.5mm to 12.5mm, 30 holes)	2 nos.
115.	Cast Iron Globe Valve (Flanged type)	150NB, Class# 150 Flange: ANSI125-B16.1	2 nos.
116.	C.I. Sluice / Gate valve (flanged type)	150NB, Class# 150 Flange:	2 nos.

		ANSI125-B16.1	
117.	Stop cock	25NB (2-way, Threaded end)	2 nos.
118.	M.S. Pipe	150NB, Sch.40, ERW, IS:1239	as required
119.	G.I. Pipe	25mm, Sch.40, ERW	as required
120.	Slip-on Forged steel Flange	150NB, ANSI-B16.5, Class#150	4 nos.
121.	Bolt & Nut with washer (May be manufactured in-house)	M20x2.5x90Long (part thread - Hex. Head)	20 nos.
122.	Pipe threading die with handle	Ratchet type Die head of 1/2”, 3/4" and 1"	2 nos.
123.	Jigs & Fixture (sample)-For demonstration (May be manufactured in-house)		1 no.
124.	Pulleys (for V-belt or Flat belt)	to fit on 50mm dia. Shaft with key slot	1 no.
125.	Steel keys (May be manufactured in-house)	to fit with key slot of shaft & pulley	2 nos.
126.	Damaged old spur gear	to fit 50mm dia. Shaft	2 nos.
127.	V-belt and Flat belt	to fit on pulley	1 each
128.	Packing gasket	PTFE gasket roll small size	1 no.
129.	Washer, clutch, keys, jib, cotter &circlip	minimum 25mm size, carbon steel material	2 each
130.	Hollow punch	Straight Shank Hollow Punch Sets 5-12mm	1 set
131.	Drill Drift (May be manufactured in-house)	200mm hardened and black finish	2 nos.
132.	Bearing different types	each type of diameter 25mm (min.)	1 each
133.	Lifting sling	8mm Nominal Dia. Single leg sling	2 nos.
134.	Bearing extractor	Universal gear puller 2 or 3 jaws adjustable	1 no.
135.	Pulley extractor	- do -	1 no.
C. TOOLS FOR ALLIED TRADE - SHEET METAL WORKER (Note: - Those additional items are to be provided for the Allied Trade Training where the Sheet Metal trade does not exist.)			
136.	Trammel	300 mm	1 no.
137.	Pocker		2 nos.
138.	Prick punch	100 mm	2 nos.
139.	Mallet.	Dia. 100 mm X 150 mm	2 nos.
140.	Aviation Snips straight Cut	300 mm	2 nos.
141.	Flat headed hammers with handle.		2 nos.

142.	Planishing hammer.		2 nos.
143.	Snip bent Left Cut	250 mm	2 nos.
144.	Stake hatchet with Leg.	300 X 200 X 20 mm	2 nos.
145.	Stake grooving.	100 X 100 X 300 mm	2 nos.
D. MODIFIED LIST OF TOOLS FOR THE 2ND YEAR FOR FITTER TRADE			
INSTRUMENT			
146.	Slip Gauge as Johnson metric set.	87 Pieces Set	1 Set
147.	Gauge snap Go and Not Go	25 to 50 mm by 5 mm, Set of 6 pieces	1 Set
148.	Gauge plug	Single ended 5 to 55 by 5 mm. Set of 11 pcs.	1 Set
149.	Gauge telescopic set.	8 - 150 mm	1 no.
150.	Dial test indicator on stand	0.01 mm least count	1 no.
151.	Sine bar	125 mm	1 no.
152.	Dial Vernier caliper. (Universal type)	0 - 300 mm, LC 0.05 mm	1 no.
153.	Screw thread micrometer with interchangeable. Pitch anvils for checking metric threads 60.	0 - 25 mm LC 0.01 mm	1 no.
154.	Depth micrometer. 0-25 mm	Accuracy 0.01 mm with standard set of extension rods up to 200 mm	1 no.
155.	Digital vernier caliper.	0 - 150 mm with least count 0.02mm	1 no.
156.	Digital Micrometer outside.	0 - 25 mm L.C. 0.001 mm.	1 no.
157.	Comparators Gauge - Dial Indication with Stand and Bracket.	LC 0.01mm	1 no.
158.	Engineer's try square (knife-edge)	150 mm Blade	1 no.
159.	Surface roughness comparison plates	N1 - N12 Grade	1 Set
160.	Digital Vernier caliper	0 - 200 mm L.C. 0.01 mm (Optional)	1no.
161.	Vernier Bevel protector	Range 360deg, LC. : 5min(150mm blade)	1no.
GENERAL SHOP OUTFIT			
162.	Carbide Wear Block.	1 mm - 2 mm	2 each
163.	Lathe tools H.S.S. tipped set.		2 nos.
164.	Lathe tools bit.	6 mm x 75 mm HSS/Carbide	2 nos.
165.	Lathe tools bit.	8 mm x 75 mm HSS/Carbide	2 nos.
166.	Lathe tools bit.	10 mm x 75 mm HSS/Carbide	2 nos.
167.	Arm strong type tool bit holder.	Right hand	2 nos.
168.	Arm strong type tool bit holder.	Left hand	2 nos.

169.	Arm strong type tool bit holder.	Straight	2 nos.
170.	Stilson wrenches/pipe wrerch	250 mm	2 nos.
171.	Pipe cutter wheel type.	6 mm to 25 mm	1 no.
172.	Pipe bender machine spool type with stand manually operated.	up to 25 mm cold bending	1 no.
173.	Adjustable pipe chain tonge to take pipes	up to 300 mm	1 no.
174.	Adjustable spanner.	380 mm long	1 no.
E. GENERAL MACHINERY INSTALLATION			
175.	SS and SC centre lathe (all geared) with minimum specification	Centre height 150 mm and centre distance 1000 mm along with 3 & 4 jaw chucks, auto feed system, safety guard, taper turning attachment, motorized coolant system, lighting arrangement & standard accessories.	2 Nos.
176.	Pillar Type Drilling machine	Sensitive 0-20 mm cap. with swivel table motorized with chuck & key.	1 no.
177.	Drilling machine bench	Sensitive 0-12 mm cap motorized with chuck and key.	2 nos.
178.	D.E. pedestal Grinding machine with wheels rough and smooth	2 H.P.-3Phase-415V, 1500 rpm,250 dia. wheel	1 no.
F. LIST OF ADDITIONAL TOOLS FOR ALLIED TRADE IN WELDING (Note: - Those additional items are to be provided for the Allied Trade Training where the Welder trade does not exist.)			
179.	Transformer welding set - continuous welding current, with all accessories and electrode holder 60% Duty Cycle with Standard Accessories	300 A, OCV 60 - 100 V,	1 Set
180.	Welder cable	Able to carry 300 amps. With flexible rubber cover	20 Meter
181.	Lugs for cable		12 Nos.
182.	Earth clamps.		2 Nos.
183.	Arc welding table (all metal top) with positioner.	1200 X 1200 X 750 mm	1 No.
184.	Oxy - acetylene gas welding set equipment with hoses, Oxygen & Acetylene cylinders, regulator and other accessories.		1 Set.

185.	Gas welding table with positioner with Fire Bricks	900 X 600 X 750 mm	1 No
186.	Welding torch tips of different sizes for Oxy - acetylene gas welding	To fit nozzle no. 1, 2, & 3	1 Set
187.	Gas lighter.		2 Nos.
188.	Trolley for gas cylinders.		1 No
189.	Chipping hammer.		2 Nos.
190.	Gloves (Leather)		2 Pairs
191.	Leather apron.		2 Nos.
192.	Spindle key for cylinder valve.		2 Nos.
193.	Welding torches.	Nozzles no. 1, 2, & 3	1 Set.
194.	Welding goggles		4 Pairs.
195.	Welding helmet with coloured flame retardant glass		2 Nos.
196.	Tip cleaner		5 Sets.
#G. LIST OF TOOLS & ACCESSORIES FOR PNEUMATICS AND HYDRAULICS			
197.	Compressor unit	suitable for Pressure: 8 bar, Delivery: 50 lpm (or more), Reservoir capacity: 24 Litres (or more), 230V, 50 Hz, with pressure regulator and water separator	1 No.
198.	Pneumatic Trainer Kit, each consisting of the following matching components and accessories:		01 sets
	I. Single acting cylinder	Max. stroke length 50 mm, Bore dia. 20 mm	1 No
	II. Double acting cylinder	Max. stroke length 100 mm, Bore dia 20 mm, magnetic type	1 No
	III. 3/2-way valve	manually-actuated, Normally Closed	2 Nos.
	IV. 3/2-way valve	pneumatically-actuated, spring return	1 No
	V. One-way flow control valve		2 Nos.
	VI. 5/2-way valve	with manually-operated switch	1 No
	VII. 5/2-way valve	pneumatically-actuated, spring return	1 No
	VIII. 5/2-way pneumatic actuated valve	double pilot	1 No
	IX. 3/2-way roller lever valve	direct actuation Normally	2 Nos.

			Closed	
	X.	Shuttle valve (OR)		1 No
	XI.	Two-pressure valve (AND)		1 No
	XII.	Pressure gauge	0-16 bar	1 Nos.
	XIII.	Manifold with self-closing	NRV, 6-way	1 No
	XIV.	Pushbutton station for electrical signal input	with 3 illuminated momentary-contact switches (1 NO + 1 NC) and 1 illuminated maintained-contact switch (1 NO + 1 NC), Contact load 2A	1 No
	XV.	Relay station	with 3 relays each with 4 contact sets (3NO+1NC or Change-over type), 5 A	1 No
	XVI.	3/2-way single solenoid valve	with LED	1 No
	XVII.	5/2-way single solenoid valve	with manual override and LED	1 No
	XVIII.	5/2-way double solenoid valve	with manual override and LED	1 No
	XIX.	Power supply unit,	Input voltage 85 – 265 V AC, Output voltage: 24 V DC, Output current: max. 4.5 A, short-circuit-proof.	1 No
	XX.	Profile plate, Anodised Aluminium	1100x700 mm, with carriers, mounting frames and mounting accessories (To be fitted onto the pneumatic workstation)	1 set
199.	Pneumatic Workstation with 40 square mm aluminium profile legs, wooden work surface, and one pedestal drawer unit having 5 drawers, each with handles and individual locks, on metallic full panel drawer slide:		(1) Worktable – Size (Approx.) L1200mmXW900mmXH900 mm, with four castor wheels including two lockable wheels at the front side, (2) Drawer – Size (Approx.) – L460mmxW495mm xH158mm each, and overall size of Drawer unit (Approx.) - L470mmxW495mmxH825mm and (3) Drawer slide height (Approx.) 85mm.	1 No

200.	Carrier for mounting components, such as PB & relay boxes.		1 No
201.	Cut section model for pneumatic components		1 set
202.	Hydraulic Trainer Kit, each consisting of the following matching components and accessories:		01 set
	I. Hydraulic Power pack	with (1) external gear pump having a delivery rate of 2.5 lpm, (approx.) @ 1400 rpm operating pressure 60 bar, coupled to a single-phase AC motor (230 V AC) having start capacitor and ON/OFF switch and overload protection, (2) pressure relief valve adjustable from 0 – 60 bar, (3) oil reservoir, ≥5 litres capacity having sight glass, drain screw, air filter, and P and T ports.	1 No.
	II. Pressure relief valve	pilot-operated	1 No
	III. Drip tray, steel	size 1160 mm x 760 mm.	1 No.
	IV. Pressure Gauge	Glycerin-damped, Indication range of: 0 – 100 bars	1 No.
	V. Four-Way distributor	with five ports, equipped with a pressure gauge	1 No.
	VI. Double acting hydraulic cylinder	with a control cam, Piston diameter16 mm, Piston rod diameter10 mm, Stroke length 200 mm.	1 No.
	VII. Suitable Weight	for vertical loading of hydraulic cylinder	1 No.
	VIII. Mounting kit for weight	for realizing pulling and pushing load.	1 No.
	IX. 3/2-way directional control valve	with hand lever actuation.	1 No.
	X. 4/2-way directional control valve	with hand lever actuation.	1 No.
	XI. 4/3-way directional control valve	closed-centre position, with hand lever actuation.	1 No.
	XII. Non-return valve.		1 No.
	XIII. Pilot-operated check valve	Pilotto open.	1 No.
	XIV. One-way flow control valve	Withintegrated check valve.	1 No.
	XV. T-Connector with self-sealing		2 Nos.

	coupling nipples (2 Nos.) and quick coupling socket (1 No.).		
	XVI. Profile plate,	Anodised Aluminium, 1100x700 mm, with carriers, mounting frames and mounting accessories (To be fitted onto the Hydraulic workstation)	1 set
203.	Hydraulic Workstation with 40 square mm aluminium profile legs, wooden work surface, and one pedestal drawer unit having 5 drawers, each with handles and individual locks, on metallic full panel drawer slide:	(1) Worktable – Size (Approx.) L1200mmXW900mmXH900 mm, with four castor wheels including two lockable wheels at the front side, (2) Drawer – Size (Approx.) – L460mmxW495mm xH158mm each, and overall size of Drawer unit (Approx.) L470mmxW495mmxH825mm and (3) Drawer slide height (Approx.) 85mm.	1 No
204.	Cut-section models for hydraulic components		1 set

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*
2. *For items under #G (List of Tools & Accessories for Pneumatics and Hydraulics), may be installed in the existing workshop for units up to 8 (4+4). For units beyond 8(4+4), separate room (having area: 20 sq. m) for installation of these items is essential.*
3. *Internet facility is desired to be provided in the classroom.*
4. ***All the electrical items should be purchased with "Star rating" as available in market. So that the power consumption may be reduced.***

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

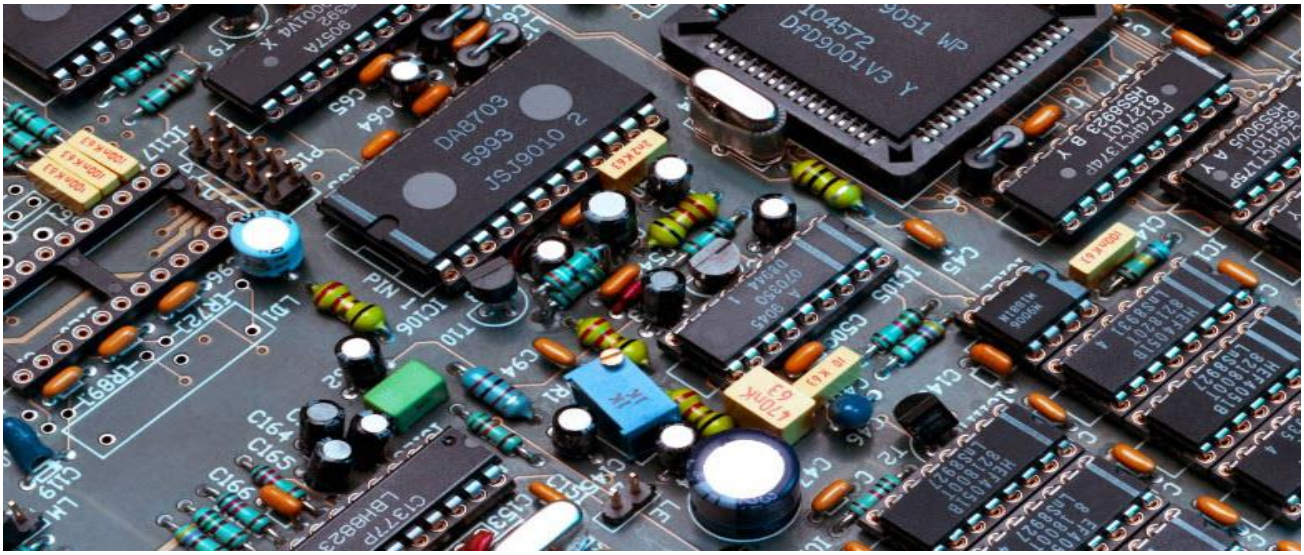
COMPETENCY BASED CURRICULUM

ELECTRONICS MECHANIC

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



Sector –Electronics & Hardware

Directorate General of Training

ELECTRONICS MECHANIC

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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CONTENTS

1. COURSE INFORMATION

During the two-year duration of Electronics Mechanic trade a candidate is trained on professional skill, professional knowledge and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered professional skill, subjects are as below:-

FIRST YEAR: In this year trainees will learn about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. Theygets the idea of trade tools & its standardization, Familiarize with basics of electricity. They will measure the various parameters by DSO and execute the result with standard one. Skilling practice on different types & combination of cells for operation and maintenance of batteries being done. They can Identify and test passive and active electronic components. Trainees will also construct and test unregulated and regulated power supplies. Trainees will practice soldering and de-soldering of various types of electrical and electronic components on through hole PCBs. The candidates will be able to construct and test amplifier, oscillator and wave shaping circuits, testing of power electronic components. They can be able to construct and test power control circuits, Identify and test opto electronic devices. They will able to achieve the skill on SMD Soldering and De-soldering of discrete SMD components. Trainees will verify the truth tables of various digital ICs by referring Data book also they practice circuit simulation software to simulate and test various circuits. In the end of first year the trainees will construct and test various circuits using linear ICs 741 & 555.

SECOND YEAR: In this year the trainees will be able to Identify, prepare, terminate and test various types of electronic cables used in various electronic systems. They assemble a computer system, install OS, Practice with MS office, use the internet, browse, create mail IDs, download desired data from internet using search engines. Gaining the skill by practicing SMD Soldering and De-soldering of various types of IC Packages. Able to identify the defects and do rework of PCB. They construct and test simple electrical control circuits and various electrical protective devices. The trainees will assemble and test a commercial AM/ FM receiver. They will identify various functional blocks and I/O Ports of a 8051 microcontroller system, Familiarize with the instruction set of 8051 micro controller, interface a model application with the Microcontroller kit and run the application. The trainee will identify and test various types of sensors used in electronic industries and construct and test circuits using various sensors system. They can construct and test analog and digital IC based application circuits as a part of project work. The trainees will work with DPM Modules to measure various electrical parameter, also interface the LCD modules to display a word. They will also skilled with various modulation techniques to acquaint with fibre optic communication techniques by using trainer kit. Identify various Input and output sockets/connectors of the given SMPS and UPS. Install and troubleshoot the given solar panel system. Dismantle and assemble various types of cell / smart phones and trouble shoot the cell/smart phone. Dismantle and assemble the given LED light stack. Design a LED light for the given ratings. Assemble decorative lighting system (serial lights) using LED strips. Dismantle, assemble, trouble shoot and rectify LED and LCD TV sets.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for propagating vocational training.

Electronics Mechanic trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Employability Skills) impart requisite core skill & knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates need broadly to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and repair & maintenance work.
- Check the job with circuit diagrams/components as per drawing for functioning, diagnose and rectify faults in the electronics components/module.
- Document the technical parameters in tabulation sheet related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	1200	1200

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal)during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India trade Test for awarding NTC will be conducted by **Controller of examinations**, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitive to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices,	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment

has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Electronics Fitter, General; fits, assembles and repairs various kinds of electronic equipment in factory or workshop or at place of use. Examines drawings and wiring diagrams; checks parts for accuracy of fit and minor adjustments; assembles parts or mounts them on chassis or panels with aid of hand tools; installs and connects wiring, soldering joints equipment, diagnoses faults with aid of electronic testing equipment; dismantles equipment if required and replaces faulty parts or wiring.

Electronics Fitter, other; include all other workers engaged in fitting, assembling, repairing and maintaining electronic equipment, machinery, appliances, etc., not elsewhere classified.

Electronics Mechanic; Electronic Equipment Mechanic repairs electronic equipment, such as computers, industrial controls, transmitters, and telemetering control systems following blueprints and manufacturer's specifications and using hand tools and test instruments. Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using instruments, such as oscilloscopes, signal generators, ammeters and voltmeters. Replaces defective components and wiring and adjusts mechanical parts, using hand tools and soldering iron. Aligns, adjusts and calibrates testing instruments. Maintains records of repairs, calibrations and test.

Radio Technician (Radio Manufacturing); tests assembled radio sets with testing equipment to ensure that assembly soldering, frequency, performance, etc. are in accordance with prescribed standards. Places assembled radio set in position and visually examines it to ensure that position of components, connections, soldering, wiring, etc. are in order. Switches on and operates different knobs to check calibration, audibility and general performance of set by varying its tone and listening to various stations and frequencies. Tightens loose nuts and screws, locates faults, replaces defective components and conducts necessary changes. Approves correctly assembled sets for further processing and rejects defective ones for rectification. May tests sets at different stages of assembly. May service, repair and overhaul radio sets.

Solar Panel Installation Technician; is also known as 'Panel Installer', the Solar Panel Installation Technician is responsible for installing solar panels at the customers' premises. The individual at work checks the installation site, understands the layout requirement as per design, assesses precautionary measures to be taken, installs the solar panel as per customer's requirement and ensures effective functioning of the system post installation.

Optical fibre technician; is responsible for maintaining uptime and quality of the network segment (both optical media and equipment) assigned to him by undertaking periodic preventive maintenance activities and ensuring effective fault management in case of fault occurrence. He is also required to

coordinate activities for installation and commissioning of Optical Fibre Cable (OF) as per the route plan.

Field Technician: UPS and Inverter; is also called, 'UPS repair Technician', this is an after sales service job for installing and providing support to customers of different types of UPS and inverters. The individual at work installs the newly purchased UPS or inverter. The individual also and interacts with customers to diagnose problems in them, assesses possible causes, rectifies faults or replaces faulty modules or recommends factory repairs for bigger faults as per the route plan. Installation, service, repair and overhaul radio sets service centre. May install television sets.

Television Installation Man; installs and adjusts television receivers and antennas, using hand tools. Selects antenna according to type of set and location of transmitting station. Bolts cross arms and dipole elements in position to assemble antenna. Secures antenna in place with bracket and guy wires, observing insurance codes and local ordinances to protect installation from lighting and other hazards. Drills and waterproofs holes in building to make passage for transmission line. Connects line between receiver and antenna and fastens it in place. Tunes receiver on all channels and adjusts screws to obtain desired density, linearity, focus and size of picture. Orients antenna and installs reflector to obtain strongest possible reception.

Cable Television Installer; installs cable television cables and equipment on customer's premises, using electrician's tools and test equipment: Measures television signal strength at utility pole, using electronic test equipment. Computes impedance of wire from pole to house to determine additional resistance needed for reducing signal to desired level. Installs terminal boxes and strings lead-in wires, using electrician's tools. Connects television set to cable system and evaluates incoming signal. Adjusts and repairs cable system to ensure optimum reception. May collect installation fees and explain cable service operation to subscriber. May clean and maintain tools, test equipment.

Television Service and Repairman; repairs and adjusts radios and television receivers, using hand tools and electronic testing instruments. Tunes receiver on all channels and observes audio and video characteristics to locate source of trouble. Adjusts controls to obtain desired density, linearity, focus and size of picture. Examines chassis for defects. Tests voltages and resistance of circuits to isolate defect following schematic diagram and using voltmeter, oscilloscope, signal generator and other electronic testing instruments. Tests and changes tubes, solders loose connections and repairs or replaces defective parts, using hand tools and soldering iron. Repair radios and other audio equipment.

Television Repair Technician; job role is applicable to both Television manufacturing facilities as well as electronics service centers. This role pertains to rectify faults identified during testing of TV on in manufacturing process and providing after sales assistance and ensuring appropriate functioning of

television sets. A TV repair technician identifies the section in the TV that is not functioning. If the problem identified is in the Printed Circuit Board (PCB), the technician identifies the specific fault in the PCB and corrects it. Replaces the dysfunctional PCB with a new one, if the damage identified requires fixing at the service centre.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Reference NCO-2015:

a) 7421.0100 - Electronics Fitter, General
b) 7421.0300 - Electronics Mechanic
c) 7422.1100 - Television Installation Man
d) 7422.1200 - Cable Television Installer
e) 7422.1300 - Television Service and Repairman
f) 7422.1302 - Television Repair Technician
g) 7422.1400 - Radio Technician (Radio Manufacturing)
h) 7421.1401 - Solar Panel Installation Technician
i) 7422.0801 -Optical fibre technician
j) 7421.0801 - Field Technician: UPS and Inverter

Reference NOS:

a) ELE/N1002
b) ELE/N7001
c) ELE/N7812
d) ELE/N5804
e) ELE/N1201
f) ELE/N6102
g) ELE/N6307
h) ELE/N4614
i) ELE/N5102
j) ELE/N9802
k) ELE/N7202
l) ELE/N5902
m) ELE/N8107
n) ELE/N9302
o) ELE/N3102
p) ELE/N9401
q) ELE/N9402
r) ELE/N9403
s) ELE/N9404
t) ELE/N9405
u) ELE/N9406

v) ELE/N9407
w) ELE/N9408
x) ELE/N9409
y) CSC/N9401
z) CSC/N9402

4. GENERAL INFORMATION

Name of the Trade	**ELECTRONICSMECHANIC**
Trade Code	DGT/1005
NCO - 2015	7421.0100, 7421.0300, 7422.1100, 7422.1200. 7422.1300, 7422.1302, 7422.1400, 7421.1401, 7422.0801, 7421.0801
NOS Covered	ELE/N1002, ELE/N7001, ELE/N7812, ELE/N5804, ELE/N1201, ELE/N6102, ELE/N6307, ELE/N4614, ELE/N5102, ELE/N9802, ELE/N7202, ELE/N5902, ELE/N8107, ELE/N9302, ELE/N3102, ELE/N9401, ELE/N9402 ELE/N9403 ELE/N9404, ELE/N9405, ELE/N9406, ELE/N9407, ELE/N9408, ELE/N9409,CSC/N9401, CSC/N9402
NSQF Level	Level-4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM, SLD
Unit Strength (No. Of Student)	24(There is no separate provision of supernumerary seats)
Space Norms	56 Sq. m
Power Norms	3.04 KW
Instructors Qualification for	
1. Electronics Mechanic Trade	B.Voc/Degree in Electrical/ Electrical and Electronics Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Electrical/ Electrical and Electronics Engineering from AICTE /recognized board of technical education or relevant

	Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field **OR** NTC/NAC passed in the Trade of "Electronics Mechanic" With three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. **NOTE: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However both of them must possess NCIC in any of its variants.**
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.

4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum age for Instructor	21 years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

FIRST YEAR:

1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care & safety following safety precautions. (NOS: ELE/N1002)
2. Select and perform electrical/ electronic measurement of single range meters and calibrate the instrument. ELE/N9401
3. Test &service different batteries used in electronic applications and record the data to estimate repair cost. (NOS: ELE/N7001)
4. Measure AC/DC using proper measuring instruments and compare the data using standard parameter. ELE/N9402
5. Measure the various parameters by DSO and execute the result with standard one. ELE/N9403
6. Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits. (NOS: ELE/N7812)
7. Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS: ELE/N5804)
8. Assemble simple electronic power supply circuit and test for functioning. (NOS: ELE/N5804)
9. Construct, test and verify the input/ output characteristics of various analog circuits. ELE/N9404
10. Plan and construct different power electronic circuits and analyse the circuit functioning. ELE/N1201
11. Select the appropriate opto electronics components and verify the characteristics in different circuit. ELE/N6102

12. Assemble, test and troubleshoot various digital circuits. (NOS: ELE/N1201)
13. Simulate and analyze the analog and digital circuits using Electronic simulator software. (NOS: ELE/N6102)
14. Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits. ELE/N9405
15. Read and apply engineering drawing for different application in the field of work. CSC/N9401
16. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402

SECOND YEAR:

17. Prepare, crimp, terminate and test various cables used in different electronics industries. (NOS: ELE/N6307)
18. Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application. (NOS: ELE/N4614)
19. Identify, place, solder and desolder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup. (NOS: ELE/N5102)
20. Rework on PCB after identifying defects from SMD soldering and de-soldering. (NOS: ELE/N5102)
21. Construct different electrical control circuits and test for their proper functioning with due care and safety. ELE/N9407
22. Assemble and test a commercial AM/ FM receiver and evaluate performance. ELE/N9408
23. Test, service and troubleshoot the various components of different domestic/ industrial programmable systems. ELE/N9802
24. Execute the operation of different sensors, identify, wire & test various transducers of IoT Applications. ELE/N9409
25. Identify different IoT Applications with IoT architecture. ELE/N3102
26. Plan and carry out the selection of a project, assemble the project and evaluate performance for a domestic/commercial application. (NOS: ELE/N9802)
27. Prepare fibre optic setup and execute transmission and reception. ELE/N5902
28. Plan and Interface the LCD, LED DPM panels to various circuits and evaluate performance. ELE/N8107
29. Detect the faults and troubleshoot SMPS, UPS and inverter. (NOS: ELE/N7202)

30. Identify, Test and verify characteristics of Photovoltaic cells, Modules, Batteries and Charge controllers. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter. (NOS: ELE/N5902)
31. Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot. (NOS: ELE/N8107)
32. Check the various parts of a LED lights & stacks and troubleshoot. (NOS: ELE/N9302)
33. Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote. (NOS: ELE/N3102)
34. Read and apply engineering drawing for different application in the field of work. CSC/N9401
35. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care &safety following safety precautions. (NOS: ELE/N1002)	Identify basic hand tools for fitting, riveting, drilling etc. with due care and safety.
	Fix surface mounting type of accessories in a panel board.
	Connect electrical accessories.
	Make and Wire up of a test board and test it.
2. Select and perform electrical/ electronic measurement of single range meters and calibrate the instrument. ELE/N9401	Plan work in compliance with standard safety norms.
	Identify the type of electronic instruments.
	Determine the measurement errors while measuring resistance by voltage drop method.
	Extend the range of MC voltmeter and ammeter.
	Measure the value of resistance, voltage and current using digital multimeter.
	Calibrate analog multimeter.
3. Test & service different batteries used in electronic applications and record the data to estimate repair cost. (NOS:ELE/N7001)	Identify Tools and instruments for testing of batteries.
	Observe safety procedure during testing of batteries and work as per standard norms and company guidelines
	Identify the primary and secondary cells.
	Measure and test the voltages of the given cells/battery using analog / digital multimeter.
	Charging and discharging the battery.
	Maintain and estimate the repair cost of secondary battery.
	Use a hydro meter to measure the specific gravity of the secondary battery.
4. Measure AC/DC using proper measuring instruments and compare the data using standard parameter. ELE/N9402	Construct a test lamp and use it to check mains healthiness.
	Measure the gauge of the wire using SWG and outside micrometer.
	Measure AC and DC voltages using multi meter.
	Carryout mechanical zero setting of a meter.

	Measure voltage and current using clamp meter.
5. Measure the various parameters by DSO and execute the result with standard one. ELE/N9403	Identify and demonstrate various control elements on front panel of a DSO.
	Measure different parameters of electronic signals using DSO.
	Store the waveform of a signal in DSO.
	Connect DSO with a printer and take printout of signal waveforms.
6. Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits. (NOS:ELE/N7812)	Plan work in compliance with standard safety norms.
	Identify different types of mains transformers and test.
	Identify the primary and secondary transformer windings and test the polarity.
	Measure the primary and secondary voltage of different transformers.
	Solder the given components
	Identify and test the variac.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
7. Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS:ELE/N5804)	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Identify the different types of resistors.
	Measure the resistor values using colour code and verify the reading by measuring in multi meter.
	Identify the power rating using size.
	Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter.
	Identify different inductors and measure the values using LCR meter.
	Identify the different capacitors and measure capacitance of various capacitors using LCR meter.
	Ascertain and select tools and materials for the job and make this available for use in.
8. Assemble simple electronic power supply circuit and	Practice soldering on components, lug and board with safety.
	Identify the passive /active components by visual appearance,

test for functioning. (NOS:ELE/N5804)	Code number and test for their condition.
	Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
	Construct and test a half & full wave rectifiers with and without filter circuits.
	Construct and test a bridge rectifier with and without filter circuits.
	Construct and test a Zener based voltage regulator circuit.
9. Construct, test and verify the input/ output characteristics of various analog circuits. ELE/N9404	Ascertain and select tools and instruments for carrying out the jobs.
	Plan and work in compliance with standard safety norms.
	Practice on soldering components on lug board with safety.
	Identify the passive /active components by visual appearance, Code number and test for their condition.
	Construct and test the transistor based switching circuit
	Construct and test CB,CE& CC amplifier circuit
	Ascertain the performance of different oscillator circuits.
	Construct and test Clipper, Clamper and Schmitt trigger circuit.
10. Plan and construct different power electronic circuits and analyse the circuit functioning. ELE/N1201	Construct and test of Transistor and JFET amplifiers, oscillators and multi vibrators.
	Construct and test a UJT as relaxation oscillator.
	Construct and test lamp dimmer using TRIAC/DIAC with safety.
	Construct and test MOSFET, IGBT test circuit and apply for suitable operation with proper safety.
	Construct and test the universal motor speed controller using SCR with safety.
	Construct and test a switching circuits using optical devices.
11. Select the appropriate opto electronics components and verify the characteristics in different circuit. ELE/N6102	Plan work in compliance with standard safety norms.
	Identify the different types of LEDs and IR LEDs.
	Measure the resistance, voltage, current through electronic circuit using multimeter.
	Construct and test a circuit using photo transistor and verify its characteristics.
	Identify photo coupler/ optical sensor input/output terminals and measure the quantum of isolation between the terminals.

12. Assemble, test and troubleshoot various digital circuits.(NOS:ELE/N1201)	Illustrate to practice the digital trainer kit with safety.
	Identify various digital ICs, test IC using digital IC tester and verify the truth table.
	Construct and verify the truth table of all gates using NOR and NAND gates.
	Construct an adder cum substractor circuits and verify the truth table.
	Construct a decoder and encoder, multiplexer and de-multiplexer circuits and verify the truth table.
	Construct a multiplexer and de-multiplexer and verify the truth table.
	Construct and verify the truth table of various flip flop, counter and shift register circuits.
13. Simulate and analyze the analog and digital circuits using Electronic simulator software. (NOS:ELE/N6102)	Plan the work incompliance with standard procedure.
	Prepare simple analog and digital electronic circuits using the simulator software.
	Simulate and test the prepared analog and digital circuits.
	Convert the prepared circuit into layout diagram.
	Explore various trouble shooting and fault finding the resources provided in the simulation software
14. Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits and execute the result. ELE/N9405	Demonstrate analog trainer kit with safety precautions.
	Identify various ICs, differentiate by code No. and test for their condition.
	Construct and test various OPAMP circuits.
	Construct and test R-2R ladder type digital to analog converter circuit.
	Construct and test different configurations of 555 IC e.g. astable, monostable, bi-astable and VCO circuits.
15. Read and apply engineering drawing for different application in the field of work. CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

16. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
17. Prepare, crimp, terminate and test various cables used in different electronics industries. (NOS: ELE/N6307)	Plan and work incompliance with standard safety norms.
	Prepare, terminate and test various electronics cable using proper crimping tools.
18. Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application. (NOS:ELE/N4614)	Plan, work in compliance with standard safety norms.
	Select hardware and software component.
	Install and configure operating systems and applications.
	Integrate IT systems into networks.
	Deploy tools and test programmes.
	Avoid e-waste and dispose the waste as per the procedure.
19. Identify, place, solder and desolder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup. (NOS:ELE/N5102)	Identify the various crimping tools for various IC packages.
	Identify different types of soldering guns and choose the suitable tip for the application.
	Practice the soldering and de-soldering the different active and passive components, IC base on GPCBs using solder, flux, pump and wick.
	Make the necessary setting on SMD soldering station to solder and de-solder various IC's of different packages by following the safety norms.
	Identify SMD components, de-solder and solder the SMD components on the PCB.
	Check the cold continuity, identify loose/dry solder and broken track on printed wired assemblies and rectify the defects.
	Avoid waste, ascertain unused materials and components for safe disposal.

20. Rework on PCB after identifying defects from SMD soldering and de-soldering. (NOS:ELE/N5102)	Plan the work in compliance with standard safety procedures.
	Demonstrate various tools and accessories used in PCB rework.
	Construct a PCB to demonstrate defects on soldered joints.
	Repair defective soldered joints.
21. Construct different electrical control circuits and test for their proper functioning with due care and safety. ELE/N9407	Measure the coil winding of the given motor.
	Prepare the setup and control an induction motor using a DOL starter by following the safety norms.
	Construct a direction control circuit to change direction of an induction motor.
	Connect an overload relay and test for its proper functioning.
22. Assemble and test a commercial AM/ FM receiver and evaluate performance. ELE/N9408	Plan and select tools to assemble the receiver.
	Modulate and Demodulate various signals using AM and FM on the trainer kit and observe waveforms.
	Construct and test IC based AM Receiver.
	Construct and test IC based FM transmitter and receiver.
	Modulate and Demodulate a signal using PAM, PPM, PWM Techniques.
	Troubleshoot and replace the faulty components.
	Check the functionality of AM/FM receiver.
23. Test, service and troubleshoot the various components of different domestic/ industrial programmable systems. ELE/N9802	Understand and interpret the procedure as per manual of Micro controller.
	Identity various ICs & their functions on the given Microcontroller Kit.
	Identify the address range of RAM & ROM.
	Write data into RAM & observe its volatility.
	Identify the port pins of the controller & configure the ports for Input & Output operation.
	Demonstrate entering of simple programs, execute & monitor the results.
24. Execute the operation of different sensors, identify, wire & test various transducers of IoT Applications. ELE/N9409	Ascertain and select tools, material for the job and make this available for use in the timely manner.
	Plan work in compliance with safety norms.
	Demonstrate possible solution and agree task within the team.
	Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive,

	capacitive and photo electric), load cells, strain gauge. LVDT by their appearance.
	Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart.
	Measure temperature of a lit fire using RTD and record the readings referring to data chart.
	Measure the DC voltage of a LVDT.
	Detect different objectives using capacitive, inductive and photoelectric proximity sensors.
25. Identify different IoT Applications with IoT architecture. ELE/N3102	Identify various IoT Applications in smart city viz. smart street light and smart water & waste management.
	Recognise the functions of various IoT Technician (Smart City) (IoT) applications & their distinctive advantages.
	Identify and explore different functional building blocks of IOT enabled system / application.
	Explore signal flow into IOT enabled system/application as per the IOT architecture.
26. Plan and carry out the Selection of a project, assemble the project and evaluate performance fora domestic/commercial applications. (NOS: ELE/N7202)	Plan, analyze and estimate the cost of the particular project.
	Identify the various tools required for the job.
	Prepare the simple digital/ analog electronic circuit.
	Simulate and test the prepared circuit.
	Assemble and test the circuit.
27. Prepare fibre optic setup and execute transmission and reception. ELE/N5902	Plan and select appropriate tools to complete the job safely.
	Identify the resources and their need on the given fiber optic trainer kit.
	Make optical fibre setup to transmit and receive analog and digital data.
	Demonstrate and apply FM modulation and demodulation using OFC trainer kit using audio signal and voice link.
	Demonstrate PWM modulation and demodulation using OFC trainer kit using audio signal and voice link.
	Demonstrate PPM modulation and demodulation using OFC trainer kit using audio signal and voice link.

28. Plan and Interface the LCD, LED, DPM panels to various circuits and evaluate performance. ELE/N8107	Identify LCD/LED Display module and its decoder/driver ICs and display a word on a two line LCD/LED.
	Measure/current flowing through a resistor and display it. Measure/current flowing through a sensor and display it on a LCD/LED module (DPM).
	Avoid waste and dispose the waste as per the procedures.
29. Detect the faults and troubleshoot SMPS, UPS and inverter. (NOS: ELE/N7202)	Identify the tools and equipments to perform the job with due care and safety.
	Dismantle the given stabilizer and find major sections/ ICs components.
	Identify various input and output sockets / connectors of the given SMPS.
	Identify major sections/ ICs/components of SMPS.
	Identify and replace the faulty components and construct and test IC Based DC-DC converter for different voltages.
	Identify front panel control & indicators of UPS.
	Connect Battery & load to UPS & test on battery mode.
	Open Top cover of UPS & identify isolator transformer & UPS transformer & additional circuit other than inverter.
	Identify various circuit boards in UPS and monitor voltages at various test points.
	Test UPS under Fault condition & rectify fault.
30. Identify, Test and verify characteristics of Photovoltaic cells, Modules, Batteries and Charge controllers. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter. (NOS: ELE/N5902) (NOS:ELE/N5902)	Connect solar panels in series & parallel and measure voltage and current.
	Charge & discharge a solar battery rated 12V, 100 Ah using Battery charger by CV and CC method and Tabulate the observations during charging & discharging cycle.
	Connect the charge controller (12V, 10A) with Solar battery (12V, 100Ah), Solar panel (75W) and DC load.
	Test the charge controller working with the above circuit.
	Select appropriate tools and equipment.
	Install a solar panel to a roof.
	Wire a solar panel to a solar controller.
	Wire a solar controller to a battery storage station.
	Connect storage batteries to a power inverter.
	Wire a power inverter to an electrical service panel.
	Connect and test solar panel to the Inverter and run the load.

	Installation of Solar Inverter.
	Demonstrate the installation with team.
31. Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot. (NOS:ELE/N8107)	Understand and interpret repair procedure as per manual of cell phone and select appropriate tools & equipment for undertaking job.
	Plan to repair and assemble the components used as per circuit diagram.
	Dismantle, identify the parts and assemble different types of smart phones.
	Interface the cell phone/smart phone to the PC and transfer the data and browse internet.
	Flash the various brands of cell phone/smart phone (at least 3) and upgrade the OS.
	Format the cell phone/smart phone for virus (approach the mobile repair shop/service centre).
	Identify the defective parts and rectify.
32. Check the various parts of a LED lights & stacks and troubleshoot. (NOS:ELE/N9302)	Understand and interpret measuring procedure as per manual.
	Conduct systematic trouble shooting.
	Dismantle the LED light, identify the connections of LEDs stacks, protection circuits, regulator.
	Measure the voltage across LED stacks.
	Identify the rectifier, controller part of LED lights.
	Test various subassemblies of the given LED light system.
	Comply with safety rules when performing the above operations.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
33. Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote. (NOS:ELE/N3102)	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan to Dismantle and assemble modules as per circuit diagram.
	Identification and operate different Controls on LCD, LED TV.
	Dismantle, Identify the parts of the remote control.
	Trace and rectify the faults of a various remote controls.
	Identify various connectors and connect the cable operator's external decoder (set top box) to the TV.

	Comply with safety rules when performing the above operations.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
34. Read and apply engineering drawing for different application in the field of work. CSC/N9401	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
35. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR ELECTRONICS MECHANIC TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 65 Hrs; Professional Knowledge 10 Hrs	Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care & safety following safety precautions. (Mapped NOS: ELE/N1002)	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. (05 Hrs.) 2. Identify safety signs for danger, warning, caution & personal safety message. (03 Hrs.) 3. Use of personal protective equipment (PPE). (05 Hrs.) 4. Practice elementary first aid. (05 Hrs.) 5. Preventive measures for electrical accidents & steps to be taken in such accidents. (02 Hrs.) 6. Use of Fire extinguishers. (05 Hrs.)	Familiarization with the working of Industrial Training Institute system. Importance of safety and precautions to be taken in the industry/shop floor. Introduction to PPEs. Introduction to First Aid. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Occupational Safety & Health**:** Health, Safety and Environment guidelines, legislations & regulations as applicable. (05 Hrs.)
		Hand tools and their uses 7. Identify the different hand tools. (05 Hrs.) 8. Selection of proper tools for operation and precautions in operation. (05 Hrs.) 9. Care & maintenance of trade tools. (05 Hrs.) 10. Practice safety precautions while working in fitting jobs. (10 Hrs.)	Identification, specifications, uses and maintenance of commonly used hand tools. State the correct shape of files for filing different profiles. Riveting of tags and lugs, cutting and bending of sheet metals, chassis and cabinets. (05 Hrs.)

		11. Workshop practice on filing and hacks awing. (05 Hrs.) 12. Practice simple fitting and drilling. (10 Hrs.)	
Professional Skill 50 Hrs; Professional Knowledge 15 Hrs	Select and perform electrical/ electronic measurement of single range meters and calibrate the instrument. ELE/N9401	**Basics of AC and Electrical Cables** 13. Identify the Phase, Neutral and Earth on power socket, use a testers to monitor AC power. (02 Hrs.) 14. Construct a test lamp and use it to check mains healthiness. (03 Hrs.) 15. Measure the voltage between phase and ground and rectify earthing. (04 Hrs.) 16. Identify and test different AC mains cables. (03 Hrs.) 17. Prepare terminations, skin the electrical wires /cables using wire stripper and cutter. (03 Hrs.) 18. Measure the gauge of the wire using SWG and outside micrometer. (03 Hrs.) 19. Refer table and find current carrying capacity of wires. (02 Hrs.) 20. Crimp the lugs to wire end. (03 Hrs.) 21. Measure AC and DC voltages using multi meter. (03 Hrs.)	Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC. Various terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents. Insulators, conductors and semiconductor properties. Different type of electrical cables and their Specifications. Types of wires & cables, standard wire gauge (SWG). Classification of cables according to gauge (core size), number of conductors, material, insulation strength, flexibility etc. (08 Hrs.)
		22. Identify the type of meters by dial and scale marking/ symbols. (03	**Single range meters** Introduction to electrical and electronic measuring

		Hrs.) 23. Demonstrate various analog measuring Instruments. (04 Hrs.) 24. Find the minimum and maximum measurable range of the meter. (03 Hrs.) 25. Carryout mechanical zero setting of a meter. (04 Hrs.) 26. Check the continuity of wires, meter probes and fuse etc. (05 Hrs.) 27. Measure voltage and current using clamp meter. (05 Hrs.)	instruments. Basic principle and parts of simple meters. Specifications, symbols used in dial and their meaning. (07 Hrs.)
Professional Skill 25 Hrs; Professional Knowledge 06 Hrs	Test &service different batteries used in electronic applications and record the data to estimate repair cost. (Mapped NOS: ELE/N7001)	**Cells & Batteries** 28. Identify the +ve and -ve terminals of the battery. (02 Hrs.) 29. Identify the rated output voltage and Ah capacity of given battery. (01 Hrs.) 30. Measure the voltages of the given cells/battery using analog/ digital multimeter. (03 Hrs.) 31. Charge and discharge the battery through load resistor. (05 Hrs.) 32. Maintain the secondary Battery. (05 Hrs.) 33. Measure the specific gravity of the electrolyte using hydrometer. (03 Hrs.) 34. Test a battery and verify whether the battery is ready for use or needs	**Cells & Batteries** Construction, types of primary and secondary cells/battery. Materials used, Specification of cells and batteries. Charging process, efficiency, life of cell/battery. Selection of cells / Batteries etc. Use of Hydrometer. Types of electrolytes used in cells and batteries. Series/ parallel connection of batteries and purpose of such connections. (06 Hrs.)

		recharging. (06 Hrs.)	
Professional Skill 60 Hrs; Professional Knowledge 10 Hrs	Measure AC/DC using proper measuring instruments and compare the data using standard parameter. ELE/N9402	**AC & DC measurements** 35. Use the multi meter to measure the various functions (AC V, DC V, DC I, AC I, R). (10 Hrs.) 36. Identify the different types of meter for measuring AC & DC parameters. (10 Hrs.) 37. Identify the different controls on the CRO/DSO front panel and observe the function of each control. (14 Hrs.) 38. Measure DC voltage, AC voltage, time period using CRO/DSO sine wave parameters. (14 Hrs.) 39. Identify the different controls on the function generator front panel and observe the function of each control. (12 Hrs.)	Introduction to electrical measuring instruments. Importance and classification of meters. MC and MI meters. Characteristics of meters and errors in meters. Multi meter, use of meters in different circuits. Care and maintenance of meters. Use of CRO/DSO, Function generator, LCR meter (10 Hrs.)
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Measure the various parameters by DSO and execute the result with standard one. ELE/N9403	**Digital Storage Oscilloscope** 40. Identify the different front panel control of a DSO. (05 Hrs.) 41. Measure the Amplitude, Frequency and time period of typical electronic signals using DSO. (06 Hrs.) 42. Take a print of a signal from DSO by connecting it to a printer and tally with applied signal. (07 Hrs.) 43. Construct and test function generator using IC 8038. (07 Hrs.)	Advantages and features of DSO. Block diagram of Digital storage oscilloscope (DSO)/ CRO and applications. Applications of digital CRO. Block diagram of function generator. Differentiate a CRO with DSO. (09 Hrs.)

Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits. (Mapped NOS: ELE/N7812)	**Soldering/ De-soldering and Various Switches** 44. Practice soldering on different electronic components, small transformer and lugs. (04 Hrs.) 45. Practice soldering on IC bases and PCBs. (04 Hrs.) 46. Practice de-soldering using pump and wick. (04 Hrs.) 47. Join the broken PCB track and test. (04 Hrs.) 48. Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries. (04 Hrs.) 49. Make a panel board using different types of switches for a given application. (05 Hrs.)	Different types of soldering guns, related to Temperature and wattages, types of tips. Solder materials and their grading. Use of flux and other materials. Selection of soldering gun for specific requirement. Soldering and De-soldering stations and their specifications. Different switches, their specification and usage. (05 Hrs.)
Professional Skill 100 Hrs; Professional Knowledge 25 Hrs	Test various electronic components using proper measuring instruments and compare the data using standard parameter. (Mapped NOS: ELE/N5804)	**Active and Passive Components** 50. Identify the different types of active electronic components. (06 Hrs.) 51. Measure the resistor value by colour code and verify the same by measuring with multimeter. (06 Hrs.) 52. Identify resistors by their appearance and check physical defects. (06 Hrs.) 53. Identify the power rating of carbon resistors by their size. (06 Hrs.) 54. Practice on measurement of parameters in	Ohm's law and Kirchhoff's Law. Resistors; types of resistors, their construction & specific use, color-coding, power rating. Equivalent Resistance of series parallel circuits. Distribution of V & I in series parallel circuits. Principles of induction, inductive reactance. Types of inductors, construction, specifications, applications andenergy storage concept.

		combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. (06 Hrs.) 55. Measurement of current and voltage in electrical circuits to verify Kirchhoff's Law. (06 Hrs.) 56. Verify laws of series and parallel circuits with voltage source in different combinations. (06 Hrs.) 57. Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter. (06 Hrs.) 58. Identify different inductors and measure the values using LCR meter. (06 Hrs.) 59. Identify the different capacitors and measure capacitance of various capacitors using LCR meter. (06 Hrs.) 60. Identify and test the circuit breaker and other protecting devices. (06 Hrs.) 61. Dismantle and identify the different parts of a relay. (06 Hrs.) 62. Connect a timer relay in a circuit and test for its working. (06 Hrs.) 63. Connect a contactor in a circuit and test for its working. (06 Hrs.)	Self and Mutual induction. Behaviour of inductor at low and high frequencies. Series and parallel combination, Q factor. Capacitance and Capacitive Reactance, Impedance. Types of capacitors, construction, specifications and applications. Dielectric constant. Significance of Series parallel connection of capacitors. Capacitor behaviour with AC and DC. Concept of Time constant of a RC circuit. Concept of Resonance and its application in series and parallel circuit. Properties of magnets and their materials, preparation of artificial magnets, significance of electromagnetism, types of cores. Relays, types, construction and specifications etc (25 Hrs.)

		64. Construct and test RC time constant circuit. (06 Hrs.) 65. Construct a RC differentiator circuit and convert triangular wave into square wave. (05 Hrs.) 66. Construct and test series and parallel resonance circuit. (05 Hrs.)	
Professional Skill 60 Hrs; Professional Knowledge 10 Hrs	Assemble simple electronic power supply circuit and test for functioning. (Mapped NOS: ELE/N5804)	**Power Supply Circuits** 67. Test the given diode using multi meter and determine forward to reverse resistance ratio. (05 Hrs.) 68. Measure the voltage and current through a diode in a circuit and verify its forward characteristic. (05 Hrs.) 69. Identify different types of transformers and test. (05 Hrs.) 70. Identify the primary and secondary transformer windings and test the polarity. (05 Hrs.) 71. Construct and test a half wave, full wave and Bridge rectifier circuit. (05 Hrs.) 72. Measure ripple voltage, ripple frequency and ripple factor of rectifiers for different load and filter capacitors. (05 Hrs.) 73. Construct and test Zener based voltage regulator circuit. (05 Hrs.) 74. Calculate the percentage	Semiconductor materials, components, PN Junction, Forward and Reverse biasing of diodes. Forward current and Reverse voltage. Packing styles of diodes. Different diodes, Rectifier configurations, their efficiencies, Filter components and their role in reducing ripple. Working principles of Zener diode, varactor diode, their specifications and applications. Working principle of a Transformer, construction, Specifications and types of cores used. Step-up, Step down and isolation transformers with applications. Losses in Transformers. (07 Hrs.)

		regulation of regulated power supply. (05 Hrs.)	
		IC Regulators 75. Construct and test a +12V fixed voltage regulator. (05 Hrs.) 76. Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series). (04 Hrs.) 77. Observe the output voltage of different IC 723 metal/ plastic type. (04 Hrs.) 78. Construct and test a 1.2V – 30V variable output regulated power supply using IC LM317T. (05 Hrs.)	Regulated Power supply using 78XX series, 79XX series. Op-amp regulator, 723 regulator, (Transistorized & IC based). Voltage regulation, error correction and amplification etc. (03 Hrs.)
Professional Skill 90 Hrs; Professional Knowledge 15 Hrs	Construct, test and verify the input/ output characteristics of various analog circuits. ELE/N9404	**Transistor** 79. Identify different transistors with respect to different package type, B-E-C pins, power, switching transistor, heat sinks etc. (06 Hrs.) 80. Test the condition of a given transistor using ohm-meter. (06 Hrs.) 81. Construct and test a transistor based switching circuit to control a relay (use Relays of different coil voltages and Transistors of different β) (06hrs)	Construction, working of a PNP and NPN Transistors, purpose of E, B & C Terminals. Significance of α, β and relationship of a Transistor. Need for Biasing of Transistor. VBE, VCB, VCE, IC, IB, Junction Temperature, junction capacitance, frequency of operation. Transistor applications as switch and amplifier. Transistor input and output characteristics. Transistor power ratings & packaging styles and use of different heat sinks. (5 Hrs.)
		Amplifier	Different types of biasing,

		82. Construct and test fixed-bias, emitter-bias and voltage devider-bias transistor amplifier. (06 Hrs.) 83. Construct and Test a common emitter amplifier with and without bypass capacitors. (06 Hrs.) 84. Construct and Test common collector/emitter follower amplifier. (06 Hrs.) 85. Construct and test a two stage RC Coupled amplifier. (06 Hrs.)	various configurations of transistor (C-B, C-E & C-C), their characteristics and applications. Transistor biasing circuits and stabilization Techniques. Classification of amplifiers according to frequency, mode of operation and methods of coupling. Voltage amplifiers - voltage gain, loading effect. Single stage CE amplifier and CC amplifier. Emitter follower circuit and its advantages. RC coupled amplifier, Distinguish between voltage and power amplifier, Alpha, beta, voltage gain, Concept of dB dBm. Feedback and its types. (5 Hrs.)
		Oscillators 86. Demonstrate Colpitts oscillator, Hartley oscillator circuits and compare the output frequency of the oscillator by CRO. (06 Hrs.) 87. Construct and test a RC phase shift oscillator circuits. (06 Hrs.) 88. Construct and test a crystal oscillator circuits. (06 Hrs.) 89. Demonstrate Astable, monostable, bistable circuits using transistors. (06 Hrs.)	Introduction to positive feedback and requisites of an oscillator. Study of Colpitts, Hartley, Crystal and RC oscillators. Types of multi vibrators and study of circuit diagrams. (03 Hrs.)

		Wave shaping circuits 90. Construct and test shunt clipper. (06 Hrs.) 91. Construct and test series and dual clipper circuit using diodes. (06 Hrs.) 92. Construct and test clamper circuit using diodes. (06 Hrs.) 93. Construct and test Zener diode as a peak clipper. (06 Hrs.)	Diode shunt clipper circuits, Clamping / limiting circuits and Zener diode as peak clipper, uses their applications. (02 Hrs.)
Professional Skill 80 Hrs; Professional Knowledge 20 Hrs	Plan and construct different power electronic circuits and analyse the circuit functioning. ELE/N1201	**Power Electronic Components** 94. Identify different power electronic components, their specification and terminals. (05 Hrs) 95. Construct and test a FET Amplifier. (15 Hrs) 96. Construct a test circuit of SCR using UJT triggering. (15 Hrs) 97. Construct a simple dimmer circuit using TRIAC. (10 Hrs) 98. Construct UJT based free running oscillator and change its frequency. (15 Hrs)	Construction of FET & JFET, difference with BJT. Purpose of Gate, Drain and source terminals and voltage / current relations between them and Impedances between various terminals. Heat Sink- Uses & purpose. Suitability of FET amplifiers in measuring device applications. Working of different power electronic components such as SCR, TRIAC, DIAC and UJT. (12 Hrs.)
		MOSFET & IGBT 99. Identify various Power MOSFET by its number and test by using multimeter. (05 Hrs) 100. Construct MOSFET test circuit with a small load. (05 Hrs) 101. Identify IGBTs by their numbers and test by using multimeter. (05 Hrs)	MOSFET, Power MOSFET and IGBT, their types, characteristics, switching speed, power ratings and protection. Differentiate FET with MOSFET. Differentiate Transistor with

		102. Construct IGBT test circuit with a small load. (05 Hrs)	IGBT. (08 Hrs.)
Professional Skill 50 Hrs; Professional Knowledge 06 Hrs	Select the appropriate opto electronics components and verify the characteristics in different circuit. ELE/N6102	**Opto Electronics** 103. Test LEDs with DC supply and measure voltage drop and current using multimeter. (11 Hrs.) 104. Construct a circuit to test photo voltaic cell. (13 Hrs.) 105. Construct a circuit to switch a lamp load using photo diode. (13 Hrs.) 106. Construct a circuit to switch a lamp load using photo transistor. (13 Hrs.)	Working and application of LED, IR LEDs, Photo diode, photo transistor, their characteristics and applications. Optical sensor, opto-couplers, circuits with opto isolators. Characteristics of LASER diodes. (06 Hrs.)
Professional Skill 80 Hrs; Professional Knowledge 15 Hrs	Assemble, test and troubleshoot various digital circuits. (Mapped NOS: ELE/N1201)	**Basic Gates** 107. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. (05 Hrs.) 108. Construct and verify the truth table of all the gates using NAND and NOR gates. (05 Hrs.) 109. Use digital IC tester to test the various digital ICs (TTL and CMOS). (05 Hrs.)	Introduction to Digital Electronics. Difference between analog and digital signals. Number systems (Decimal, binary, octal, Hexadecimal). BCD code, ASCII code and code conversions. Various Logic Gates and their truth tables. (05 Hrs.)
		Combinational Circuits 110. Construct Half Adder circuit using ICs and verify the truth table. (07 Hrs.) 111. Construct Full adder with two Half adder circuit using ICs and verify the truth table. (07 Hrs.)	Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders, 2-bit and four bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic

		112. Construct the adder cum subtractor circuit and verify the result. (07 Hrs.) 113. Construct and Test a 2 to 4 Decoder. (07 Hrs.) 114. Construct and Test a 4 to 2 Encoder. (07 Hrs.) 115. Construct and Test a 4 to 1 Multiplexer. (05 Hrs.) 116. Construct and Test a 1 to 4 De Multiplexer. (05 Hrs.)	operations. Concept of encoder and decoder. Basic Binary Decoder and four bit binary decoders. Need for multiplexing of data. 1:4 line Multiplexer / De-multiplexer. (07 Hrs.)
		Flip Flops 117. Identify different Flip-Flop (ICs) by the number printed on them. (05 Hrs.) 118. Construct and test four bit latch using 7475. (05 Hrs.) 119. Construct and test R-S flip-flop using IC7400 with clock and without clock pulse. (05 Hrs.) 120. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs. (05 Hrs.)	Introduction to Flip-Flop. S-R Latch, Gated S-R Latch, D-Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop. Master-Slave flip flops and Timing diagrams. Basic flip flop applications like data storage, data transfer and frequency division. (03 Hrs.)
Professional Skill 50 Hrs; Professional Knowledge 04 Hrs	Simulate and analyze the analog and digital circuits using Electronic simulator software. (Mapped NOS: ELE/N6102)	**Electronic circuit simulator** 121. Prepare simple digital and electronic circuits using the software. (13 Hrs.) 122. Simulate and test the prepared digital and analog circuits. (13 Hrs.) 123. Convert the prepared circuit into a layout	Study the library components available in the circuit simulation software. Various resources of the software. (04 Hrs.)

		diagram. (12 Hrs.) 124. Prepare simple, power electronic and domestic electronic circuit using simulation software. (12 Hrs.)	
Professional Skill 80 Hrs; Professional Knowledge 15 Hrs	Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits and execute the result. ELE/N9405	**Op – Amp & Timer 555 Applications** 125. Use analog IC tester to test the various analog ICs. (06 Hrs.) 126. Construct and test various Op-Amp circuits Inverting, Non-inverting and Summing Amplifiers. (06 Hrs.) 127. Construct and test Differentiator and Integrator. (06 Hrs.) 128. Construct and test a zero crossing detector. (06 Hrs.) 129. Construct and test Instrumentation amplifier. (06 Hrs.) 130. Construct and test a Binary weighted and R-2R Ladder type Digital-to-Analog Converters. (08 Hrs.) 131. Construct and test Astable timer circuit using IC 555. (08 Hrs.) 132. Construct and test mono stable timer circuit using IC 555. (08 Hrs.) 133. Construct and test VCO (V to F Converter) using IC 555. (08 Hrs.) 134. Construct and test 555	Block diagram and Working of Op-Amp, importance, Ideal characteristics, advantages and applications. Schematic diagram of 741, symbol. Non-inverting voltage amplifier, inverting voltage amplifier, summing amplifier, Comparator, zero cross detector, differentiator, integrator and instrumentation amplifier, other popular Op-Amps. Block diagram of 555, functional description w.r.t. different configurations of 555 such as monostable, astable and VCO operations for various application. (15 Hrs.)

		timers as pulse width modulator. (08 Hrs.)	
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED -40 Hrs.	Read and apply engineering drawing for different application in the field of work. CSC/N9401	**ENGINEERING DRAWING:** Introduction to Engineering Drawing and Drawing Instrument – • Conventions • Sizesandlayoutof drawingsheets • TitleBlock, itspositionandcontent • DrawingInstrument Freehanddrawingof– • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free handdrawingofhandtools. DrawingofGeometricalfigures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke Symbolicrepresentation– • Different Electronic symbols used in therelatedtrades ReadingofElectronicCircuitDiagram. ReadingofElectronicLayoutdrawing. **Material Science** Types metals, types of ferrous and non ferrous metals. Introduction of iron and cast iron.	
WORKSHOP CALCULATION & SCIENCE: 35 Hrs			
Professional Knowledge WCS -35 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion. Factors, HCF, LCM and problems. Fractions - Addition, substraction, multiplication & division. Decimal fractions - Addition, subtraction, multiplication & division. Solving problems by using calculator. **Square root, Ratio and Proportions, Percentage** Square and suare root. Simple problems using calculator. Applications of pythagoras theorem and related problems. Ratio and proportion. Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction.	

		Material Science Types metals, types of ferrous and non ferrous metals. Introduction of iron and cast iron. **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals. Scales of temperature, celsius, fahrenheit, kelvin and conversion between scales of temperature. **Basic Electricity** Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC,DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel. Ohm's law, relation between V.I.R & related problems. Electrical power, energy and their units, calculation with assignments. Magnetic induction, self and mutual inductance and EMF generation Electrical power, HP, energy and units of electrical energy **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
Project work / Industrial visit **Broad Areas:** a) Delayed automatic power on circuit. b) Neon flasher circuit using IC 741 c) UJT act as a relaxation oscillator d) Up/down synchronous decade counter e) Portable continuity cum capacitor tester		

SYLLABUS FOR ELECTRONICS MECHANIC TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 25 Hrs; Professional Knowledge 06 Hrs	Prepare, crimp, terminate and test various cables used in different electronics industries. (Mapped NOS: ELE/N6307)	**Electronic Cables & Connectors** 135. Identify various types of cables viz. RF coaxial feeder, screened cable, ribbon cable, RCA connector cable, digital optical audio, video cable, RJ45, RJ11, Ethernet cable, fibre optic cable splicing, fibre optic cable mechanical splices, insulation, gauge, current capacity, flexibility etc. used in various electronics products, different input output sockets. (05 Hrs.) 136. Identify suitable connectors, solder/crimp /terminate & test the cable sets. (05 Hrs.) 137. Check the continuity as per the marking on the connector for preparing the cable set. (05 Hrs.) 138. Identify and select various connectors and cables inside the CPU cabinet of PC. (05 Hrs.) 139. Identify the suitable connector and cable to connect a computer with a network switch and prepare a cross over cable	Cable signal diagram conventions Classification of electronic cables as per the application w.r.t. insulation, gauge, current capacity, flexibility etc. Different types of connector & their terminations to the cables. Male / Female type DB connectors. Ethernet 10 Base cross over cables and pin out assignments, UTP and STP, SCTP, TPC, coaxial, types of fibre optical Cables and Cable trays. Different types of connectors Servo 0.1” connectors, FTP, RCA,BNC,HDMI Audio/video connectors like XLR, RCA (phono), 6.3 mm PHONO, 3.5 / 2.5 mm PHONO, BANTAM, SPEAKON, DIN, mini DIN, RF connectors, USB, Fire wire, SATA Connectors, VGA, DVI connectors, MIDI and RJ45,RJ11 etc. (06 Hrs.)

		to connect two network computers. (05 Hrs.)	
Professional Skill 80 Hrs; Professional Knowledge 34 Hrs	Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application. (Mapped NOS: ELE/N4614)	**Computer Hardware, OS, MS office and Networking** 140. Demonstrate various parts of the system unit and motherboard components. (06 Hrs.) 141. Identify various computer peripherals and connect it to the system. (04Hrs.) 142. Disable certain functionality by disconnecting the concerned cables SATA/ PATA. (05 Hrs.) 143. Replace the CMOS battery and extend a memory module. (06 Hrs.) 144. Test and Replace the SMPS. (05 Hrs.) 145. Replace the given DVD and HDD on the system. (06 Hrs.) 146. Dismantle and assemble the desktop computer system. (07 Hrs.) 147. Boot the system from Different options. (07 Hrs.) 148. Install OS in a desktop computer. (05 Hrs.) 149. Install a Printer driver software and test for print outs. (05 Hrs.) 150. Install antivirus software, scan the system and explore the options in the antivirus software. (05 Hrs.)	Basic blocks of a computer, Components of desktop and motherboard. Hardware and software, I/O devices, and their working. Different types of printers, HDD, DVD. Various ports in the computer. Windows OS MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management, installation of program, setting and using of control panel, application of accessories, various IT tools and applications. Concept of Internet, Browsers, Websites, search engines, email, chatting and messenger service. Downloading the Data and program files etc. **Computer Networking:-** Network features - Network medias Network topologies, protocols- TCP/IP, UDP, FTP, models and types. Specification and standards, types of cables, UTP, STP, Coaxial cables. Network components like hub, Ethernet switch, router, NIC Cards, connectors, media and firewall. Difference between PC &Server.

		151. Install MS office software. (05 Hrs.) 152. Browse search engines, create email accounts, practice sending and receiving of mails and configuration of email clients. (08 Hrs.) 153. Prepare terminations, make UTP and STP cable connectors and test. (08 Hrs.) 154. Configure a wireless Wi-Fi network. (10 Hrs.)	(34 Hrs.)
Professional Skill 70 Hrs; Professional Knowledge 20 Hrs	Identify, place, solder and desolder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup. (Mapped NOS: ELE/N5102)	**Basic SMD (2, 3, 4 terminal components)** 155. Identification of 2, 3, 4 terminal SMD components. (05 Hrs.) 156. De-solder the SMD components from the given PCB. (05 Hrs.) 157. Solder the SMD components in the same PCB. (05 Hrs.) 158. Check for cold continuity of PCB. (05 Hrs.) 159. Identification of loose /dry solder, broken tracks on printed wired assemblies. (05 Hrs.)	Introduction to SMD technology Identification of 2, 3, 4 terminal SMD components. Advantages of SMD components over conventional lead components. Soldering of SM assemblies - Reflow soldering. Tips for selection of hardware, Inspection of SM. (05 Hrs.)
		SMD Soldering and De-soldering 160. Identify various connections and setup required for SMD Soldering station. (05 Hrs.) 161. Identify crimping tools for various IC packages. (05 Hrs.)	Introduction to Surface Mount Technology (SMT). Advantages, Surface Mount components and packages. Introduction to solder paste (flux). Soldering of SM assemblies, reflow soldering.

		162. Make the necessary settings on SMD soldering station to de-solder various ICs of different packages (at least four) by choosing proper crimping tools. (07 Hrs.) 163. Make the necessary settings on SMD soldering station to solder various ICs of different packages (at least four) by choosing proper crimping tools. (8 Hrs.) 164. Make the necessary setting rework of defective surface mount component used soldering / de-soldering method. (8 Hrs.)	Tips for selection of hardware, Inspection of SM. Identification of Programmable Gate array (PGA) packages. Specification of various tracks, calculation of track width for different current ratings. Cold/ Continuity check of PCBs. Identification of lose / dry solders, broken tracks on printed wiring assemblies. Introduction to Pick place Machine, Reflow Oven, Preparing stencil,& stencil printer (15 Hrs.)
Professional Skill 20 Hrs; Professional Knowledge 10 Hrs	Rework on PCB after identifying defects from SMD soldering and de-soldering. (Mapped NOS:ELE/N5102)	**PCB Rework** 165. Checked and Repair Printed Circuit Boards single, Double layer and important tests for PCBs. (10 Hrs.) 166. Inspect soldered joints, detect the defects and test the PCB for rework. (10Hrs.)	Introduction to Static charges, prevention, handling of static sensitive devices, various standards for ESD. Introduction to non-soldering interconnections. Construction of Printed Circuit Boards (single, Double, multi-layer), Important tests for PCBs. Introduction to rework and repair concepts. Repair of damaged track. Repair of damaged pad and plated through hole. Repair of solder mask. (10 Hrs.)
Professional Skill 30 Hrs;	Construct different electrical control	**Protection devices** 167. Identify different types of	Necessity of fuse, fuse ratings,

Professional Knowledge 10 Hrs	circuits and test for their proper functioning with due care and safety. ELE/N9406	fuses along with fuse holders, overload (no volt coil), current adjust (Biometric strips to set the current). (06 Hrs.) 168. Test the given MCBs. (03 Hrs.) 169. Connect an ELCB and test the leakage of an electrical motor control circuit. (05 Hrs.)	types of fuses, fuse bases. Single/ three phase MCBs, single phase ELCBs. Types of contactors, relays and working voltages. Contact currents, protection to contactors and high current applications. (05 Hrs.)
		170. Test DC motor and its operating voltage. (03 Hrs.) 171. Test DC motor control signal. (03 Hrs.) 172. Test various Low potential motors. (03 Hrs.) **Stepper Motor** 173. Test stepper motor. (03 Hrs.) 174. Demonstrate working process of stepper motor in various Equipment. (04 Hrs.)	1.LOW VOLTAGE DC MOTOR (Low Potential motor) Introduction of DC motor. Types of DC motor .Types of DC motor controller. DC Motor power. Types of DC Motor power regulation. Application area of DC motor controller. 2.What is a Stepper motor and its types. Stepper Motor working Principal. How to select a stepper motor Types of wiring of stepper motor. Stepper motor control By varying clock pulses. Advantage of stepper motor. (05 Hrs.)
Professional Skill 60 Hrs; Professional Knowledge 15 Hrs	Assemble and test a commercial AM/ FM receiver and evaluate performance. ELE/N9407	**Communication electronics** 175. Modulate and Demodulate various signals using AM and FM on the trainer kit and observe waveforms. (08 Hrs.) 176. Test IC based AM Receiver (08 Hrs.)	Radio Wave Propagation – principle, fading. Need for Modulation, types of modulation and demodulation. Fundamentals of Antenna, various parameters, types of Antennas & application. Introduction to AM, FM & PM,

		177. Test IC based FM transmitter. (06 Hrs.) 178. Test IC based AM transmitter and test the transmitter power. Calculate the modulation index. (08 Hrs.) 179. Dismantle the given FM receiver set and identify different stages (AM section, audio amplifier section etc). (10 Hrs.) 180. Modulate two signals using AM kit draw the way from and calculate percent (%) of modulation. (10 Hrs.) 181. Modulate and Demodulate a signal using PAM, PPM, PWM Techniques. (10 Hrs.)	SSB-SC & DSB-SC. Block diagram of AM and FM transmitter. FM Generation & Detection. Digital modulation and demodulation techniques, sampling, quantization & encoding. Concept of multiplexing and de multiplexing of AM/ FM/ PAM/ PPM /PWM signals. ***A simple block diagram approach to be adopted for explaining the above mod/demod techniques.*** (15 Hrs.)
Professional Skill 60 Hrs; Professional Knowledge 15 Hrs	Test, service and troubleshoot the various components of different domestic/ industrial programmable systems. ELE/N9407	**Microcontroller (8051)** 182. Identify various ICs & their functions on the given Microcontroller Kit. (07 Hrs.) 183. Identify the address range of RAM & ROM. (07 Hrs.) 184. Measure the crystal frequency, connect it to the controller. (07 Hrs.) 185. Identify the port pins of the controller & configure the ports for Input & Output operation. (07 Hrs.) 186. Use 8051 microcontroller, connect 8 LED to the port, blink the LED with a switch. (08 Hrs.)	Introduction Microprocessor & 8051Microcontroller, architecture, pin details & the bus system. Function of different ICs used in the Microcontroller Kit. Differentiate microcontroller with microprocessor. Interfacing of memory to the microcontroller. Internal hardware resources of microcontroller. I/O port pin configuration. Different variants of 8051 & their resources. Register banks & their functioning. SFRs & their configuration for different

		187. Perform the initialization, load & turn on a LED with delay using Timer. (08 Hrs.) 188. Perform the use of a Timer as an Event counter to count external events. (08 Hrs.) 189. Demonstrate entering of simple programs, execute & monitor the results. (08 Hrs.)	applications. Comparative study of 8051 with 8052. Introduction to PIC Architecture. (15 Hrs.)
Professional Skill 60 Hrs; Professional Knowledge 15 Hrs	Execute the operation of different sensors, identify, wire & test various transducers of IOT Applications ELE/N9408	**Sensors, Transducers used in IOT Applications** 190. Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT PT 100 (platinum resistance sensor), water level sensor, thermostat float switch, float valve by their appearance. (15 Hrs.) 191. Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. (10 Hrs.) 192. Measure temperature of a lit fire using RTD and record the readings referring to data. (10 Hrs.) 193. Measure the DC voltage of a LVDT. (10 Hrs.) 194. Detect different objectives using	Basics of passive and active transducers. Role, selection and characteristics. Sensor voltage and current formats. Thermistors/ Thermocouples - Basic principle, salient features, operating range, composition, advantages and disadvantages. Strain gauges/ Load cell – principle, gauge factor, types of strain gauges. Inductive/ capacitive transducers - Principle of operation, advantages and disadvantages. Principle of operation of LVDT, advantages and disadvantages. Proximity sensors – applications, working principles of eddy current, capacitive and inductive proximity sensors. (15 Hrs.)

		capacitive, inductive and photoelectric proximity sensors. (15 Hrs.)	
Professional Skill 20 Hrs.; Professional Knowledge 06 Hrs.	Identify different IoT Applications with IoT architecture. ELE/N9409	195. Connect and test microcontroller to computer and execute sample programs (04hrs.) 196. Upload computer code to the physical board (Microcontroller) to blink a simple LED. (02hrs.) 197. Write and upload computer code to the physical Micro controller to sound buzzer. (02hrs.) 198. Circuit and program to Interface light sensor – LDR with Microcontroller to switch ON/OFF LED based on light intensity. (03hrs.) 199. Set up & test circuit to interface potentiometer with Microcontroller and map to digital values for e.g. 0-1023. (03hrs.)	Introduction to Internet of Things applications environment, smart street light and smart water & waste management. What is an IOT? What makes embedded system an IOT? Role and scope of IOT in present and future marketplace. Smart objects, Wired – Cables, hubs etc. Wireless – RFID, WiFi, Bluetooth etc. Different functional building blocks of IOT architecture. (06 hrs.)
Professional Skill 90 Hrs; Professional Knowledge 18 Hrs	Plan and carry out the selection of a project, assemble the project and evaluate performance for a domestic/commercial applications. (Mapped NOS: ELE/N9802)	**Analog IC Applications** Make simple projects/ Applications using ICs 741, 723, 555, 7106, 7107 Sample projects: • Laptop protector • Mobile cell phone charger • Battery monitor • Metal detector • Mains detector • Lead acid battery charger • Smoke detector • Solar charger	Discussion on the identified projects with respect to data of the concerned ICs. Components used in the project. (09 Hrs.)

		• Emergency light • Water level controller • Door watcher **(Instructor will pick up any five of the projects for implementation)** (45 Hrs.)	
		Digital IC Applications Make simple projects/Applications using various digital ICs (digital display, event counter, stepper motor driver etc) • Duty cycle selector • Frequency Multiplier • Digital Mains Resumption Alarm • Digital Lucky Random number generator • Dancing LEDs • Count down timer • Clap switch • Stepper motor control • Digital clock • Event counter • Remote jammer **(Instructor will pick up any five of the projects for implementation)** (45 Hrs.)	Discussion on the identified projects with respect to data of the concerned ICs. Components used in the project. (09 Hrs.)
Professional Skill 15 Hrs; Professional Knowledge 05 Hrs	Prepare fibre optic setup and execute transmission and reception. ELE/N9409	**Fiber optic communication** 200. Identify the resources and their need on the given fiber optic trainer kit. (02 Hrs.) 201. Make optical fiber setup to transmit and receive analog and digital data. (02 Hrs.) 202. Set up the OFC trainer kit	Introduction to optical fiber, optical connection and various types optical amplifier,its advantages, properties of optic fiber, testing, losses, types of fiber optic cables and specifications. Encoding of light. Fiber optic joints, splicing,

		to study AM, FM, PWM modulation and demodulation. (02 Hrs.) 203. Perform FM modulation and demodulation using OFC trainer kit using audio signal and voice link. (03 Hrs.) 204. Perform PWM modulation and demodulation using OFC trainer kit using audio signal and voice link. (03 Hrs.) 205. Perform PPM modulation and demodulation using OFC trainer kit using audio signal and voice link. (03 Hrs.)	testing and the related equipment/ measuring tools. Precautions and safety aspects while handling optical cables. (05 Hrs.)
Professional Skill 35 Hrs; Professional Knowledge 05 Hrs	Plan and Interface the LCD, LED DPM panels to various circuits and evaluate performance. ELE/N3102	**Digital panel Meter** 206. Identify LED Display module and its decoder/driver ICs. (05 Hrs.) 207. Display a word on a two line LED. (06 Hrs.) 208. Measure/current flowing through a resistor and display it on LED Module. (06 Hrs.) 209. Measure/current flowing through a sensor and display it on a LED module (DPM). (06 Hrs.) 210. Identify LCD Display module and its decoder/driver ICs. (06 Hrs.) 211. Measure/current flowing through a resistor and display it. (06 Hrs.)	Different types of seven segment displays, decoders and driver ICs. Concept of multiplexing and its advantages. Block diagrams of 7106 and 7107 and their configuration for different measurements. Use of DPM with seven segment display. Principles of working of LCD. Different sizes of LCDs. Decoder/ driver ICs used with LCDs and their pin diagrams. Use of DPM with LCD to display different voltage & current signals. (05 Hrs.)

Professional Skill 120 Hrs; Professional Knowledge 40 Hrs	Detect the faults and troubleshoot SMPS, UPS and inverter. (Mapped NOS: ELE/N7202)	**SMPS and Inverter** 212. Identify the components/devices and draw their corresponding symbols. (03 Hrs.) 213. Dismantle the given stabilizer and find major sections/ ICs components. (06 Hrs.) 214. List the defect and symptom in the faulty SMPS. (05 Hrs.) 215. Measure / Monitor major test points of computer SMPS. (07 Hrs.) 216. Troubleshoot the fault in the given SMPS unit. Rectify the defect and verify the output with load. Record your procedure followed for trouble shooting the defects. (08 Hrs.) 217. Use SMPS used in TVs and PCs for Practice. (05 Hrs.) 218. Install and test the SMPS in PC. (05 Hrs.) 219. Install and test an inverter. (05 Hrs.) 220. Troubleshoot the fault in the given inverter unit. Rectify the defects and verify the output with load. (08 Hrs.) 221. Construct and test IC Based DC-DC converter for different voltages. (08 Hrs.) 222. Construct and test a switching step down	Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p voltage adjustment. Voltage cut-off systems, relays used in stabilizer. Block Diagram of different types of Switch mode power supplies and their working principles. Inverter; principle of operation, block diagram, power rating, change over period. Installation of inverters, protection circuits used in inverters. Battery level, overload, over charging etc. Various faults and its rectification in inverter. Block diagram of DC-DC converters and their working principals. (20 Hrs.)

		regulator using LM2576. (08 Hrs.) 223. Construct and test a switching step up regulator using MC 34063. (08 Hrs.)	
		UPS 224. Connect battery stack to the UPS. (07 Hrs.) 225. Identify front panel control & indicators of UPS. (05 Hrs.) 226. Connect Battery & load to UPS & test on battery mode. (06 Hrs.) 227. Open top cover of a UPS; identify its isolator transformers, the UPS transformer and various circuit boards in UPS. (08 Hrs.) 228. Identify the various test point and verify the voltages on these. (05 Hrs.) 229. Identify various circuit boards in UPS and monitor voltages at various test points. (05 Hrs.) 230. Perform load test to measure backup time. (08 Hrs.)	Concept of Uninterrupted power supply. Difference between Inverters and UPS. Basic block diagram of UPS & operating principle. Types of UPS : Off line UPS, On line UPS, Line interactive UPS & their comparison UPS specifications. Load power factor & types of indications & protections Installation of single phase & UPS. (20 Hrs.)
Professional Skill 60 Hrs; Professional Knowledge 15 Hrs	Identify, Test and verify characteristics of Photovoltaic cells, Modules, Batteries and Charge controllers. Install a	1. Identify and Test an LED and a Photodiode to verify the photo emitting effect and light sensitivity. (04 hrs) 2. Test a Photo voltaic cell for different illumination levels and verify photovoltaic	Semiconductor properties and types. P-type and N-type semiconductors, PN junction, etc. Conversion of solar radiation to electricity.

	solar panel, execute testing and evaluate performance by connecting the panel to the inverter. (Mapped NOS: ELE/N5902)	property. (04 hrs) 3. Plot I-V curve for photovoltaic cell based on the illumination at constant temperature. (04hrs) 4. Plot I-V curve for photovoltaic cell based on temperature at constant illumination. (04 hrs) 5. Test photovoltaic cell in sunlight at various angles of inclination and direction. (04 hrs)	Main materials used to develop solar cells (Silicon, Cadmium tellurides, etc.) Light sensitive properties of PN junction. Difference of photo electric and photo voltaic effects of a PN junction. PV cell characteristics, I–V curve, effects of temperature. Photovoltaic effect. Photo voltaic module: minimal functional specification, cells per module, max watts per module, maximum voltage at max power, maximum current at max power. (05)
		Solar Power (Renewable Energy System) 231. Wire a solar controller to a battery storage station. (08 Hrs.) 232. Connect storage batteries to a power inverter. (08Hrs.) 233. Connect and test solar panel to the Inverter and run the load. (08Hrs.) 234. Install a solar power to charge a rechargeable 12 V DC battery and find out the charging time. (08 Hrs.) 235. Install a Solar Inverter. (08 Hrs.)	Need for renewable energy sources, Solar energy as a renewable resource. Materials used for solar cells. Principles of conversion of solar light into electricity. Basics of photovoltaic's cell. Module, panel and Arrays. Factors that influence the output of a PV module. SPV systems and the key benefits. Difference between SPV and conventional power. Solar charge controller or regulator and its role. Safety precautions while working with solar systems. (10 Hrs.)

Professional Skill 30 Hrs; Professional Knowledge 10 Hrs	Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot. (Mapped NOS: ELE/N8107)	**Cell phones** 236. Dismantle, identify the parts and assemble different types of smart phones. (04 Hrs.) 237. Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks. (04 Hrs.) 238. Interface the cell phone/smart phone to the PC and transfer the data card. (03 Hrs.) 239. Flash the various brands of cell phone/smart phone (at least 3). (03 Hrs.) 240. Format the cell phone/ smart phone for virus (approach the mobile repair shop/ service centre). (04 Hrs.) 241. Perform the interfacing of cell phone/smart phone to the PC and dismantle the cell phone and identify the power section and test its healthiness. (04 Hrs.) 242. Find out the fault of basic cell phone system. Rectify the fault in ringer section and check the performance. (04 Hrs.) 243. Replace various faulty parts like mic, speaker, data/ charging/ audio jack etc. (04 Hrs.)	Introduction to mobile communication. Concept cell site, hand off, frequency reuse, block diagram and working of cell phones, cell phone features. GSM and CDMA technology. Use IEMI number to trace lost/misplaced mobile phone. (10 Hrs.)
Professional	Check the various	**LED Lights**	

Skill 15 Hrs; Professional Knowledge 05 Hrs	parts of a LED lights & stacks and troubleshoot. (Mapped NOS: ELE/N9302)	244. Dismantle the LED light, identify the connections of LEDs stacks, protection circuits, regulator. (03 Hrs.) 245. Identify the rectifier, controller part of LED lights. (03 Hrs.) 246. Make series string connection of six LED's and connect four Series strings in parallel. (03 Hrs.) 247. Connect to such parallel sets in Series to create a matrix of LED's. (03 Hrs.) 248. Apply suitable voltage and check Voltage across series strings. (03 Hrs.)	Types of LED panels used in various lighting applications. Stacking of LEDs. Driving of LED stacks. (05 Hrs.)
Professional Skill 50 Hrs; Professional Knowledge 15 Hrs	Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote. (Mapped NOS: ELE/N3102)	**LCD and LED TV** 249. Identify and operate different Controls on LCD, LED TV. (05 Hrs.) 250. Identify components and different sectors of LCD and LED TV. (05 Hrs.) 251. Dismantle; Identify the parts of the remote control. (05 Hrs.) 252. Dismantle the given LCD/LED TV to find faults with input stages through connectors. (05 Hrs.) 253. Detect the defect in a LED/LCD TV receiver given to you. Rectify the fault. (10 Hrs.) 254. Troubleshoot the faults in the given LED/LCD TV receiver. Locate and	Difference between a conventional CTV with LCD & LED TVs. Principle of LCD and LED TV and function of its different section. Basic principle and working of 3D TV. IPS panels and their features. Different types of interfaces like HDMI, USB, RGB etc. TV Remote Control –Types, parts and functions, IR Code transmitter and IR Code Receiver. Working principle, operation of remote control. Different adjustments, general faults in Remote Control. (15 Hrs.)

		rectify the faults. (10 Hrs.) 255. Test LED/LCD TV after troubleshooting the defects. (05 Hrs.) 256. Identify various connectors and connect the cable operators external decoder (set top box) to the TV. (05 Hrs.)	
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED 40 Hrs	Read and apply engineering drawing for different application in the field of work. CSC/N9401	**ENGINEERING DRAWING:** • Reading of Electronics Sign and Symbols. • Sketches of Electronics components. • Reading of Electronics wiring diagram and Layout diagram. • Drawing of Electronicscircuitdiagram. DrawingofBlockdiagramofInstruments&equipmentoftrades.	
WORKSHOP CALCULATION & SCIENCE: 16 Hrs			
Professional Knowledge WCS 16 Hrs	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402	**WORKSHOP CALCULATION & SCIENCE:** **Algebra,** Addition, Subtraction,Multiplication&Divisions. Algebra– Theoryofindices, Algebraicformula,relatedproblems. **EstimationandCosting** Simpleestimationoftherequirementofmaterialetc.,asapplicabletothe trade. Problemsonestimationand costing.	
Project work / Industrial visit **Broad areas:** a) Remote control for home appliances b) Solar power inverter c) Musical light chaser d) 7 segment LED display decoder drive circuit			

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs + 60 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

List of Tools & Equipment			
ELECTRONICS MECHANIC(for batch of 24 candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Connecting screwdriver	10 X 100 mm	12 Nos.
2.	Neon tester 500 V.	500 V	8 Nos.
3.	Screw driver set	Set of 7	12 Nos.
4.	Insulated combination pliers	150 mm	8 Nos.
5.	Insulated side cutting pliers	150mm	10 Nos.
6.	Long nose pliers	150mm	8 Nos.
7.	Soldering iron	25 Watt, 240 Volt	12 Nos.
8.	Electrician knife	100 mm	8 Nos.
9.	Tweezers	150 mm	12 Nos.
10.	Digital Multimeter	(3 3/4 digit) ,4000 Counts	12 Nos.
11.	Soldering Iron Changeable bits	15Watt, 240 Volt	8 Nos.
12.	De- soldering pump electrical heated, manual operators	230 V, 40 W	12 Nos.
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units no additional items are required			
Lists of Tools:			
13.	Steel rule graduated both in Metric and English Unit	300 mm,	4 Nos.
14.	Precision set of screw drivers	T5, T6, T7	2 Nos.
15.	Tweezers – Bend tip		2 Nos.
16.	Steel measuring tape	3 meter	4 Nos.
17.	Tools makers vice	100mm (clamp)	1 No.
18.	Tools maker vice	50mm (clamp)	1 No.
19.	Crimping tool (pliers)	7 in 1	2 Nos.
20.	Magneto spanner set	8 Spanners	2 Nos.
21.	File flat bastard	200 mm	2 Nos.
22.	File flat second cut	200 mm	2 Nos.
23.	File flat smooth	200 mm	2Nos.
24.	Plier - Flat Nose	150 mm	4 Nos.

25.	Round Nose pliers	100 mm	4 Nos.
26.	Scriber straight	150 mm	2 Nos.
27.	Hammer ball pen	500 grams	1 No.
28.	Allen key set (Hexagonal -set of 9)	1 - 12 mm, set of 24 Keys	1 No.
29.	Tubular box spanner	Set - 6 - 32 mm	1 set.
30.	Magnifying lenses	75 mm	2 Nos.
31.	Continuity tester		6 Nos.
32.	Hacksaw frame adjustable	300 mm	2 Nos.
33.	Chisel - Cold - Flat	10 mm X 150 mm	1 No.
34.	Scissors	200mm	1No.
35.	Handsaw 450mm	Hand Saw - 450 mm	1 No.
36.	Hand Drill Machine Electric with Hammer Action	13 mm	2 Nos.
37.	First aid kit		1 No.
38.	Bench Vice	Bench Vice - 125 mm	1 No. each
		Bench Vice - 100 mm	
		Bench Vice - 50 mm	
List of Equipments			
39.	Air Conditioner	Two ton split ac	As required
40.	Dual DC regulated power supply	30-0-30 V, 2 Amps	4 Nos.
41.	DC Regulated Variable Programmable DC Power Supply	0-30V/3A	2 Nos.
42.	LCR meter (Digital) Handheld		1 No.
43.	CRO Dual Trace	20 MHz (component testing facilities)	2 Nos.
44.	Signal Generator with Digital Display for Frequency Amplitude	10 Hz to 100 Khz, 50/600 Ohms (output impedance)	2 Nos.
45.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30 Amp	1 No.
46.	Analog multimeter		4 Nos.
47.	Clamp meter	0 - 10 A	2 Nos.
48.	Function generator (DDS Technology (Sine, Square, Triangle, Ramp, Pulse, Serial Data, TTL and Modulation.)	1 mHz -10 MHz Function-Pulse – Modulation Generator with Built in 40MHz Frequency Counter	2 Nos.
49.	Dimmer starter	3 Amps	2 Nos.

50.	Autotransformer	15 Amps	2 Nos.
51.	Analog Component Trainer	Breadboard for Circuit design with necessary DC /AC power supply: Sine, Square, Triangle Modulating Signal Generator and Simulation Software	4 Nos.
52.	Milli Ammeter (AC)	0 – 200 mA	2 Nos.
53.	Milli Ammeter (DC)	0 – 500 mA	2 Nos.
54.	Op Amp trainer		2 Nos.
55.	Digital IC Trainer	Breadboard for Circuit design with necessary DC Power Supply, Graphical LCD, Clock Frequency 4 different steps, Data Switches: 8 Nos, LED Display: 8 Nos. (TTL), Seven Segment Display, Teaching Simulation Software	4 Nos.
56.	Digital IC Tester		1 No.
57.	Digital and Analog Bread Board Trainer	DC/AC Power Supply, Sine/ Square/ TTL Generator Data Switches, LED indication, LED Display: 8 in Nos Simulation/Teaching Content through software	6 Nos.
58.	Rheostats various values and ratings		2 Nos. each
59.	POWER ELECTRONICS TRAINER with at least 6 no's of application board MOSFET Characteristics SCR Characteristics SCR Lamp Flasher SCR Alarm Circuit Series Inverter Single Phase PWM Inverter		4 No.
60.	Computers in the assembled		4 Nos.

	form (including cabinet, motherboards, HDD, DVD, SMPS, Monitor, KB, Mouse, LAN card, Blu-Ray drive and player), MS Office education version.		
61.	Laptops latest configuration	I5 and i7 and above configuration	1 No.
62.	Laser jet Printer		1 No.
63.	INTERNET BROADBAND CONNECTION		1 No.
64.	Electronic circuit simulation software with 10 user licenses	Circuit Design and Simulation Software with PCB Design with Gerber and G Code Generation, 3D View of PCB, Breadboard View, Fault Creation and Simulation.	1 No.
65.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
66.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB		As required
67.	DSO (colour)	4 Channel , 50MHz Real Time Sampling 1G Samples/Sec, 12 Mpts Memory with PC Interface USB, LAN and math function includes +, -, FFT, differential, integral, abs, log etc.	1 No.
68.	Soldering & De soldering Station	200 watt adjustable	1 No.
69.	SMD Soldering & De soldering Station with necessary accessories	With temperature controller Digital display	2 Nos.
70.	Frequency modulator and Demodulator trainer kit	FM Modulator Type : Reactance Modulator, Varactor	2 Nos.

		Modulator, VCO Based Modulator FM Demodulator type All 5 demodulation techniques Detailed teaching and learning contents through software.	
71.	PAM, PPM,PWM trainer kit		2 Nos.
72.	AM/FM Commercial radio receivers		2 Nos.
73.	Microcontroller kits (8051) along with programming software (Assembly level Programming)	Core 8051, ready to run programmer for AT89C51/52 & 55, programming modes Key Pad and PC circuits. Detailed learning content through simulation Software.	4 Nos.
74.	Application kits for Microcontrollers 6 different applications	1. Input Interface : 4x4 Matrix Keypad, ASCII Key PAD, Four Input Switch 2. Display Module 16X2 LCD, Seven Segment, LED Bar Graph 3. ADC/DAC Module with most popular DC/DAC0808 4. PC Interface: RS232 & USB 5. Motor Drive: DC, Servo, Stepper 6. DAQ: Data Acquisition to sense different sensors signals	1 set
75.	Sensor Trainer Kit Containing following Sensors 1. Thermocouple 2. RTD 3. Load Cell/ Strain Gauge 4. LVDT 5. Smoke Detector Sensors 6. Speed Sensor 7. Limit Switch 8. Photo sensors 9. Optocouplor 10. Proximity Sensor	Graphical touch LCD with inbuilt processor for viewing the output waveforms, In built DAQ, and standard processing circuits like Inverting , Non – Inverting , Power, Current , Instrumentation Differential Amplifier, F/V,V/F,V/I,I/V Converter, **Sensors :**RTD,NTC Thermistor,LM35 Thermocouple, Gas(Smoke) Sensor, Load cell, LVDT Sensor,	2 Nos.

		Speed Sensor	
76.	Various analog and digital ICs useful for doing project works mentioned in the digital and analog IC applications modules		As required
77.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
78.	Fiber optic communication trainer	Full Duplex Analog & Digital Trans-receiver with 660nm & 950nm, Noise Generator with variable gain, Four Seven Segment Display BER Counter, Eye Pattern.	2 Nos.
79.	Seven segment DPM trainer		6 Nos.
80.	LCD based DPM		6 Nos.
81.	SMPS of different make		4 Nos.
82.	UPS trainer	PWM switching technology, Test points to measures the voltages of different sections Overall functioning of UPS Trainer, AVR transformer, UPS with load condition	1No.
83.	UPS		As required
84.	Mobile phone Trainer	2G /3G/4G Dual SIM GSM Handset. Frequency measurement and band verification. Real time Mobile Operation	1 No.
85.	Smart phones of different make (android/Windows)		4 Nos.
86.	Cell phone power source with charger chords for different cell phones		As required
87.	LCD TV (Trainer kit)	21-inch full HD LCD Color Television should support PAL/ NTSC video formats Complete block diagram of a	1 No.

		LCD TV system, Study board indicating various sections of LCD TV along with the test points and switch faults	
88.	LCD TV (21”)		2 Nos.
89.	LED TV (Trainer kit)	20-inch full HD LED Color Television, PAL/ NTSC video formats, complete block diagram of a LED TV system, Study board indicating various sections of LED TV along with the test points and switch faults Trouble shooting in different sections.	1 No.
90.	LED TV (21”)		2 Nos.
91.	Home theatre system		1No.
92.	Solar Training Kit/ Simulator	With built in meters for DCV, DCA, AC multifunction Meter (for ACI, ACV, Power, Frequency), Protection Circuits, BS-10 terminals for making the connection, Single/ Dual axis tracking system Charge Controller : PWM based MPPT, Charging Stage : Bulk, Absorptions and Float	1 No.
93.	LED lighting system	Measurement of Power, Voltage, Current, Power Factor and Light output performance of different lighting products like LED, CFL at variable input voltages 0 to 245V variable AC	2 sets
C. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required.			
94.	Instructor’s table		1 No.
95.	Instructor’s chair		2 Nos.
96.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
97.	Lockers with 16 drawers standard		2 Nos.

	size		
98.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	2 Nos.
99.	Black board/white board		1 No.
100.	Fire Extinguisher	Arrange all proper NOCs and equipments from Municipal/Competent authorities.	

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

GOVERNMENT OF INDIA
MINISTRY OF SKILL
DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

COMPUTER OPERATOR AND PROGRAMMING ASSISTANT (COPA)

(Duration: One Year)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3

SECTOR – IT & ITeS

Directorate General of Training

COMPUTER OPERATOR AND PROGRAMMING ASSISTANT

(Non-Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 3

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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CONTENTS

1. COURSE INFORMATION

During the one-year duration of Computer Operator and Programming Assistant trade a candidate is trained on professional skill, professional knowledge and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered under the professional skill subject are as below:

The trainee learns about safety and environment, use of fire extinguishers. He learns about trade tools, identifies computer peripherals, internal components, basic DOS commands, Windows and Linux interface and its related software installation process. Trainees will work with MS Office package to create word document, practice with excel sheet and get idea to create a good power point presentation, maintain database with MS Access. They will set up and configure a network system of an organization. They will understand and able to work on Advanced excel concepts. They will use internet to search information using browser along with official/ social communication process. Trainees will learn E-commerce system and will be able to browse, select and transact using different E-commerce websites. They will identify different type of cybercrimes now days and will be able to secure information from Internet by using cyber security concept. The trainees will be able to use cloud for their projects. They will comprehend the basic programming techniques and can create algorithms and flow charts. Trainees will create basic static webpage using HTML. Trainees can go on industrial visit or projects specified in the syllabus. The trainee learns scripting language i.e. JavaScript and will develop dynamic webpage and hosting technique in a registered domain. They will be able to develop programmes using Python.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

"Computer Operator and Programming Assistant" trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of one year duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill, knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Trainee needs to demonstrate broadly that they are able to:

- Read and interpret technical parameters/ documentation, plan and organize work processes, identify necessary materials and tools.
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations.
- Apply professional knowledge & employability skills while performing the job and repair & maintenance work.
- Check the job/ assembly as per drawing for functioning identify and rectify errors in job/ assembly.
- Document the technical parameter related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as computer operator and will progress further as assistant programmer, programmer and can rise up to the level of senior programmer.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one year: -

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	840
2	Professional Knowledge (Trade Theory)	240
3	Employability Skills	120
	Total	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

On the Job Training (OJT)/ Group Project	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge, and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute must maintain individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All-India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guideline. The pattern and marking structure are being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidence and records of internal (Formative) assessments are to be preserved until forthcoming year examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an	• Demonstration of good skills and accuracy in the field of work/ assignments. • A fairly good level of neatness and consistency to accomplish job activities.

acceptable standard of craftsmanship.	• Occasional support in completing the task/ job.
(b)Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels and accuracy in the field of work/ assignments. • A good level of neatness and consistency to accomplish job activities. • Little support in completing the task/ job.
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels and accuracy in the field of work/ assignments. • A high level of neatness and consistency to accomplish job activities. • Minimal or no support in completing the task/ job.

3. JOB ROLE

Computer Operator: operates computer and peripheral equipment to process business, scientific, engineering, or other data, according to operating instructions. Enters commands, using keyboard of computer terminal, and presses buttons and flips switches on computer and peripheral equipment, such as tape drive, printer, data communications equipment, and plotter, to integrate and operate equipment, following operating instructions and schedule. Loads peripheral equipment with selected materials, such as tapes and printer paper for operating runs, or oversees loading of peripheral equipment by Peripheral Equipment Operators. Enters commands to clear computer system and start operation, using keyboard of computer terminal. Observes peripheral equipment and error messages displayed on monitor of terminal to detect faulty output or machine stoppage. Enters commands to correct error or stoppage and resume operations. Notifies supervisor of errors or equipment stoppage. Clears equipment at end of operating run and reviews schedule to determine next assignment. Records problems which occurred, such as down time, and actions taken. May answer telephone calls to assist computer users encountering problem. May assist workers in classifying, cataloguing, and maintaining tapes.

Programming Assistant: installs, maintains, and updates computer programs by making minor changes and adjustments to them under the guidance of computing professionals. Maintains and updates documents of computer programs and installations. Applies knowledge of principles and practices in programming and computing in order to identify and solve problems arising in the course of their work. They may receive guidance from managers or professionals. May supervise other workers also.

Web Developer: Web Developer is responsible for designing and maintaining web-based applications that include static and dynamic content. This includes the design, layout, and coding of a website. They may work standalone or along with application/functional developers as part of the overall solution that includes a web-based component.

User Interface Developer: I Developer is responsible for creating complex user interfaces for a variety of applications, such as computer programs, databases, and websites.

Data Communication Analyst/Network Administrator: Data Communication Analyst researches, tests, evaluates, and recommends data communications hardware and software: Identifies areas of operation which need upgraded equipment, such as modems, fibre optic cables and telephone wires. Conducts survey to determine user needs. Reads technical manuals and brochures to determine equipment which meets establishment requirements. Visits vendors to learn about available products or services. Tests and evaluates hardware and software to determine efficiency, reliability, and compatibility with existing system, using equipment such as computer terminal and modem. Analyses test data and recommends hardware or software for purchase. Develops and writes procedures for installation, use, and solving problems of communications hardware and

software. Monitors system performance. Trains users in use of equipment. Assists users to identify and solve data communication problem. May write technical specifications to send to vendors for bid. May oversee or assist in the installation of communications hardware. May perform minor equipment repairs.

Reference NCO-2015: -

i) 4131.0600 – Computer Operator
i) 3514.0300 – Programming Assistant
ii) 2513.0101 – Web Developer
iii) 2513.0201 – User Interface Developer
iv) 2523.0100 – Data Communication Analyst/Network Administrator

Reference NOS:

i) SSC/N3022
ii) SSC/N0503
iii) SSC/N0501
iv) SSC/N9401
v) SSC/N9402
vi) SSC/N9403
vii) SSC/N9404
viii) SSC/N9405
ix) SSC/N9406
x) SSC/N9407

4. GENERAL INFORMATION

Name of the Trade	**COMPUTER OPERATOR AND PROGRAMMING ASSISTANT**
Trade Code	DGT/1003
NCO - 2015	4131.0600, 3514.0300, 2513.0101, 2513.0201, 2523.0100
NOS Covered	SSC/N3022, SSC/N0503, SSC/N0501
NSQF Level	Level-3
Duration of Craftsmen Training	One Year (1200 Hours + 150 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, CP, LC, DW, AA, LV, HH, AUTISM, SLD
Unit Strength (No. Of Student)	24(There is no separate provision of supernumerary seats)
Space Norms	60 sq. metre
Power Norms	5.5 KW
Instructors Qualification for	
1. Computer Operator And Programming Assistant Trade	B.Voc/Degree in Computer Science/ IT from AITCE/UGC Recognized University with one year expreience in the relevant field. OR Post Graduate in Computer Science /Computer Application / IT from UGC Recognized University or NIELIT B Level with one year expreience in the relevant field. OR Bachelor in Computer Science / Computer Application / IT OR PGDCA from UGC recognized University or NIELIT A Level with two year expreience in the relevant field. OR 03 years Diploma in Computer Science / IT from recognized Board/ Institute or relevant Advanced Diploma (Vocational) (ADIT) from DGT with two year expreience in the relevant field. OR

	NTC/NAC in COPA or any trade in IT-ITeS sector trade with three year expreience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT.
2. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.
3. Minimum Age for Instructor	21 Years
List of Tools & Equipment	As per Annexure-I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

1. Install and setup operating system and related software in a computer following safety precautions. (NOS: SSC/N3022)
2. Create, format and edit document using word processing application software. (NOS: SSC/N3022)
3. Create, format, edit and develop a workbook by using spreadsheet application software. (NOS: SSC/N3022)
4. Create and customize slides for presentation. (NOS: SSC/N3022)
5. Create and manage database file using MySQL. (NOS: SSC/N9401)
6. Install, setup/configure, troubleshoot and secure computer network including Internet. (NOS: SSC/N3022)
7. Develop web pages using HTML and CSS. (NOS: SSC/N0503, SSC/N0501)
8. Develop web pages using Java Script. (NOS: SSC/N0503, SSC/N0501)
9. Create workbooks with advanced formulae, macros, charts, pivot tables and demonstrate ability to use Power tools. (NOS: SSC/N9402)
10. Browse, select and transact using E commerce websites. (NOS: SSC/N9403)
11. Secure information from Internet by using cyber security concept. (NOS: SSC/N9404)
12. Explain Cloud concepts & services. (NOS: SSC/N9405)
13. Write programs using Python / Java language. (NOS: SSC/N9406, SSC/N9407)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Install and setup operating system and related software in a computer following safety precautions. (NOS: SSC/N3022)	Identify basic first aid and use them under different circumstances.
	Identify different fire extinguisher and use the same as per requirement.
	Assemble a computer
	Install and configure Windows OS.
	Install the printer and other peripheral devices.
	Install application software.
	Troubleshoot the PC.
	Execute DOS and LINUX commands.
	Customize Windows and LINUX OS settings.
2. Create, format and edit document using word processing application software. (NOS: SSC/N3022)	Create your resume using editing/formatting options in a document.
	Create purchase order using tables and images.
	Create magazine using columns page borders, header footers.
	Create an invitation letter using mail merge for n invitees.
3. Create, format, edit and develop a workbook by using spreadsheet application software. (NOS: SSC/N3022)	Identify Excel tools in the Ribbon.
	Create mark sheet using a spreadsheet with data validation.
	Create a chart for the mark sheet.
	Create Pay slip using functions and formulae with sharing two different sheets/files.
	Create a table and Perform Sorting; filtering, Subtotal, validation, and goal seek on a table.
	Prepare a pivot table on any existing table with data.
	Create a table and Perform Sorting; filtering, Subtotal, validation, and goal seek on a table.
	Prepare a pivot table on any existing table with data.
4. Create and customize slides for presentation. (NOS: SSC/N3022)	Create simple presentations
	Create presentations with tables, images & graphic elements
	Create presentations with audio & video elements with transitions
5. Create and manage database file by using MySQL. (NOS: SSC/N9401)	Create simple database on Relational Database in MySQL using data validation, filters, sorting, query.
	Import, Export, Link, Backup and Retrieve database in MySQL.
	Create query with functions, joins, sub-query.

6. Install, setup/configure, troubleshoot and secure computer network including Internet. (NOS: SSC/N3022)	Identify different cables and connectors used in networking.
	Assign Computer Name and workgroup to a computer Prepare UTP cross cable & connect computers.
	Share a printer with Network.
	Share Internet using Windows Tools.
	Check Network connectivity.
	Configure HUB & Switch.
	Configure DHCP and firewall.
	Secure Network with various tools.
	Create E Mail ID and sending / receiving mails Perform text chat and video chat using social network sites Configure Outlook Express.
7. Develop web pages using HTML, CSS . (NOS: SSC/N0503, SSC/N0501)	Create Text, Lists, Tables, and Frames with HTML.
	Create Hyperlinks, Images and Multimedia Working with Forms and controls.
	Create Lists and Tables with CSS.
	Create Box Model by using borders, Padding, and Margin with CSS.
	Create CSS document by Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector.
	Create simple static Web Pages using internal styles (CSS) and external style.
8. Develop web pages using Java Script. (NOS:SSC/N0503, SSC/N0501)	Design a dynamic Web Page in JavaScript using various operators.
	Design a dynamic Web Page in JavaScript using various control statements and looping structures.
	Design a dynamic Web Page in JavaScript using strings and functions.
	Design a dynamic Web Page in JavaScript using Arrays and objects.
	Design a dynamic Web Page in JavaScript using Web Forms and images.
9. Create workbooks with advanced formulas, macros, charts, pivot tables and demonstrate ability to use Power tools.	Create workbooks with advanced functionalities in Excel.
	Create advanced charts & Pivot Tables.
	Create output files using specific Power tool.
10. Browse, select and transact using E-commerce websites.	Place order for products from E commerce websites for purchase.
	Upload a product in E Commerce site for sale.
	Identify security issues in E- commerce and payment operations.

11. Secure information from Internet by using cyber security concept.	Provide firewall security for Internet connection and Network System.
	Make backup copies of important file, data, and information.
	Secure your Wi-Fi networks using wireless security features.
12. Explain Cloud concepts & services and Describe Application Development Life Cycle.	Create cloud concepts.
	Use common cloud services such as Office 365, Google Drive, Dropbox.
	Identify the phases of Application Development Life Cycle.
	Describe Roles in each of phases of the Application Development Life Cycle.
13. Write programs using Python / Java language.	Install Python / Java.
	Perform operations on Python / Java ; construct simple code and document these.
	Perform Document code segments using comments and documentation strings.
	Perform operations using in-built modules / libraries.

7. TRADE SYLLABUS

SYLLABUS FOR COMPUTER OPERATOR AND PROGRAMMING ASSISTANT			
DURATION: ONE YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill - 94 Hrs; Professional Knowledge - 32 Hrs	Install and setup operating system and related software in a computer following safety precautions. (Mapped NOS: SSC/N3022)	**Safe working practices (10 Hrs)** 1. Visit COPA Lab. of the institutes and locate the electrical connections with computer system setup. (3 Hrs) 2. Identifying safety symbols and hazard identification. (3 Hrs) 3. Practice safe methods of fire fighting in case of electrical fire. (2 Hrs) 4. Use of fire extinguishers. (2Hrs) **Assemble a Desktop PC (8 hrs)** 5. Identify computer peripherals and internal components of a desktop computer. (4 Hrs) 6. Assemble components of desktop computer. (4 Hrs) **Using Windows Operating Systems (20 hrs)** 7. Practice on Windows interface and navigating windows. (3 Hrs) 8. Practice on managing files and folders using removable drives. (4 Hrs) 9. Customize the desktop (2 hrs) 10. Settings and manage user accounts. (1 Hr) 11. View system properties and control panel details. (3 Hrs) 12. Work with keyboard shortcut commands. (4 Hrs) 13. Print and scan document using different commands. (3 Hrs) **Computer basics and Software Installation (20 Hrs)**	**Introduction to Computers (3 Hrs)** • Safe working practices • Scope of the COPA trade. • Safety rules and safety signs. • Types and working of fire extinguishers. Introduction to Computer components **Introduction to computer system (4 Hrs)** • Concepts of Hardware and Software. • Function of motherboard components and various processors. • Various Input/ Output devices in use and their features **Introduction Windows Operating System (9 Hrs)** • Introduction to operating System • Main features of Windows OS

		14. View the BIOS settings and their modifications. (3 Hrs) 15. Install Windows operating system. (4 Hrs) 16. Format hard disk and create partition. (3 Hrs) 17. Identify and rectify common hardware and software issues during OS installation. (3 Hrs) 18. Install necessary application software for Windows i.e. Office Package, PDF Reader, Media Player etc. (2 Hrs) 19. Configure Bluetooth and Wi-Fi settings. (1 Hr) 20. Install Drivers for printer, scanner, webcam and DVD etc. (2 Hrs) 21. Burn data, video and audio files on CD/DVD using application software. (2 Hrs) **DOS Command Line Interface (9Hrs)** 22. Use basic DOS commands for directory listing. (5 Hrs) 23. Manage files and folders using DOS commands. (4 Hrs) **Install Ubuntu Linux operating system and execute basic Linux commands (27 Hrs)** 24. Installation of Ubuntu Linux operating system (6 Hrs) 25. Install necessary application software for Linux i.e. Office Package, PDF Reader, Media Player etc. (4 Hrs) 26. Use Basic Linux commands for directory listing, file and folder management, password etc. (6 Hrs) 27. Use the Linux graphical user interface for file and folder management, exploring the system etc. (6 Hrs) 28. Customize desktop settings and manage user accounts in Linux. (3 Hrs)	• Concept of various shortcut commands. **Introduction to the booting process (6 Hrs)** • Introduction to various types of memories and their features. • Basic Hardware and software issues and their solutions. • Usage of Application software and Antivirus. **Introduction to DOS Command Line Interface & Linux Operating Systems (10 Hrs)** • Introduction to basic DOS Internal and External Commands. • Introduction to Open Source Software • Introduction to Linux Operating System features, structure, files and processes • Basic Linux commands.

		29. View system properties and manage system setting in Linux. (2 Hrs)	
Professional Skill – 47 Hrs.; Professional Knowledge - 14 Hrs	Create, format, and edit document using word processing application software. (Mapped NOS: SSC/N3022)	**Using Word Processing Software (47 hrs)** **Manage documents (11 Hrs.)** 30. **Navigate within documents (2 Hrs)** • Search for text • Link to locations within documents • Move to specific locations and objects in documents • Show and hide formatting symbols and hidden text 31. **Format documents (4.6 Hrs)** • Set up document pages • Apply style sets • Insert and modify headers and footers • Configure page background elements 32. **Save and share documents (2 Hrs)** • Save documents in alternative file formats • Modify basic document properties • Modify print settings • Share documents electronically 33. **Inspect documents for issues (2.4 Hrs)** • Locate and remove hidden properties and personal information • Locate and correct accessibility issues • Locate and correct compatibility issues **Format documents (8 Hrs.)** 34. **Insert text and paragraphs (2 Hrs)** • Find and replace text	**Using Word Processing Software (14 Hrs)** • Introduction to the various applications in MS office. • Introduction to Word features, Office button, toolbars. • Creating, saving and formatting and printing documents using Word. • Working with objects, macro, mail merge, templates and other tools in Word.

		• Insert symbols and special characters 35. **Format text and paragraphs (3 Hrs)** • Apply text effects • Apply formatting by using Format Painter • Set line and paragraph spacing and indentation • Apply built-in styles to text • Clear formatting 36. **Create and configure document sections (3 Hrs)** • Format text in multiple columns • Insert page, section, and column breaks • Change page setup options for a section **Manage tables and lists (9.5 Hrs)** 37. **Create tables (3 Hrs)** • Convert text to tables • Convert tables to text • Create tables by specifying rows and columns 38. **Modify tables (3 Hrs)** • Sort table data • Configure cell margins and spacing • Merge and split cells • Resize tables, rows, and columns • Split tables • Configure a repeating row header 39. **Create and modify lists (3.5 Hrs)** • Format paragraphs as numbered and bulleted lists • Change bullet characters and number formats • Define custom bullet characters and number formats • Increase and decrease list levels	

		• Restart and continue list numbering • Set starting number values **Create and manage references (3 Hrs.)** 40. **Create and manage reference elements (1.4 Hrs)** • Insert footnotes and endnotes • Modify footnote and endnote properties • Create and modify bibliography citation sources • Insert citations for bibliographies 41. **Create and manage reference tables (1.6 Hrs)** • Insert tables of contents • Customize tables of contents • Insert bibliographies **Manage graphic elements (8.5 Hrs.)** 42. **Insert illustrations and text boxes (3 Hrs)** • Insert shapes • Insert pictures • Insert 3D models • Insert Smart Art graphics • Insert screenshots and screen clippings • Insert text boxes 43. **Format illustrations and text boxes (3 Hrs)** • Apply artistic effects • Apply picture effects and picture styles • Remove picture backgrounds • Format graphic elements • Format SmartArt graphics • Format 3D models 44. **Add text to graphic elements (1 Hr)** • Add and modify text in text boxes • Add and modify text in shapes	

		• Add and modify SmartArt graphic content 45. **Modify graphic elements (1.5 Hrs)** • Position objects • Wrap text around objects • Add alternative text to objects for accessibility **Manage document collaboration (3.5 Hrs.)** 46. **Add and manage comments (1 Hrs)** • Add comments • Review and reply to comments • Resolve comments • Delete comments 47. **Manage change tracking (2.5 Hrs)** • Track changes • Review tracked changes • Accept and reject tracked changes • Lock and unlock change tracking **Manage Mailings (3.5 Hrs)** 48. **Perform mail merge (3.5 Hrs)** • Create envelopes • Create labels • Create a new mailing list • Perform mail merge using an existing list	
Professional Skill - 72 Hrs.; Professional Knowledge - 18 Hrs	Create, format, edit and develop a workbook by using spreadsheet application software. (Mapped NOS: SSC/N3022)	**Spread Sheet Application (72 Hrs)** **Manage Worksheets and Workbooks (12 Hrs.)** 49. **Open files in MS Excel (1.5 Hrs)** • Open MS Excel • Create a new Excel file • Create a new Excel file from a template • Open an existing Excel file 50. **Import data (1.5 Hrs)** • Import data from txt files • Import data from csv files	**Spread Sheet Application (18 Hrs)** • Introduction to Excel features and Data Types. • Cell referencing and linking Sheets. • Introduction to various functions in all categories of Excel.

		51. **Navigate within workbooks (2 Hrs)** • Search data • Navigate to named cells, ranges or workbook elements • Insert and remove hyperlinks 52. **Format worksheets and workbooks (2 Hrs)** • Modify page setup • Adjust row height and column width • Customize headers and footers 53. **Customize options and views (3 Hrs)** • Display and modify content in different views • Freeze rows and columns • Change window views • Modify basic workbook properties • Display formulas 54. **Configure content for collaboration (2 Hrs)** • Set a print area • Save workbooks in alternative file formats • Configure print settings **Manage data cells and ranges (12 Hrs.)** 55. **Manipulate data (3 Hrs)** • Paste data by using special paste options • Fill cells by using Auto Fill • Insert and delete multiple columns or rows • Insert and delete cells 56. **Format cells and ranges (5 Hrs)** • Merge and Unmerge cells • Modify cell alignment, orientation and indentation • Format cells using Format Painter • Wrap text within cells • Apply number formats	• Concepts of sorting, filtering and validating data. • Analyzing data using charts, data tables, pivot tables, goal seek and scenarios

		• Apply cell formats from the Format cells dialog box • Apply cell styles • Clear cell formatting 57. **Define and reference named ranges (4 Hrs)** • Define a named range • Name a table • Summarize data visually Insert spark lines • Apply built in conditional formatting • Remove conditional formatting **Manage tables and table data (12 Hrs.)** 58. **Create and format tables (4 hrs)** • Create excel tables from cell ranges • Apply table styles • Convert tables to cell ranges 59. **Manage tables and table data (5 Hrs)** • Add or remove table rows and columns • Configure table style options • Insert and configure total rows 60. **Filter and sort table data (3 Hrs)** • Filter records • Sort data by multiple columns **Perform operations using formulas and functions (12 Hrs.)** 61. **Insert references (3 Hrs)** • Insert relative, absolute and mixed references • Reference named ranges and named tables in formulas 62. **Calculate and transform data (5 Hrs)** • Perform calculations using AVERAGE(), MIN(), MAX() and SUM()	

		• Count cells by using COUNT(), COUNTIF() and COUNTBLANK() • Perform conditional operations by using the IF() function 63. **Format and modify text(4 Hrs)** • Format text using RIGHT(),LEFT() and MID() functions • Format text using UPPER(), LOWER() and LEN() functions • Format text using CONCAT() and TEXTJOIN() functions **Manage Charts (12 Hrs.)** 64. **Create Charts (3 Hrs)** • Create charts • Create chart sheets 65. **Modify charts (4 Hrs)** • Add data series to charts • Switch between rows and columns in source data • Add and modify chart elements • Add trend lines to chart 66. **Format charts (5 Hrs)** • Apply chart layouts • Apply chart styles • Add alternative text to charts for accessibility **Manage Pivot Tables (12 Hrs.)** 67. **Create Pivot Tables(12 Hrs)** • Create Pivot tables from cell ranges • Manipulate fields (columns) to get desired analysis • Use Filters for pivot tables • Represent data as Count, Sum, Average & % of row / column • Group data in Columns & rows for aggregate reports	
Professional Skill - 53 Hrs;	Create and customize slides for presentation.	**Power point Presentations (9.5 Hrs.)** 68. **Open files in MS PowerPoint (1 Hr)**	**Power point Presentations (13 Hrs.)**

Professional Knowledge - 13 Hrs	(Mapped NOS: SSC/N3022)	• Open MS PowerPoint • Create a new PowerPoint file • Create a new PowerPoint file from a template • Open an existing PowerPoint file 69. **Format PowerPoint Presentations (1.5 Hrs)** • Add slides • Add titles and text • Select slide layouts • Add PowerPoint templates • Duplicate slides 70. **Modify slide masters, handout masters, and note masters (2 Hrs)** • Change the slide master theme or background • Modify slide master content • Modify slide layouts 71. **Change presentation options and views (1.5 Hrs)** • Change slide size • Display presentations in different views 72. **Save and share PowerPoint Presentations (1.5 Hrs)** • Save presentations in alternative file formats • Configure different Print settings • Share presentations electronically 73. **Configure and present slide shows (1 Hr)** • Hide unwanted slides while presenting • Configure slide show options • Present slide shows by using Presenter View 74. **Prepare presentations for collaboration (1 Hrs)** • Protect presentations by using passwords	• Image editing, Presentations • Introduction to Open Office. • Introduction to the properties and editing of images. • Introduction to different formats of images and their uses. • Introduction to Power Point and its advantages. • Creating Slide Shows. Fine tuning the presentation and good presentation technique

		• Export presentations to other formats **Format presentations (6.5 Hrs.)** 75. **Insert text and paragraphs (2 Hrs)** • Find and replace text • Insert symbols and special characters 76. **Format text and paragraphs (2 Hrs)** • Apply text effects • Apply formatting by using Format Painter • Set line and paragraph spacing and indentation • Apply built-in styles to text 77. **Create and configure sections (2.5 Hrs)** • Format text in multiple columns • Text and image presentation styles • Clear formatting **Manage tables and bulleted text (8 Hrs)** 78. **Create tables (3 Hrs)** • Insert tables in PowerPoint • Apply built-in table styles • Create tables by specifying rows and columns 79. **Modify tables (3 Hrs)** • Insert and delete table rows and columns • Configure cell margins and spacing • Merge and split cells • Resize tables, rows, and columns 80. **Create and modify bulleted text (2 Hrs)** • Format paragraphs as numbered and bulleted lists • Change bullet characters and number formats	

		• Increase and decrease list indents • Set starting number values • Restart and continue list numbering on different slides **Create and manage reference elements (hyperlinks) (1.25 Hrs)** • Create hyperlinks within presentations • Create hyperlinks in presentations for files and other sources **Manage graphic elements (11.5 Hrs)** 81. **Insert illustrations and text boxes (3.5 Hrs)** • Insert shapes • Insert pictures • Insert SmartArt graphics • Insert screenshots and screen clippings 82. **Format illustrations and text boxes (4 Hrs)** • Apply artistic effects • Apply picture effects and picture styles • Remove picture backgrounds • Crop images • Format graphic elements • Format SmartArt graphics 83. **Add and modify text in graphic elements (4 Hrs)** • Add and modify text in text boxes • Add and modify text in shapes • Add and modify SmartArt graphic text • Create, insert and modify charts **Manage Audio & Video elements (6.5 Hrs)** 84. **Add Audio elements (2 Hrs)** • Import audio files in presentations • Configure audio playback options	

		85. **Add Video elements (4.5 Hrs)** • Import video files in presentations • Resize video to fit slide • Configure video playback options **Manage transitions and animations (9 Hrs)** 86. **Add slide transitions (5 Hrs)** • Add same slide transition for all slides • Set transition effect duration • Configure transition start and finish options • Customise select slide transitions 87. **Add animations (4 Hrs)** • Animate text and graphic elements • Order shapes, images, and text boxes • Group shapes, images, and text boxes • Configure animation effects • Configure animation paths • Reorder animations on a slide **Manage collaboration (0.75 Hrs)** 88. **Add and manage comments (0.75 Hrs)** • Add comments • Review and reply to comments	
Professional Skill - 53 Hrs.; Professional Knowledge - 13 Hrs	Create and manage database file by using MySQL. (NOS: SSC/N9401)	**Demonstrate on (15 Hrs.)** 89. Installation of MySQL. (1 Hr) 90. Troubleshooting basic installation issues. (1 Hr) 91. Creation and use of database. (3 Hr) 92. Designing of tables. (3 Hr) 93. Applying data integrity rules. (2 Hr) 94. Using the DDL, DCL and DML statements. (2 Hrs)	**Database Concepts (4 Hrs.)** • Concept of DBMS, RDBMS. • Data Models, Concept of DBA, Database Users. • Database Schema. • Designing Database using Normalization Rules. • Various data types Data integrity, DDL DML and DCL statements. • Enforcing Primary key and foreign key.

		95. Enforcing constraints, primary key and foreign key. (2 Hrs) 96. Adding indices to Tables. (1 Hr) **Demonstrate on (15 Hrs)** 97. Simple select queries. (5 Hrs) 98. Insert and delete queries Update queries. (10 Hrs) **Demonstrate on (23 Hrs)** 99. Using the Number, Date and Character functions. Joins and Functions (11.5 Hrs) 100. Joins, Group by, Having, Sub query. (11.5 Hrs)	• Adding Indices. **Queries (4 Hrs)** • Concepts of Transactions • ACID Property of Transaction Constraints. **Joins and Functions (5 Hrs)** • Joining of tables • Sub Queries • Functions used in query like sum, average, max, min, count etc.
Professional Skill - 68 Hrs; Professional Knowledge - 16 Hrs	Install, setup/ configure, troubleshoot, and secure computer network including Internet. (Mapped NOS: SSC/N3022)	**Computer Network (68 Hrs.)** **Set-up & configure a Computer Network (48 Hrs.)** 101. View Network connections. (2 Hrs) 102. Connect a computer to a network and share Devices i.e. Printers, files, folders and drives. (4 Hrs) 103. Work with various Network devices, connectors and cables. Create straight and cross cable and punch a UTP cable in the patch socket and test the connectivity. (4 Hrs) 104. Practice IP Addressing and Subnet masking for IPV4/ IPV6 and pinging to test networks. (4 Hrs) 105. Configure Hub and Switch. (4 Hrs) 106. Set up and configure wired and wireless LAN in a Computer Lab within at least three computers. (6 Hrs)	**Communicating in a Connected World (12 Hrs.)** • Local Networks, • Communicating on a Local Network, Principles of Communications, • How do Ethernet Networks Work?, • How are Networks Built?, • Routing Across Networks • Explain how end-user devices and local networks interact with the global Internet. • Communicating in a Connected World Explain the concept of network communication.

		107. Use patch panel & I/O Box for wired LAN and installing & configuring Internet connection in a single PC and in a LAN. (6 Hrs) 108. Set up a proxy server/ DHCP Server with firewall. (8 Hrs) 109. Set up video conferencing using open-source software. (4 Hrs) 110. Use various tools (by open source /free) for network troubleshooting, maintenance and security for both Wired and Wireless (6 Hrs) 111. **Set up Internet access & communication (10 Hrs)** • Set-up internet connectivity • Set-up digital communication 112. **Use the Internet (10 Hrs)** • Browse the Internet • Use e-mail • Use Social Media • Use the phone for online activities	• Local Networks Explain the roles of devices in a network. • What Does a Home Network Look Like? • How Does Wi-Fi Work? • Introduction to LAN Devices, Internetworking Devices, **Internet Concepts (4 Hrs)** • Introduction to www, Concept of Internet, Web Browsers, internet servers and search engines. • Concepts of Domain naming Systems and E mail communication. • Introduction to video chatting tools and Social Networking concepts.
Professional Skill - 67 Hrs; Professional Knowledge - 17 Hrs	Develop web pages using HTML and CSS. (Mapped NOS: SSC/N0503, SSC/N0501)	**Create simple static web pages using HTML tags (67 Hrs.)** 113. **Practice HTML (46 Hrs)** • Practice with basic HTML elements (e.g. head, title, body), tag and attributes. • Design simple web page with text, paragraph and line break using HTML tags • Format text, change background colour and insert pictures in web page • Design simple web page with tables and lists.	**Web Design Concepts (17 Hrs)** • Concepts of Static and Dynamic Web pages. • Introduction to HTML and various tags in HTML. • Concepts of different controls used in Web Pages. • Concepts of CSS and applying CSS to HTML. • Introduction to open source CMS

		• Use marquees, hyperlinks and mail to link in designing web pages • Create frames, add style and design layout. • Display a web page within a web page using iframes. • Insert text, check and combo box in web page. • Design web page using password field, submit button • Reset button and radio button etc. • Design a web page adding flash file, audio and video files. • Design web page with forms and form controls using HTML tags 114. **Create simple static web pages using CSS (21 Hrs)** • CSS syntax, Adding colors, fonts, backgrounds, images borders, text alignment, text transformation, Lists etc. • 3 types of CSS • Adding a Navigation Bars(vertical/horizontal bars) • CSS drop downs & Forms • CSS counters and website layout, Multiple backgrounds & Putting the stylesheet in a separate file • CSS Animations & CSS Buttons	viz, Joomla, Word press etc. and Web authoring tools viz. Kompozer, WordPress, Front Page etc.
Professional Skill - 173 Hrs; Professional Knowledge - 35 Hrs	Develop web pages using JavaScript. (Mapped NOS: SSC/N0503, SSC/N0501)	**JavaScript (173 Hrs)** **Embed JavaScript in HTML Pages (127 Hrs)** 115. Practicing the JavaScript in creating dynamic HTML pages. (53 Hrs) 116. Embed JavaScript in HTML to Display Information in Web pages. (31 Hrs)	**Introduction to JavaScript (35 Hrs)** • Introduction to Programming and Scripting Languages. • Introduction to JavaScript and its application for the web.

		117. Use error handling techniques in JavaScript. (11 Hrs) 118. Use objects and classes in JavaScript. (31 Hrs) 119. Describe Animation and Multimedia using JavaScript. (1 Hr) **Create a dynamic website using an open-source tool (40** Hrs**)** 120. Develop dynamic HTML pages using JavaScript. **Deploy a simple web project (6 Hrs)** 121. Deploy web project using IIS.	• Introduction to Web Servers and their features. • JavaScript Basics – Data types, Variables, Constants and Conversion between data types. • Arithmetic, Comparison, Logical Operators in JavaScript. Operator precedence. • Program Control Statements and loops in JavaScript. • Arrays in JavaScript – concepts, types and usage. • The String data type in JavaScript. Introduction to String, Math and Date. • Introduction to Functions in JavaScript. • Built in JavaScript functions overview. • Concepts of Pop Up boxes in JavaScript. • Introduction to the Document Object Model. • Concepts of using Animation and multimedia files in Java Script.
Professional Skill – 73 Hrs	Create workbooks with advanced formulas, macros, charts, pivot tables	**Data Visualization or analysis using Excel – (73 Hrs)** **Create advanced formulas and macros (24 Hrs)**	**Advanced Excel Concepts - Theory- (17 Hrs)**

Professional Knowledge - 17 Hrs.	and demonstrate ability to use Power tools. (NOS: SSC/N9402)	122. Create and modify simple macros (6 Hrs) 123. Perform form controls and create simple data entry form with macros. (6 Hrs) 124. Look up data by using functions. (6 Hrs) 125. Use advanced date functions.(6 Hrs) **Manage advanced charts and tables (21 hrs)** 126. Create and modify advanced charts. (10 Hrs) 127. Create and modify PivotTables. (11 Hrs) **Use Power Query and Power BI (24 Hrs)** 128. Create a Power Query, Power Query Function. Invoking the Power Query function and combining queries. Organize the workbook queries (12 Hrs) 129. Use Power BI for simple data visualizations. (12 Hrs) **Make a dashboard in Excel (4 Hrs)**	• MS excel revision (row, columns, basic formatting, insert menu, Print setup, etc.) and Look up introduction and functions • Types of references and cell naming • Excel Linkage Custom Format and Excel Protection • Tips and tricks • Pivot table and Pivot chart • Conditional formatting • Advanced Graphs • Power Queries
Professional Skill - 25hrs; Professional Knowledge - 10 Hrs.	Browse, select, and transact using E-commerce websites(NOS: SSC/N9403)	**Browse e-Commerce sites to identify products & services (6.5 Hrs)** 130. Demonstrate e-Commerce sites. (1.5 Hrs) 131. List features of e-commerce sites. (2 Hrs) 132. Use e-commerce sites to source an item. (3 Hrs) **Shop online (4.5 Hrs)** 133. Undertake transactions on an e-commerce site. (4.5 Hrs) **Manage e-commerce operations (14 Hrs)** 134. Add products to an ecommerce website. (4 Hrs) 135. Practice order processing. (3 Hrs) 136. Practice payment processing. (4.5 Hrs)	**e-Commerce (10 Hrs)** • Introduction to E Commerce and advantages. • Building business on the net. • Payment and Order Processing, Authorization, Chargeback and other payment methods. • Security issues and payment gateways.

		137. Identify common security issues. (3.5 Hrs)	
Professional Skill - 20 Hrs Professional Knowledge - 10 Hrs.	Secure information from Internet by using cyber security concept. (NOS: SSC/N9404)	138. **Protect information, computers and networks from viruses, spyware and other malicious code (19 Hrs)** • Explain Cyber security (2 Hrs) • Secure computers & the network (5.5 Hrs) • Reduce cyber security threats (2 Hrs) • Secure a Wi-Fi Network (4 Hrs) • Use Anti-Virus software (3 Hrs) • Perform back-ups of files, data & information (2.5 Hrs) 139. **Explain compliance with IT Act (1 Hr)** • Identify steps for information privacy. (0.5 Hrs) • Identify common cybercrimes and penalties applicable. (0.5 Hrs)	**Cyber Security (10 Hrs)** • Overview of Information Security, SSL, HTTPS, Security threats, information Security vulnerability and Risk management. • Introduction to Directory Services, Access Control, Security, Privacy protection, Audit and Security. • Introduction to IT Act and penalties for cybercrimes.
Professional Skill –25 Hrs; Professional Knowledge 15 Hrs.	Explain Cloud concepts &services and Describe Application Development Life Cycle. (NOS: SSC/N9405)	**Cloud Computing (15 Hrs)** **Working with Cloud Services (12 Hrs)** 140. Practice with IaaS using free cloud services. (4 Hrs) 141. Practice with PaaS using free cloud services. (4 Hrs) 142. Practice with SaaS using free cloud services. (4 Hrs) **Web hosting in Cloud (3 Hrs)** 143. Host a website in a free cloud. (3 Hrs) **Develop an application and perform the Application Development Life Cycle (10 Hrs)** 144. Identify Phases of the Application Development Life Cycle. (5 Hrs) 145. Describe Roles in each of the phases of Application	**Introduction to Cloud Computing (12 Hrs)** • Benefits of cloud services, different categories. • Resources available in cloud. **Explain the** Application Development Life Cycle **(3 Hrs)** • Identify Phases of the Application Development Life Cycle. • Describe Roles in each of phases of the Application Development Life Cycle.

		Development Life Cycle. (5 Hrs)	

To be selected either "Programming in Python" or "Programming in Java" as Elective Module for COPA.

COPA - Elective Module – I		Programming in Python	
Professional Skill - 70 Hrs; Professional Knowledge - 30 Hrs.	Write programs using Python language. (NOS: SSC/N9406)	**Programming language (Python)** **Use Python from command line (7 Hrs)** 1. Install, set up the environment & run Python. (3 Hrs) 2. Use Command Line and IDE to create and execute a python program. (4 Hrs) **Perform Operations using Data Types and Operators (15 Hrs)** 3. Write and test a python program to demonstrate print statement, comments, different types of variables. (5 Hrs) 4. Write and test a python program to perform data and data type operations, string operations, date, input and output, output formatting and operators. (5 Hrs) 5. Determine the sequence of execution based on operator precedence. (5 Hrs) **Control Flow with Decisions and Loops (20hrs)** 6. Construct and analyze code segments that use branching statements. (10 Hrs) 7. Construct and analyze code segments that perform iteration. (10 Hrs) **Document and Structure Code (18 Hrs)**	**Programming language (Python) (30 Hrs)** • Introduction to Python History • Features, Setting up path Basic Syntax, Comments, Variable • Different Data Types • Casting, string, Boolean • Python Operators • Conditional Statements • Looping • Control Statements, String Manipulation, Lists, Tuple, sets • Dictionaries • Arrays • Iterators, modules, dates, math, • Modules, Input and Output.

		8. Document code segments using comments and documentation strings. (3 Hrs) 9. Construct and analyze code segments that include List comprehensions, tuple, set and Dictionary comprehensions. (16 Hrs) **Perform Operations Using Modules and Tools (10 Hrs)** 10. Perform basic operations using built-in modules. (5 Hrs) 11. Solve complex computing problems by using built-in modules. (5 Hrs)	

COPA - Elective Module – II		Programming in JAVA	
Professional Skill - 70 Hrs; Professional Knowledge - 30 Hrs.	Writing programs using JAVA. (SSC/N9407)	**Object Oriented Programming and JAVA Language (15 Hrs)** 1. Installing JAVA. 2. Setting the Class path. 3. Writing and Executing a simple JAVA Program to display “Hello”. Demonstrate writing JAVA programs: 4. Use of various data types in JAVA. 5. Use of various operators in JAVA. 6. Create and use of Local, Instance and Class variables. 7. Read text from the keyboard using scanner class read text from the keyboard using console class.	Explain the following: • Object Oriented Programming with Core Java • Java Programming features • JVM, Byte codes and Class path • Java Program Development • Compilation and Execution of JAVA programs • Basic JAVA language elements – keywords, comments, data types and variables. • JAVA Arithmetic, Assignment, Relational, Logical, Increment /

			Decrement operators and expressions. • JAVA String Operators • JAVA Input and Output streams, System in, System out. • Input using Scanner class and Console class methods. (10Hrs.)
		JAVA Program Flow Control (20 Hrs) Demonstrate writing JAVA programs: 8. Use of the if and if … else statements. 9. Use of the Switch statement. 10. Use of the Do … While and while – do loops. 11. Use of the For Loop. 12. Use of the Break and Continue Keywords. 13. Use of the JAVA Numbers Class methods. 14. Use of the JAVA Character Class methods. 15. Use of the JAVA String Class methods. 16. Create and use of arrays.	Explain the following: • Decision making and flow control using if…then, if then else, nested if, switch case and the conditional ternary operators in JAVA. • Loop control flow using while – do, do – while loops, for loop, using the break, continue statements. • Terminating the JAVA program. JAVA Number, Character and String Classes. Arrays in JAVA. (6Hrs.)

		JAVA Classes, Overloading and Inheritance (20 Hrs) Demonstrate writing JAVA programs: 17. Create and use of simple classes, objects and methods in JAVA. 18. Pass data and Objects to Methods. 19. Return data and Objects from Methods. 20. use of constructors in JAVA. 21. Create and use of Overloaded methods in JAVA. 22. Override methods in JAVA. 23. Create and use of Super class, Sub class in JAVA.	Explain the following: • JAVA Objects, Classes and Methods. • Passing data and objects as parameters to methods. • Method Overloading. • Constructors and Overloaded constructors. • Inheritance in JAVA. • Method Overriding in JAVA. (8Hrs.)
		Abstract Classes and Interfaces in JAVA (15 Hrs) Demonstrate writing JAVA programs: 24. Create and use virtual methods. 25. Create abstract classes and methods. 26. Create interfaces in JAVA. 27. Override methods in JAVA. 28. Create and implement an interface. 29. Extend interfaces in JAVA. 30. Create and use a package in JAVA.	Explain the following: • Concept of Virtual methods. • Concept of Abstract classes and methods • Features of Abstract Classes • JAVA Interfaces and their advantages • Method Overriding in JAVA • Polymorphism in JAVA • Creating, implementing and extending interfaces • Creating and using Packages in JAVA. (6Hrs.)

		Troubleshooting Java issues Download and Install Java, Check and Verify Java Configurations, Test Java, Remove Old Versions of Java, Find Java version, Always redirected to the java.com download page.	

Industrial Visit/Project work
Broad Area:

a) Create and host a web site of at least 6 web pages using JavaScript & CSS containing interactive objects, functions etc.
b) Create a project with Excel on Payroll Systems.
c) Create a database with MySQL on Library management system.
d) Create project in Python/Java programming language.

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

LIST OF TOOLS & EQUIPMENT			
COMPUTER OPERATOR AND PROGRAMMING ASSISTANT (for Batch of 24 Candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. Trainees Tools/ Equipment			
1.	Desktop Computer	CPU: 32/64 Bit, 7th Generation or higher, i3 or latest processor, Speed: 3 GHz or Higher. RAM: 8 GB or higher, 1TB HDD/SDD, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (as available in the market). Or All in one PC Licensed Operating System and Antivirus compatible with trade related software.	24 Nos.
2.	Laptop	4th Gen Ci5 or higher Processor, 4GB RAM, 1TB Hard Disk, Win8/latest Preloaded Licensed OS, 2GB Graphics Card, DVD Writer, Standard Ports and Connectors.	01 No.
3.	Wi–Fi Router	With Wireless Connectivity	01 No.
4.	Switch	24 Port	02 Nos.
5.	Structured cabling in Lab	To enable working with Wired Networks for Practical	As required
6.	Internet Connectivity	Broadband connection with min. 2 Mbps speed/Optical Fiber	As required
7.	Registered Domain	At least 100 MB Web Space	As required
8.	All in One printer	A4 size	01 No.
9.	Digital Web Cam	High Resolution (3.1 Megapixel or higher)	04 Nos.
10.	DLP Projector with Screen/Multimedia Projector with screen/Smart Interactive Board/Smart TV		01 No.
11.	Online UPS	5 KVA	01 No.
12.	Crimping Tool	RJ-45	05 Nos.
13.	Network Rack	4U for 24 ports	02 Nos.
14.	Digital Multimeters	3.5-digit handheld type.	04 Nos.
15.	Screwdriver Set	Standard	04 Sets
16.	Mini Dongle for Bluetooth devices Connection	USB	04 Nos.
17.	Headphone &mic. set	Wired	05 Nos.

18.	Sound System	2:1	01 No.
19.	External Hard Disk	1 TB	02 Nos.
20.	Patch Panel	24 Port	02 Nos.
21.	LAN Tester	UTP cat5 cable tester (RJ 45)	05 Nos.
22.	Punching Tool	for punching RJ 45 socket with cat 5 cable	05 Nos.
B. Software			
23.	MS Office	2010 (Academic) or the latest version available at the time of procurement	25 Licenses
24.	Antivirus for – clients / workstations in profile	As required	25 Licenses
25.	Open Office or equivalent	Latest version	Open-source software
26.	Python / Java JDK	Latest Version	Open-source software
27.	GIMP or equivalent	Latest version	Open-source software
28.	LINUX OS	Latest version	Open-source software
29.	E Commerce Simulation Software	Latest version	Open-source software
30.	Web Server	HTTP Web server / XAMPP or any other similar server	Open-source software
31.	MySQL	Latest version	Open-source software
C. List Of Other Items/Furniture			
32.	Chair and table for the instructor	As required	01 each (for classroom & laboratory)
33.	Dual Desk or Chair and Tables for Trainees	As required	12 / 24 Nos.
34.	Computer table/Work benches	As required	For 24 Computers
35.	Operators chair	As required	24 Nos.
36.	Air conditioner	As required	As required
37.	White Board	As required	01 No.
38.	Almirah	As required	01 No.
39.	Fire Extinguisher	Arrange all proper NOCs and equipments from Municipal/Competent authorities.	

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

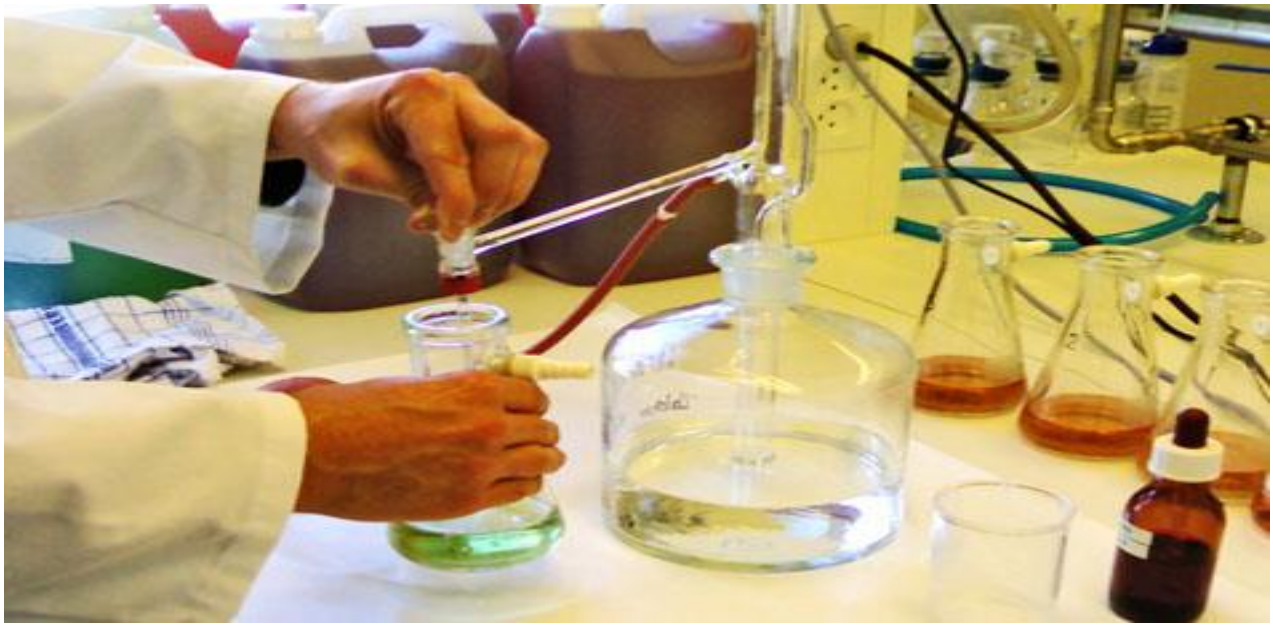
COMPETENCY BASED CURRICULUM

LABORATORY ASSISTANT (CHEMICAL PLANT)

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



SECTOR – CHEMICALS AND PETROCHEMICALS

Directorate General of Training

LABORATORY ASSISTANT (CHEMICAL PLANT)

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During the two-year duration of Laboratory Assistant (Chemical Plant) trade a candidate is trained on professional skill, professional knowledge, and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered under Professional Skill subject are as below:-

FIRST YEAR: In this year the trainee learns about safety and environment, use of fire extinguishers & PPEs and study MSDS to begin with. He gets the idea of identification of common chemical reagents and preparation of various types of solutions. Determine strength of unknown chemical reagents by various types of titrations. Determine value of different physical parameters of materials. Verify different laws related to physical properties of materials. The trainee will be able to execute quantitative analysis of metal & non-metal by Gravimetric estimation. Perform detection of inorganic substances by qualitative analysis. Operate pressure, temp. & recording instruments.

SECOND YEAR: In this year the trainee will be able to prepare various organic compounds and determine their properties. Prepare various inorganic compounds and determine their properties. Identify various unknown organic compounds and their properties. Measure different organic compound in respect of waste water management. The trainee will perform quantitative analysis of ore, alloy, organic & inorganic substances. Perform analysis of fuel gas, sugar, oil, fat, soap & nitrogen in fertilizer. Operate various measuring instruments used in chemical plant & laboratory. Perform proximate analysis of coal and determine calorific value of different fuels. Detect micro-organism in food, pharmaceutical and other related laboratories prepared products.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variantsand Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for strengthening vocational training.

Laboratory Assistant (Chemical Plant) trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill & knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates need broadly to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and repair & maintenance work.
- Document the technical parameters in tabulation sheet related to the task undertaken.
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2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.

- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure are being notified by DGT from time to time. **The learning**

outcome and assessment criteria will be the basis for setting question papers for final assessment. The examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marks in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Laboratory Assistant, Chemical Laboratory; arranges and sets various chemicals, instruments and apparatus such as salts, acids, balances, heaters as desired by Chemists for conducting experiments in chemical laboratory. Sets up required apparatus and equipment as directed by Chemist. Performs routine tasks, such as preparations of standard solutions and common reagents, weighing and measuring of salts and chemicals, filtration, precipitation etc. and conducts simple tests as directed by Chemist. Cleans and maintains balances. Maintains laboratory clean and tidy, Keeps required chemicals readily available and replenishes stock from stores. May clean special apparatus, if required.

Laboratory Assistant, Glass and Ceramics; conducts routine tests of silica, clay and other ingredients in laboratories for manufacturing glass and ceramic products. Sets up apparatus required for performing test to determine properties of clay, silica, etc. Prepares solution and reagents. Maintains charts and tables for data observed during experimentation. May undertake tests in laboratory independently.

Laboratory Assistant, Chemical Engineering General; conducts chemical and physical laboratory tests and makes qualitative and quantitative analysis of material for purposes such as development of new products, materials, and processing methods and for maintenance of health and safety standards, working under Biochemists; Chemists, Analytical; Chemists, Inorganic; Chemists, Organic; or Chemists, Physical. Sets up laboratory equipment and instruments, such as ovens, leaching drums, gas cylinders, kilns vacuum chambers autoclaves, pyrometers and gas analyser. Analyses products, such as drugs, plastics, dyes and paints to determine strength, purity and other characteristics of chemical contents. Tests ores, minerals, gases and other materials for presence and percentage of elements and substance, such as Carbon, Tungsten, nitrogen, iron, gold or nickel. Prepares chemical solutions for use in processing materials, such as textile, detergents, paper, felt etc., following standard formulas.

Laboratory Assistant, Petroleum and Lubricants; Crude Tester; Oil Tester; Gas Analyst (Petroleum refining) tests and analyses samples of crude oil and petroleum products during processing stages, using laboratory apparatus and testing equipment and following standard test procedures to determine physical and chemical properties and ensures prescribed standards of products manufactured. Tests samples of crude and blended oils, gases, asphalts, and pressure distillates to determine characteristics, such as boiling, vapor, freeze, condensation, flash and aniline points, viscosity, specific gravity, penetration, doctor solution, distillation and corrosion, using test and laboratory equipment, such as hydrometers, fractionators, factional distillation apparatus and analytical scales. Analyses contents of products to determine presence of gases, such as propane, isobutane, butane, isopentane, and

ethane using appropriate distillation columns. Determines hydro carbon composition of gasolines, blending stocks, and gases using fractional distillation equipment and mass spectrometer. Operates fractional columns to separate crude oil into oils with different boiling points to determine their properties. Analyses composition of products to determine quantitative presence of gum, Sulphur, aromatics olefins, water and sediment. Compares colour of liquid product with charts to determine processing factors measurable by colour. Compares tests results with specifications and recommends processing changes to improve and control quality of products. May test sub-surface cores during drilling operations.

Laboratory Assistant, Metallurgical; conducts routine tests of metals and alloys to determine their physical and chemical properties. Collects metallic wastes, metal samples or ores to be examined. Sets up scientific equipment required for testing. Assist Metallurgist in testing and analyzing different types of metals, their by-products, waste and alloys. May conduct examination of metals on his initiative independently.

Chemist, Analytical; conducts chemical analysis of inorganic and organic samples to ascertain their composition, reaction and properties. Performs basic tasks like Chemist General using instruments, apparatus and standard reagents in the laboratory such as spectroscope, pressure and temperature recording devices, desiccators, balances, acids, alkalize, and standard solution indicators to determine composition, strength or conformity with prescribed standards to ascertain presence or absence of a particular element. Analyses findings and submits report to medical or other authorities. May do statistical interpretation of observations.

Reference NCO-2015:

(i) 3111.0300 – Laboratory Assistant, Chemical Laboratory
(ii) 3116.0100 –Laboratory Assistant, Glass and Ceramics
(iii) 3116.0300– Laboratory Assistant, Chemical Engineering General
(iv) 3116.0500 – Laboratory Assistant, Petroleum and Lubricants
(v) 3117.0300 – Laboratory Assistant, Metallurgical
(vi) 2113.0500 – Chemist, Analytical

Reference NOS: MIN/N9417, MIN/N 9418, MIN/N 9419,MIN/N9420, MIN/N 9421, MIN/N 9422,MIN/N9423,MIN/N9424,MIN/N9425,MIN/N9426, MIN/N9427, MIN/N 9428, MIN/N9429,MIN/N9430, MIN/N 9431, MIN/N 9432, MIN/N 9433, MIN/N 9434, MIN/N 3103,MIN/N 3104, MIN/N 3105

4. GENERAL INFORMATION

Name of the Trade	**LABORATORY ASSISTANT (CHEMICAL PLANT)**
Trade Code	DGT/1062
NCO - 2015	3111.0300, 3116.0100, 3116.0300, 3116.0500, 3117.0300, 2113.0500
NOS Covered	MIN/N9417, MIN/N 9418, MIN/N 9419,MIN/N9420, MIN/N 9421, MIN/N 9422,MIN/N9423,MIN/N9424,MIN/N9425,MIN/N9426,MIN/N9427,9428, MIN/N9429,MIN/N9430, MIN/N 9431, MIN/N 9432, MIN/N 9433, MIN/N 9434, MIN/N 3103, MIN/N 3104, MIN/N 3105
NSQF Level	Level-4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, CP, LC, DW, AA, BLIND, LV, DEAF, HH, AUTISM, ID, SLD
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	96 sq. m
Power Norms	6 KW
Instructors Qualification for	
(i) Laboratory Assistant (Chemical Plant) Trade	B.Voc/Degree in Chemical/ Petro chemical/ Technology/ Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Chemical/Petro Chemical Technology/ Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with 2 years' experience in relevant field. **OR** NTC/ NAC passed in the Trade of Laboratory Assistant (Chemical Plant) with 3 years' experience in the relevant field. **<u>Essential Qualification</u>:**

	Relevant regular/RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***Note: - Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above)

	OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
(v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES

FIRST YEAR

1. Identify common chemical reagents and prepare various types of solutions following safety precautions.(NOS:MIN/N9417)
2. Plan and estimate the strength of unknown acid, bases and other reagents by redox & iodimetric titration and prepare indicators and results of titration. (NOS:MIN/N9418)
3. Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data. (NOS:MIN/N9419)
4. Verify the physical/ thermal properties and record the analysis. (NOS:MIN/N9420)
5. Identify and test various electrical components like switches, fuses, conductors etc. (NOS:MIN/N3103)
6. Identify, test various electronic components using proper measuring instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N3104,MIN/N3105)
7. Verify the Electro-chemical properties of electrolytes. (NOS:MIN/N9421)
8. Execute quantitative analysis of metal and non-metal by Gravimetric estimations, perform stoichiometry calculations and record the results. (NOS:MIN/N9422)
9. Perform detection of inorganic substances by qualitative analysis, by dry tests, wet tests and record the procedures. (NOS:MIN/N9423)
10. Assemble, Test, calibrate and troubleshoot the pressure, temperature, recording instrument and controlling instruments. (NOS:MIN/N9424)
11. Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)

SECOND YEAR

13. Plan and organize the technique (with different unit process and unit operation) of organic compounds. (NOS:MIN/N9425)
14. Plan and organize technique of inorganic substance with quality control. (NOS:MIN/N9426)
15. Analyze different organic compounds to identify the compound and determine various parameters. (NOS:MIN/N9427)

16. Analyze different organic compounds and measurement in respect of waste water management. (NOS:MIN/N9428)
17. Perform quantitative analysis of ore, alloy, organic and inorganic substance. (NOS:MIN/N9429)
18. Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer. (NOS:MIN/N9430)
19. Operate various measuring instruments used in chemical plant and laboratory. (NOS:MIN/N9431)
20. Perform proximate analysis of coal and calorific value of different fuels. (NOS:MIN/N9432)
21. Perform detection of micro-organism in food, pharmaceutical and other related laboratories. (NOS:MIN/N9433)
22. Perform Experiments on Analyzing Equipment(NOS:MIN/N9434)
23. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Identify common chemical reagents and prepare various types of solutions following safety precautions. (NOS:MIN/N9417)	Plan, work in compliance with standard safety norms.
	Identify the glassware and chemical reagents.
	Prepare oxalic acid by exact weighing and make solution according to marking indicated in the glassware.
	Prepare Sulphuric acid by suitable laboratory reagents.
2. Plan and estimate the strength of unknown acid, bases and other reagents by redox & iodimetric titration and prepare indicators and results of titration. (NOS:MIN/N9418)	Setup electronic/ chemical balance for ideal condition.
	Label the solution with accuracy.
	Observe safety procedure during Titration as per standard norms and guidelines.
	Identify tools and instruments for titration.
	Measure the value of unknown concentration of given sample with following proper procedure.
	Detect exact end point in precipitation method.
	Detect exact end point in complex metric titration method.
3. Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data. (NOS:MIN/N9419)	Prepare various reagents required for precipitation titration.
	Prepare various indicators required for precipitation titration.
	Practice exact end point detection by Mohr method. (15 hrs.)
	Practice exact end point detection by Volhard method.
	Prepare various reagents required for complex metric titration.
	Prepare various indicators required for complex metric titration.
	Practice complex metric titration by using EDTA.
4. Verify the physical/ thermal properties and record the analysis. (NOS:MIN/N9420)	Plan working in compliance with standard safety norms.
	Identify the instruments.
	Make sure that instruments are ready to do work.
	Measure the value force, acceleration due to gravity and Young Modula's according to direction.
	Measure the value acceleration due to gravity.
	Measure the value Young Modula's according to direction.
	Tabulate the results.

5. Identify and test various electrical components like switches, fuses, conductors etc. (NOS:MIN/N3103)	Measure and test the voltage given cells and battery.
	Connect the cells in series connection and parallel connection.
	Operate the circuit in full swing.
	Measured the resistance and other parameters.
	Tabulate the results.
6. Identify, test various electronic components using proper measuring instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N3104,MIN/N3105)	Measure and test the voltage given cells and battery.
	Connect the cells in series connection and parallel connection.
	Operate the circuit in full swing.
	Verify Ohms Law.
	Verify Kirchhoff's Law.
	Determine specific resistance using wheat stone's Bridge.
7. Verify the Electro-chemical properties of electrolytes. (NOS:MIN/N9421)	Make sure the electrolytic cells are ready to work properly.
	Batteries, Ammeter and voltmeter should be properly connected to circuits.
	Running the operation in full swing.
	Measure the current from Ammeter reading.
	Measure the time for the operation.
	Measure the deposition at cathode and anode by weighing.
	Tabulate the results.
	Verify Faraday's 1st Law.
	Verify Faraday's 2nd Law.
8. Execute quantitative analysis of metal and non-metal by Gravimetric estimations, perform stoichiometry calculations and record the results. (NOS:MIN/N9422	Plan work in compliance with standard safety norms.
	Identify the type of instruments.
	Identify the reagents and glassware for the following experiments.
	Prepare the specific reagents.
	Perform the procedure for chemical reaction.
	Perform the procedure for precipitate collection.
	Dry and weighing the precipitate.
	Tabulate the results in exact norm.
9. Perform detection of	Plan work in compliance with standard safety norms.

inorganic substances by qualitative analysis, by dry tests, wet tests and record the procedures. (NOS:MIN/N9423)	Identify laboratory reagents and glassware for the job.
	Perform reaction with proper quality control.
	Collect desired chemicals by filtration method.
	Dry and weighing the chemicals.
	Tabulate the results in exact norm.
10. Assemble, Test, calibrate and troubleshoot the pressure, temperature and recording instrument. (NOS:MIN/N9424)	Plan work in compliance with standard safety norms.
	Identify the type of electrical instruments for the job.
	Assembled the different parts of the apparatus.
	Calibrate according to norms.
	Measure unknown pressure temperature etc.
11. Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
13. Plan and organize the technique (with different unit process and unit operation) of organic compounds. (NOS:MIN/N9425)	Prepare Acetanilide by Acetylation.
	Determine % yield of Acetanilide.
	Determine Melting point of Acetanilide.
	Prepare Methyl Oxalate by Esterification.
	Determine % yield of Methyl Oxalate.
	Determine Melting point of Methyl Oxalate.
	Prepare sodium benzene sulphonate by Sulphonation.
14. Plan and organize technique of inorganic substance with	Plan work in compliance with standard safety norms.
	Identify specific reagent, apparatus and glassware.

quality control. (NOS:MIN/N9426)	Perform different unit process step by step.
	Perform different unit operation step by step.
	Collect organic compounds by filtration method.
	Measure yield and melting point of the organic compounds.
15. Analyze different organic compounds to identify the compound and determine various parameters. (NOS:MIN/N9427)	Plan work in compliance with standard safety norms.
	Select appropriate reagents and glassware.
	Analyze the elements for the given organic compounds.
	Analyze the functional group for the given organic compounds.
	Prepare derivative of the organic compounds.
	Measure melting point of the organic compound.
	Measure yield and melting point the derivative.
16. Analyze different organic compounds and measurement in respect of waste water management. (NOS:MIN/N9428)	Follow and maintain procedure to achieve a safe working environment.
	Prepare reagents for COD.
	Perform the experiment with accuracy.
	Prepare reagents for BOD.
	Perform the experiment with accuracy.
	Prepare reagents for turbidity meter.
	Measure TSS in this meter.
	Tabulate the result for COD, BOD and TSS.
17. Perform quantitative analysis of ore, alloy, organic and inorganic substance. (NOS:MIN/N9429)	Perform sample collection.
	Select appropriate reagents, glassware and apparatus.
	Perform chemical reaction with accuracy.
	Collect the desired substances in quantitative ways.
	Weighing accurately.
	Tabulate the result.
18. Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer. (NOS:MIN/N9430)	Prepare reagents for orsat's apparatus.
	Fill the tube of the apparatus with reagents.
	Operate the instrument according to proper ways.
	Measure the composition of fuel gas.
	Prepare the reagents for acid value, saponification value and iodine value for oil, fat and soap analysis.
	Connect the apparatus with condenser.
	Perform the required chemical reaction.

	Perform the titration accurately.
	Tabulate the result.
	Calculation of acid value for the given oil.
	Calculation of specification value and iodine value for the given oil.
	Prepare reagents.
	Estimate % of sugar in given sample.
	Assembled Soxhlet's apparatus.
	Perform operation with given sample.
	Estimate % of fat in given sample.
	Assembled Kjeldahl's apparatus.
	Perform operation with given sample.
	Prepare table for calculation and estimate % of nitrogen in given sample.
19. Operate various measuring instruments used in chemical plant and laboratory. (NOS:MIN/N9431)	Prepare reagents.
	Perform operation of Polari- meter.
	Prepare graph and table for calculation.
	Perform operation of electrolytic analyzer.
	Prepare buffer solution and other reagents.
	Perform operation of PH meter.
	Perform operation of colorimeter.
	Perform operation of spectro photometer.
	Perform operation of flame photometer.
	Perform operation of refractometer.
	Perform operation of Karlficher apparatus.
	Perform operation of thin layer chromatography.
	Perform operation of paper chromatography.
	Perform operation of quality of water analysis.
	Perform operation of digital moisture balance.
	Perform operation of redwood viscometer.
	Perform operation of Brookfield viscometer.
	Perform operation of electrophoresis apparatus.
	Perform operation of pensky-martin apparatus.
20. Perform proximate analysis of coal and calorific value of different fuels.	Perform weight of coal sample.
	Perform operation of furnace.
	Perform weight the coal sample after furnace operation.

(NOS:MIN/N9432)	Calculate the result of volatile matter in the coal sample.
	Calculate the result of moisture in the coal sample.
	Calculate the result of ash content in the coal sample.
	Calculate the result of fixed carbon in the coal sample.
	Calculate the result of sulphur content in the coal sample.
	Plan work in compliance with standard safety and norms.
	Operate bomb calorimeter in proper way.
	Tabulate and calculate the result of calorific value of coal.
	Operate junker's calorimeter in proper way.
	Tabulate and calculate the result of calorific value of LPG.
21. Perform detection of micro-organism in food, pharmaceutical and other related laboratories. (NOS:MIN/N9433)	Perform operation and familiarity of different parts of a microscope.
	Identify common laboratory equipments and reagents used in microbiology lab.
	Prepare reagents and indicators.
	Perform Gram staining technique for detection of microorganism.
	Detection of colony formation using microscope.
22. Perform Experiments on Analyzing Equipment. NOS:MIN/N9434)	Perform experiment on particle size by particle size analyzer.
	To perform experiment on solid analyzer.
	To perform experiment on total surface area by surface area analyzer.
23. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR LABORATORY ASSISTANT (CHEMICAL PLANT) TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs.; Professional Knowledge 06 Hrs.	Identify common chemical reagents and prepare various types of solutions following safety precautions. (NOS:MIN/N9417)	1. Operate different types of fire extinguishers. (05hrs.) 2. Study Safety Data Sheet (SDS). (02hrs.) 3. Identify personal protection equipments (PPEs) used in chemical plant. (03hrs.)	Induction Training. Fire & Safety in Chemical Lab/Plant. First Aid. Introduction of pollution control. (02hrs.)
		4. Identify common chemical reagents by performing acid-base reaction. (04hrs.) 5. Identify common chemical reagents by performing precipitation reaction. (04hrs.) 6. Identify common chemical reagents by Performing colour change reaction. (04hrs.) 7. Identify common chemical reagents by generation of colour fume. (04hrs.) 8. Identify common chemical reagents by using Litmus Paper. (01 hrs.) 9. Identify common chemical reagents by performing reaction generating gas with specific smell. (04 hrs.) 10. Prepare solutions of solids by weighing. (04hrs.)	General & Physical Chemistry: Introduction to chemistry. Elements, atoms & molecules Chemical & physical changes. Concept about acid, base & salts. Determination of concentration of solutions by Normality & Molarity, IMP by weight by grams per liter. (04hrs.)

		11. Prepare solutions of liquids by weighing. (04hrs.) 12. Prepare solutions of volatiles by weighing. (03 hrs.) 13. Prepare primary standard solutions by weighing. (03 hrs.) 14. Prepare secondary standard solutions by weighing. (03 hrs.) 15. Prepare solutions of non-volatiles by weighing. (02 hrs.)	
Professional Skill 150 Hrs.; Professional Knowledge 36 Hrs.	Plan and estimate the strength of unknown acid, bases and other reagents by redox & iodimetric titration and prepare indicators and results of titration. (NOS:MIN/N9418)	16. Prepare various reagents for analysis of acid and base. (05 hrs.) 17. Prepare various indicators. (05hrs.) 18. Prepare Titration between Hydrochloric acid and sodium hydroxide. (05hrs.) 19. Prepare Titration between mixture of sodium carbonate and sodium bi-carbonate with hydrochloric acid (05hrs.). 20. Prepare Titration between vinegar and standard sodium hydroxide. (09hrs.) 21. Prepare Titration between Boric acid and sodium hydroxide. (08 hrs.) 22. Prepare Titration between Ammonium Chloride sample and sodium hydroxide.(08 hrs.) 23. Prepare Table for calculation of result	Atomic molecular and equivalent weights. Crystallography Solutions. The laws of chemical combinations. (15 hrs.)

		oftitration. (10 hrs.)	
		24. Prepare various reagents required for Redox titration (07hrs.). 25. Prepare various indicators required for Redox titration (07hrs.). 26. Prepare Permanganometry titration using permanganate solution. (10hrs.) 27. Prepare Dichrometry titrations using dichromate solution. (10hrs.) 28. Practice Redox titrations using potassium iodate solution. (10hrs.). 29. Practice Redox titrations using potassium bromate solution. (11hrs.)	Periodic table of the elements. Periodic study of S & P Block Elements: Periodic study of: a) Zero group b) Transition Elements of 3-12 groups Periodic study of: a) 14th group b) 15th group c)16th group d) 17th group e) 18th group elements. (15 hrs.)
		30. Prepare various reagents required for Iodometric and Iodimetric titration. (10 hrs.) 31. Prepare various indicators required for Iodometric and Iodimetric titration. (10 hrs.) 32. Prepare Iodometric titration using iodine solution indirectly. (10 hrs.) 33. Perform Iodimetric titration using iodine solution directly. (10 hrs.)	Chemical equilibrium. Thermo-chemistry & thermodynamics. (06 hrs.)
Professional Skill 100 Hrs.; Professional Knowledge	Execute precipitation and complex metric titration to determine the strength of unknown reagents and record the data.	34. Prepare various reagents required for precipitation titration. (10 hrs.) 35. Prepare various indicators required for precipitation titration. (10 hrs.) 36. Prepare exact end point	Metallurgy of: • Aluminum. • Copper • Silver • Chromium • Iron & Steel

18 Hrs.	(NOS:MIN/N9419)	detection by Mohr method. (15 hrs.) 37. Prepare exact end point detection by Volhard method. (15 hrs.)	• Zinc & its alloys. (09 hrs.)
		38. Prepare various reagents required for complex metric titration. (10 hrs.) 39. Prepare various indicators required for complex metric titration. (05 hrs.) 40. Prepare complex metric titration by using EDTA. (35 hrs.)	Non-Metals: Preparation, properties & uses of following: a) Hydrogen & its peroxide. b) Oxygen c) Sulphur& its compounds. d) Nitrogen & its compounds. e) Phosphorus & its compounds. f) Chlorine &Fluorine and its compounds. (09 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 11 Hrs.	Verify the physical/ thermal properties and record the analysis. (NOS:MIN/N9420)	**Physics Lab: -** 41. Verify parallelogram of forces with the help of mechanical board. (03hrs.) 42. Study of various types of Levers. (03hrs.) 43. Study of Simple Machines and finding Velocity Ratio, Mechanical Advantage and Efficiency. (04hrs.) 44. Determine acceleration due to gravity (g) by simple pendulum. (05 hrs.) 45. Determine Young's Modulus (Y) by Searle's apparatus (10 hrs.)	Moment and Levers: moments, units, arm of couple and moment of couple, types of Levers. Simple machines, efforts and load, mechanical advantage, velocity ratio, efficiency of machines, their relationship, examples. (04 hrs.)
		46. Determine coefficient of expansion of solid. (05 hrs.) 47. Determine coefficient of Thermal conductivity of metal rod. (05 hrs.) 48. Determine coefficient of	Elasticity, Introduction, stress and strain, modulus of elasticity, different types of stresses, Hook's Law, Young's modulus, Yield point, ultimate, stress-strain graph,

		Thermal conductivity of insulating material (Rubber).(15hrs.)	modulus of Rigidity, poison ration, bulk modulus, factor of safety, examples. (04 hrs.)
		49. Determine mechanical equivalent of heat by Joule's method. (25hrs.)	Heat and Temperature Heat, unit of heat, temperature, difference between heat and temp., modes of heat transfer, boiling point, melting point, scale of temp., specific heat, thermal capacity, water equivalent of heat, interchanges of heat, latent heat of fusion, latent heat of vapour, transmission of heat, thermal expansion of solids, liquids and gases, co-efficient of linear expansion, indicated thermal efficiency, brake thermal efficiency, examples. (03 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Identify and test various electrical components like switches, fuses, conductors etc. (NOS:MIN/N3103)	50. Study various types of electric cells, resistances using series connections and measure various parameters viz. voltage, current, resistance using various meters and instruments etc. (12 hrs.) 51. Study various types of electric cells, resistances using parallel connections and measure various parameters viz. voltage, current , resistance etc. (13 hrs.)	**Electricity:** Electric current, +Ve and -Ve terminals use of fuses and switches, conductors and insulators, simple electrical Circuits. (07 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge	Identify, test various electrical properties using proper measuring	52. Verify Ohm's law (06hrs.) 53. Verify Kirchhoff's law related to current and voltage. (07 hrs.)	Ohm's law, electrical insulating Materials, Kirchhoff's law, examples, Parallel and series circuit

07 Hrs.	instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N3104,MIN/N3105)	54. Determine specific resistance using wheat stone's Bridge. (12 hrs.)	connections. Whetstone's bridge potentiometer. (07 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Verify the Electro-chemical properties of electrolytes. (NOS:MIN/N9421)	55. Perform electrolysis using voltmeter and verify Faraday's First law of electrolysisand second laws of electrolysis. (25 hrs.)	Electrolysis, conservation of electrical energy into heat energy, Joule's law. Mechanical equivalent of heat. (07 hrs.)
Professional Skill 150 Hrs.; Professional Knowledge 36Hrs.	Execute quantitative analysis of metal and non-metal by Gravimetric estimations, perform stoichiometry calculations and record the results. (NOS:MIN/N9422	56. Prepare suitable reagents by weighing for Gravimetric estimations of Nickel. (05 hrs.) 57. Prepare suitable reagents by weighing for Gravimetric estimations of Iron.(10 hrs.) 58. Prepare suitable reagents by weighing for Gravimetric estimations of Barium.(05 hrs.) 59. Prepare suitable reagents by weighing for Gravimetric estimations of Lead.(10 hrs.) 60. Prepare suitable reagents by weighing for Gravimetric estimations of Silicon.(10 hrs.) 61. Perform chemical reaction between reagents and collection of precipitation for Nickel.(10 hrs.) 62. Perform chemical reaction between reagents and collection of precipitation for Iron.(10hrs.) 63. Perform chemical reaction between reagents and collection of precipitation for	General & Physical Chemistry The structure of atom. The structure of atom, Radioactivity, Chemical bonding electronic theory of valency, Gas laws, Boyle's law, Charl's law, Gas equation, Graham's Law of diffusion, Dalton's law of partial pressure. (36 hrs.)

		Barium.(10 hrs.) 64. Perform chemical reaction between reagents and collection of precipitation for Lead.(10 hrs.) 65. Perform chemical reaction between reagents and collection of precipitation for Silicon.(10 hrs.) 66. Perform furnace operation for complete drying of precipitation. (30 hrs.) 67. Estimate quantity of dried precipitation by weighing.(15 hrs.) 68. Prepare table formation and stoichiometric calculation for final estimation of given metal & non-metal.(15 hrs.)	
Professional Skill 165 Hrs.; Professional Knowledge 33 Hrs.	Perform detection of inorganic substances by qualitative analysis,by dry tests, wet tests and record the procedures. (NOS:MIN/N9423)	69. Identify Inorganic substances by their physical properties (colour, solubility, acidic or basic nature). (05hrs.) **Dry test for cations:** 70. Identify Inorganic substances by dry test tube heating. (05hrs.) 71. Identify Inorganic substances by Flame test. (05hrs.) 72. Identify Inorganic substances by Borax Bead test. (05hrs.) 73. Identify Inorganic substances by Fusion test. (05hrs.) **Dry test for Anions:** 74. Identify Inorganic substances by reaction with dilute acids. (05hrs.) 75. Identify Inorganic substances	Fertilizer its types & uses Atmosphere air, Electro-chemistry & electrolysis, Water & its type, Water Treatment (Purification). Law of mass action, Le-chatelier's principle and application in chemical industry. Study of physical properties of substances. Study of Rault's Law for dilute solution. (33 hrs.)

		by reaction with concentrated acids. (05hrs.) **Wet test for cations:** 76. Identify Inorganic substances by wet test for Gr-I metals. (10 hrs.) 77. Identify Inorganic substances by wet test for Gr-II metals. (10 hrs.) 78. Identify Inorganic substances by wet test for Gr-IIIA metals. (10 hrs.) 79. Identify Inorganic substances by wet test for Gr-IIIB metals. (10 hrs.) 80. Identify Inorganic substances by wet test for Gr-IV metals. (10 hrs.) 81. Identify Inorganic substances by wet test for Gr-V metals. (10 hrs.) **Wet test for Anions:** 82. Identify Inorganic substances by wet test for Chloride. (05 hrs.) 83. Identify Inorganic substances by wet test for Bromide. (10 hrs.) 84. Identify Inorganic substances by wet test for Iodide. (05 hrs.) 85. Identify Inorganic substances by wet test for Flouride. (05 hrs.) 86. Identify Inorganic substances by wet test for Sulphate. (05 hrs.) 87. Identify Inorganic substances by wet test for Sulphide. (05	

		hrs.) 88. Identify Inorganic substances by wet test for Sulphite. (05 hrs.) 89. Identify Inorganic substances by wet test for Thiosulphate. (05 hrs.) 90. Identify Inorganic substances by wet test for Nitrate & Nitrite. (05 hrs.) 91. Identify Inorganic substances by wet test for Phosphate. (05 hrs.) 92. Identify Inorganic substances by wet test for Chromate. (05hrs.) 93. Identify Inorganic substances by wet test for Carbonate & Bi-Carbonate. (05 hrs.) 94. Identify Inorganic substances by wet test for Borate. (05 hrs.)	
Professional Skill 75 Hrs.; Professional Knowledge 11 Hrs.	Assemble, Test, calibrate and troubleshoot the pressure, temperature, recording instrument andcontrolling instruments. (NOS:MIN/N9424)	95. Perform Calibration of Bourdon tube pressure gauges. (04hrs.) 96. Perform operation of Manometer. (04hrs.) 97. Perform Calibration of Alcohol in glass thermometer. (08 hrs.) 98. Perform Calibration of bimetallic thermometer. (09hrs.) 99. Perform operation of Resistance thermometer. (08 hrs.) 100. Perform operation of Thermocouple. (08 hrs.) 101. Perform operation of	Units of pressure and vacuum; various types of pressure and vacuum gauges, manometers; principles of operation of various pressure measuring instruments and devices; Calibration of gauges. Temperature scales, Relationship between various temperature scales; fixed points. Various types of thermometers, thermocouples and pyrometers; Working principles of various temperature measuring instruments; different

		Thermocouple Pyrometer. (09 hrs.)	methods of temperature measurement. (09 hrs.)
		102. Perform Operation of Strip chart and Circular chart recorders. (08 hrs.) 103. Perform Operation of Transmitterand Transducers (PI & IP). (08 hrs.) 104. Perform Operation of controller. (09 hrs.)	Various types of Recorders strip chart, circular chart; principles of operation of various recording instruments and their operations. Various types of Controllers On-off, P, PI, PD, PID principles of operation of various controlling instruments and their operations. Various types of Transmitters and transducers PI, IP; principles of operation of various Transmitters and transducers. (02 hrs.)
ENGINEERING DRAWING (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)	**Engineering Drawing:** Introduction to Engineering Drawing and Drawing Instruments – Conventions Sizes and layout of drawing sheets Title Block, its position and content Drawing Instrument Free hand drawing of – Geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches. Free hand drawing of hand tools. Drawing of Geometrical figures: Angle, Triangle, Circle, Rectangle, Square, Parallelogram. Lettering & Numbering – Single Stroke Dimensioning Practice Types of arrowhead Symbolic representation – Different symbols used in the related trades Reading of chemical plant Circuit Diagram Reading of Chemical plant Layout drawing	
WORKSHOP CALCULATION & SCIENCE (28 Hours)			
Professional	Demonstrate basic mathematical concept	**WORKSHOP CALCULATION & SCIENCE:** Unit, Fractions	

Knowledge WCS- 28 Hrs.	and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401	Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator Square root, Ratio and Proportions, Percentage Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction Material Science Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Mass, Weight, Volume and Density Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity Heat & Temperature and Pressure Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure Basic Electricity Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC,DC their comparison, voltage, resistance and their units Trigonometry Measurement of angles Trigonometrical ratios
Project work / Industrial visit **Broad areas:**		

a) Estimate Iron as Fe2O3 by gravimetric analysis.
b) Identify interfering radicals present in an inorganic salt mixture.
c) Perform the removal of these interfering radicals.
d) Make Block diagram of process control loop.
e) Calibration of Bourdon type pressure gauge & measure pressure by this.

SYLLABUS FOR LABORATORY ASSISTANT (CHEMICAL PLANT) TRADE			
SECOND YEAR			
Duration	**Reference Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 135Hrs.; Professional Knowledge 38 Hrs.	Plan and organize the technique (with different unit process and unit operation) of organic compounds. (NOS:MIN/N9425)	105. Prepare Acetanilide by Acetylation. (04hrs.) 106. Determine % yield of Acetanilide. (02 hrs.) 107. Determine Melting point of Acetanilide. (02 hrs.) 108. Prepare Methyl Oxalate by Etherification. (10hrs.) 109. Determine % yield of Methyl Oxalate. (04 hrs.) 110. Determine Melting point of Methyl Oxalate. (02 hrs.) 111. Prepare sodium benzene sulphonate by Sulphonation. (10hrs.) 112. Determine % yield of sodium benzene sulphonate. (04hrs.) 113. Determine Melting point of sodium benzene sulphonate. (05 hrs.) 114. Prepare Nitrobenzene by Nitration. (05hrs.) 115. Determine % yield of Nitrobenzene. (05hrs.) 116. Determine Melting point of Nitrobenzene. (02 hrs.) 117. Prepare Tribromophenol by Halogination. (10hrs.) 118. Determine % yield of Tribromophenol. (05hrs.)	Introduction to Organic Chemistry. Purification of Organic Compounds. Purification of Organic Compounds. Types of organic reactions, Classification & nomenclature. Aliphatic hydrocarbons Halogen derivatives of hydrocarbons -aliphatic alcohol Ethers, Aldehydes, Ketones Carboxylic acid. Amides & Anhydride, Acid Halides Esters Oil & Fats. Soaps & Detergents. (38 hrs.)

		119. Determine Melting point of Tribromophenol. (02 hrs.) 120. Prepare oxalic acid by Oxidation. (15hrs.) 121. Determine % yield of oxalic acid. (05hrs.) 122. Determine Melting point of oxalic acid. (02 hrs.) 123. Prepare Aniline by reduction. (10 hrs.) 124. Determine % yield of Aniline. (05hrs.) 125. Determine Melting point of Aniline.(02 hrs.) 126. Determine % yield of Methyl orange, Ozazone, Glucosazone. (04hrs.) 127. Determine Melting point of Methyl orange. (05 hrs.) 128. Prepare soap by Saponification. (10 hrs.) 129. Determine % yield of soap. (05hrs.) 130. Determine saponification value. (02hr) 131. Prepare Aspirin. (05 hrs.) 132. Determine % yield of Aspirin. (05hrs.) 133. Determine Melting point of Aspirin. (02 hr)	
Professional Skill 125 Hrs.; Professional Knowledge 45 Hrs.	Plan and organize technique of inorganic substance with quality control. (NOS:MIN/N9426)	134. Prepare sodium carbonate. (20 hrs.) 135. Determine % yield & purity. (05 hrs.) 136. Prepare copper sulphate. (20 hrs.) 137. Determine % yield & purity. (5hrs.) 138. Prepare Mohr's salt. (20	Amines Cyanogen compounds Carbohydrates & Protein Polymers, Aromatic, Hydrocarbons, aromatic ethers. halogen derivatives Compounds with nitrogen urea (45 hrs.)

		hrs.) 139. Determine % yield & purity. (05 hrs.) 140. Prepare potash alum. (20 hrs.) 141. Determine % yield & purity. (05 hrs.) 142. Prepare potassium nitrate. (20 hrs.) 143. Determine % yield & purity. (05 hrs.)	
Professional Skill 120 Hrs.; Professional Knowledge 40 Hrs.	Analyze different organic compounds to identify the compound and determine various parameters. (NOS:MIN/N9427)	**Analysis of organic compounds to determine followings:** 144. Element present. (20 hrs.) 145. Functional group. (20 hrs.) 146. Melting point of organic compound. (5 hrs.) 147. Preparation of derivatives. (60 hrs.) 148. Melting point of derivatives for following groups of compounds: Alcohol, acid, carbohydrate, Nitro compounds, Amines, halogen compounds, sulphur compounds, phenolic compounds, Aldehyde, Ketone & Ester. (15 hrs.)	Aromatic acids Compounds of double & triple rings Heterocyclic compounds Diazonium salts, colour and dyes. Percentage of elements in chemical compounds Empirical formulae of chemical compounds. Empirical formulae of chemical compounds, balancing chemical equation. Principles of Material balance as applied in chemical industries; Examples of application of Material balance in heavy chemicals manufacturing viz. Sulphuric acid, Caustic Chlorine Plants. (40 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Analyze different organic compounds and measurement in respect of waste water management. (NOS:MIN/N9428)	149. Analyze given sample of water to determine Chemical Oxygen DemandC.O.D. (05hrs.) 150. Analyze given sample of water to determine	Water Chemistry; Use of water in various industrial application viz. Steam generation; various chemical processes;. Principles of water analysis;

		Biological Oxygen Demand B.O.D. (05hrs.) 151. Analyze given sample of water to determine Total Suspended Solids T.S.S. (05 hrs.) 152. Analyze given sample of water to determine pH using different methods viz. pH paper, Indicators, pH Meter.(05 hrs.) 153. Analyze given sample of water to determine Total Hardness by EDTA method. (06 hrs.) 154. Analyze given sample of Boiler Blow Down water to determine caustic alkalinity.(06 hrs.) 155. Analyze given sample of water to determine Turbidity. (06 hrs.) 156. Analyze given sample of water to determine available chlorine.(06 hrs.) 154.Analyze given sample of water to determine Total Dissolved Solids TDS. (06 hrs.)	Meaning of the terms Hardness; Turbidity TDS, TSS, pH, DO, BOD, COD Available Chlorine, Principles adopted in determination of hardness of raw water; Analysis of Boiler feed water, Boiler Blow down Water. Principles of Analysis of Sewage water, Determination of COD, BOD, TDS, Turbidity and potable water for Municipal use, Principles of Chlorine estimation.(18 hrs.)
Professional Skill 125 Hrs.; Professional Knowledge 45Hrs.	Perform quantitative analysis of ore, estimate element, alloy, organic and inorganic substanceto estimate Pharmaceuticals (Drugs/Drug intermediates)	157. Perform chemical reaction for analysis of Bauxite or Zinc ore. (15 hrs.) 158. Estimate elements. (10 hrs.)	Flow sheet for industrial production of Ammonia, Nitric acis, sulphuric acid, urea, paper, sugar, caustic, chlorine & polymers. (09 hrs.)
		159. Perform chemical reaction for analysis of Brass or Soldering materials.(15 hrs.)	Alloys, Amalgams Definition, examples of Alloys used in industries; Principles of Analysis of Alloys to determine

	substances. (NOS:MIN/N9429)	160. Estimate elements. (10 hrs.)	compositions(09 hrs.)
		161. Perform chemical reaction for analysis of calcium in given tablet. (20 hrs.) 162. Estimate calcium. (5 hrs.)	Drugs/Drug intermediates Definitions, Examples. Principles of Analysis of Drugs/Drug intermediates.(09 hrs.)
		Estimation of formaldehyde by Iodometric method: 163. Prepare reagents. (05 hrs.) 164. Perform titration. (15 hrs.) 165. Prepare table for calculation & estimate % of formaldehyde in given sample. (05 hrs.)	Preservatives, Definition, Use, Examples of common preservatives, Principles of Analysis of Preservatives (09 hrs.)
		Estimation of aniline or phenol in the given solution by Bromination method: 166. Prepare reagents. (05 hrs.) 167. Perform titration. (15 hrs.) 168. Prepare table for calculation & estimate % of aniline or phenol in given sample. (05 hrs.)	Lipids, Definition, Meaning of the terms Oils, Fats, Acid Value, Saponification value, Iodine value; Rancidity Principles of Analysis of Lipids; Hydrogenated fat./Vanaspati Definition, Principles of checking adulteration of Ghee.(09hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 36Hrs.	Perform analysis of fuel gas, sugar, oil, fat, soap and nitrogen in fertilizer. (NOS:MIN/N9430)	169. Prepare reagents for Orsat's Apparatus. (10 hrs.) 170. Perform operation of Orsat's Apparatus. (10 hrs.) 171. Estimate composition of gases. (05 hrs.)	Flue gas., Definitions, Examples, Standard Composition, Principles of Analysis of Flue gas, Solutions used in Orsat's Apparatus, Working Principles (09hrs.)
		172. Determine acid value of an oil or fat. (20hrs.) 173. Determine saponification value of an oil or fat. (20hrs.)	Percentage of elements in chemical compounds Empirical formulae of chemical compounds. Empirical formulae of

		174. Determine Iodine value of an oil or fat. (10hrs.)	chemical compounds, balancing chemical equation (18 hrs.)
		Determination of fat by Soxhlet's Extraction method: 175. Construct Soxhlet's apparatus by assembling different parts. (02hrs.) 176. Perform operation with given sample. (08hrs.) 177. Estimate % of fat in given sample. (02hrs.)	Electrolysis, Electro chemistry, electro-chemical series, Heat effect of electricity. (05hrs.)
		Estimation of nitrogen by Kjeldahl's method: 178. Construct Kjeldahl's apparatus by assembling different parts. (04hrs.) 179. Prepare reagents. (04hrs.) 180. Perform operation with given sample. (03hrs.) 181. Prepare table for calculation & estimate % of nitrogen in given sample. (02hrs.)	Fertilizer its types & uses, Examples, compositions; Meaning of the term NPK, Principles of Analysis of Fertilizers. Material balance. (04hrs.)
Professional Skill 110 Hrs.; Professional Knowledge 29 Hrs.	Operate various measuring instruments used in chemical plant and laboratory. (NOS:MIN/N9431)	182. Prepare reagents. (05 hrs.) 183. Perform operation of the instrument. (10 hrs.) 184. Prepare graph & table for calculation. (05 hrs.)	Radio chemistry, Decay of radio isotopes. Equation of decay half time value. (07 hrs.)
		Determination optical rotation of sugar solution by Polari-meter: 185. Prepare reagents. (05 hrs.) 186. Perform operation of the instrument. (10 hrs.) 187. Prepare graph & table for calculation. (05 hrs.)	Introduction to microbiology. (07 hrs.)

		Determination of % of elements by Electrolytic analyzer: 188. Prepare reagents. (05 hrs.) 189. Perform operation of the instrument. (05 hrs.) **Determine the PH of given solutions by using PH-meter & comparator (Visual Calorimeter):** 190. Prepare Buffer solution & reagents. (05hrs.) 191. Perform operation of the pH meter. (05 hrs.)	Introduction to Bacteria cell. Lovibond comparator. (03 hrs.) Sterilization - Details study. pH Meaning, scale, different methods of finding pH; Working Principles of Visual Colorimeter; Working Principles of PH-meter (02 hrs.)
		Determine concentration of unknown coloured solution by colorimeter: 192. Prepare reagents. (10 hrs.) 193. Perform operation of the instrument. (05 hrs.) **Determine concentration of unknown solution by Spectrophotometer :** 194. Prepare reagents. (10 hrs.) 195. Perform operation of the instrument. (05hrs.)	Colorimetric Analysis Applications Examples, &Principles of Colorimetric Analysis. Introduction to Nutrition of bacteria. (05 hrs.) **Spectrophotometer** Application, Examples, Working Principles of Electrolytic Analyzer, Features & specification of **Spectrophotometer,** Precautions to be observed. Introduction to Industrial Microbiology. (05 hrs.)
		Practice operation of following laboratory instruments: 196. Digital flame photometer (05hrs.) 197. Refractometer (oil/sugar) (05hrs.) 198. Karlfischer apparatus. (05hrs.) 199. Analysis of water quality used in industry (PH, TDS, TSS, HARDNESS and elements). (05hrs.)	Fuel (Definition, classification, properties, composition & uses) (09 hrs.)

		200. Digital moisture balance (05hrs.) 201. Brookfield viscometer (05hrs.) 202. Electrophoresis apparatus (05hrs.) 203. Pensky –Martin apparatus (Flash point). (10hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform proximate analysis of coal and calorific value of different fuels. (NOS:MIN/N9432)	204. Determine moisture in given sample of coal. (03hrs.) 205. Determine volatile matter in given sample of coal. (03hrs.) 206. Determine ash content in given sample of coal (Furnace). (03hrs.) 207. Determine sulphur& fixed carbon in given sample of coal(C-S Det. App. LECO). (03hrs.)	Fuels its types & uses, Examples of Solid, Fuels, compositions; Meaning of the terms Moisture, VCM, Ash, FC, CV Principles of Analysis of Coal, Working Principles of Bomb Calorimeter.(05 hrs.)
		208. Determine calorific value of kerosene oil using Bomb Calorimeter. (04hrs.) 209. Determine calorific value of coal using Bomb Calorimeter. (06hrs.) 210. Determine calorific value of LPG using Jules Calorimeter. (03hrs.)	Identification of different micro-organism Micro- organisms & infections. Streptomycin Yeast Micro- organisms & infections. Streptomycin Yeast Bread, Alcohol, Beers, Wines (04 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform detection of micro-organism in food, pharmaceutical and other related laboratories. NOS:MIN/N9433)	211. Perform Operation of Microscope. (08 hrs.) 212. Identify common laboratory equipment's used in microbiology. (02hrs.) 213. Prepare media required for inoculations. (05 hrs.)	**Microbiology techniques**, Applications, Examples of Gram +ve& Gram –ve Microbes, Methods of media preparation & incubation. Meaning of Disinfectant, Antiseptic, Reidel- Walker Coefficient, Working Principles

		214. Identify microorganism by Gram staining technique. (10hrs.)	of Microscope. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform Experiments on Analyzing Equipment. NOS:MIN/N9434)	215. To perform experiment on particle size by particle size analyzer (08 hrs.) 216. To perform experiment on solid analyzer. (08 hrs.) 217. To perform experiment on total surface area by surface area analyzer. (09 hrs.)	**Particle size Analyzer** Application, various types Examples, Working Principles ofParticle size AnalyzerFeatures& specification of Particle size Analyzer Precautions to be observed, Tyler series, Relationship between Particle size & Surface area. Working, Principles and Uses of Analyzing equipment. (09 hrs.)
WORKSHOP CALCULATION & SCIENCE (22 Hours)			
Professional Knowledge WCS- 22 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	**<u>WORKSHOP CALCULATION & SCIENCE:</u>** Friction Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice Algebra Algebra - Addition , subtraction, multiplication & division Algebra - Theory of indices, algebraic formula, related problems Estimation and Costing Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing	

Project work / Industrial visit

Broad areas:

a) Estimation of nitrogen of a given fertilizer by Kjeldehal's method.
b) Prepare Buffer of different pH & measure unknown pH by pH meter.
c) Determination of concentration of copper present in brass sample by Spectrophotometer.
d) Determination calorific value of Kerosene.
e) Identify micro-organism by staining method.

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/dgt.gov.in

ANNEXURE-I

List of Tools & Equipment			
LABORATORY ASSISTANT (CHEMICAL PLANT) (For batch of 20 Candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. GENERAL MACHINERY&SHOP OUTFIT			
1.	Digital balance	LCD /LED display accuracy: 0.1mg, capacity 200 Gms.	5 nos.
2.	Balance (tech.)	LCD /LED display accuracy: 1gm,1 gm to 10 kg capacity.	1 no.
3.	Auto-clave electrically heated	Capacity: 55 lit, Material: SS 304, pressure gauge, temp. range 121 to 125 ^{o}C, temp. accuracy ±0.5% with auto cycle controller and solenoid valve foot lifting and drum.	1 no.
4.	Vacuum pump mounted on moving tables	0.5 HP electrical motor cap: 50 LPM /2 CFM, oil cooled	2 nos.
5.	Electric drying ovens	Working temp: 200°C size: 450*450*450 mm, inner SS chamber and outer body M.S powder coated and controlled by PID Controller and Air circulation facility.	2 nos.
6.	Water baths 6 places, electrically heated	Double Walled with Digital controller cum indicator with Stirring Arrangement inside stainless Steel Temp. Range Amb, +5deg.c. To 95. deg.c.+/-0.2	4 nos.
7.	Sand bath		1 no.
8.	Refrigerator(Deep Freezer Double Door Type)	Single door, Auto defrosting. 200-liter capacity made up of completeS.S.	1 no.
9.	Chromatographic equipment	Paper, column, thin layerColumn Type Chromatographic	1 No.

		Equipment: Gas Chromatograph, The Gas Chromatograph should be Microcontroller based system with oven, PLC based pneumatic module, temperature controller cum programmer module, FID and TCD Module, PC based Data station and also remote display unit for displaying concentration of one key component of the sample via RS 485 port, Windows based single channel software, With All accessories. Liquid Chromatographic Equipment: With Solvent delivery system, Injector, UV – VIS detector, HPLC column:	
10.	Stirrers with motors	230V, AC, capacity 5 - 7 liters with regulator	8 nos.
11.	Magnetic stirrers (with heating plate)	2 liters capacity with heating coil	2 nos.
12.	Mortar	100mm, porcelain with pestle	6 nos.
13.	Heating plates (electric)	1000 watt	1 no.
14.	Mortar & pestle	150 mm. steel / cast iron	1 no.
15.	Electric heating plates	With C.I top 16 “x18 “size and regulator	2 nos.
16.	Heating mantles (universal)		6 nos.
17.	Borer for stoppers with sharpener		1 no.
18.	Clamps with spring or screw		20 nos.
19.	Cork press		1 no.
20.	Scissors		2 nos.
21.	Bunsen's burner		20 nos.
22.	Set sieves automatic	20 – 200 mesh	1 no.
23.	Shaking machines for sieves & bottles		1 no.
24.	Steam generator (copper) for steam distillation	2 liters	10 nos.
25.	Hot water funnel with thermometer	1liter, 0 to 110 C	10 nos.

26.	Tongs (forceps) nickel for crucibles & weights		(20+1) nos.
27.	Tongs long for crucibles (muffle furnace)		6 nos.
28.	Spatulas nickel		(20+1) nos.
29.	Test tube stand	For 10 - 12 test tubes	(20+1) nos.
30.	Tripods		(20+1) nos.
31.	Test tube holders		(20+1) nos.
32.	Clamp holders		(20+1) nos.
33.	Clamps(Forced Head)		(20+1) nos.
34.	Retort Rings with clamps for filtering & heating		(20+1) nos.
35.	Stands Burret		(20+1) nos.
36.	Stands with clamps for burettes		(20+1) nos.
37.	Apparatus for distilled water and demineralizing water	Cap: 10 liter/hr, made of S.S with water level cut off	1 each
38.	Crucible nickel	30 mm. dia, height 40 mm.,	6 nos.
39.	One pan analytical balances	0.1mg. To 100 Gm. Sensibility	5 nos.
40.	LCD Multimedia projector		1 no.
41.	Computer (latest configuration) with licentiate operating software.	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch. Licensed Operating System.	1 no.
42.	Printer (Printer, Scanner & Copier)		1 no.
43.	Microscope	x 1000 (Monocular)	1 no.
44.	Polariometers with extra sodium lamp	Optical wavelength of 589nm, Measuring range of ± 89 Deg., Accuracy of 0.01- 0.002º Temperature range of 0-40 oC (accuracy +/- 0.1 Deg C) Response speed of +/- 6°/sec	2 no.
45.	Refractometers (Abbe type with refractive index)	Range of measurement nD 1.3000 – 1.7000, scale reading +0.001 and 0.0001 by estimation, Sugar scale 0.95% (+0.5%), Dispersion of	1 no.

		nD + 0.0005	
46.	pH meter Digital	With PH Range of 1 -14, Resolution of 0.01 pH, Temperature Range up to 0.0oC to 100oC, Digital LED/LCD Display, Power Supply of 230VAC ±10%, with auto calibration facility, auto manual temp., compensation facility, PH Electrode. To study the measurement of PH.	1 no.
47.	Potentiometric titration apparatus	Range: 0 to+ 1999.9mV Resolution: 1 mV	1 no.
48.	Conductivity meter	Microprocessor based, Auto ranging, Automatic End point function, LCD display, Accuracy ±1% F.S., up to 3 point calibration, Reset function, conductivity buffer option, Hold and Auto off function, temperature compensation.	1 no.
49.	Orsat's Apparatus with glassware		1 no.
50.	Karl Fisher apparatus for moisture determination	Sample size: 1 - 50 mg of water K. F. Dispensing resolution: 0. 05 ml. fully automatic.	1 no.
51.	Apparatus for determination of flash point	This apparatus is made as per IP 34, ASTMD-93 and IS 1448 (Part I) 1270 (P.21) and IS 1209-1953 method B.	1 no.
52.	Melting point apparatus	Made up of S.S. with 1% accuracy. 0.5 deg. C, with range up to 360 deg. C, temp. set point facility, digital display.	1 no.
53.	Electrolytic analyser	Analyzer for analysis of (i) Hydrogen (ii) Nitrogen (iii) Sulphur (iv) Chlorine employing electrode / induction furnace along with sensor/detectors.	1no.
54.	Photo-colorimeter	With Wave length of 400nm to	1no.

		700nm, Resolution of 0.01A, LED light source and display, Accessories like Cuvettes, Operation Manual,Cover	
55.	Bourdon Tube Pressure Gauges Different Ranges	100 mm dia, S.S. body, range: 6,10,20,30 kg/cm^2	2 each
56.	Compound Gauge	100 mm dia, S.S. body	2 No.
57.	Diaphragm Type Pressure Gauge	With Dial Size of 150 mm,	2 No.
58.	Spectroscopy-IR/NMR/UV-Visible Spectrophotometer, FTIR	UV-Visible Spectrophotometer: double beam wave length 190-1100 Nm, USB data output port LCD display, D2 lamp & tungsten lamp, printer port, multifunction software highly accurate silicon photo diode detector.	2 nos.
59.	Dead Weight Tester with Accessories	Range of 0 kg/ cm2 to 7 kg/ cm2, S.S. Sensing Element, Top & Bottom Chamber, Movement Case. To study the measurement of pressure.	1no.
60.	Heating plate (electric)	1000 watt	4 no.
61.	Pressure regulating Valve		2 No.
62.	Oswald viscometer (Consumable)	MOC: Borosilicate Glass Size: 120X1 mm Overall height: 237 mm Ready to use.	3 pieces
63.	Redwood viscometer	As per IS 1448 & IP 70 with stop watch & thermometers.	3 pieces
64.	Stop watch (Digital)	$1/10^{th}$ Sec.	6 pieces
65.	Thermostatic bath	Made up of 300 x 250 x 100 mm, double wall construction inner being of stainless steel outer of M.S. duly storing paint finish and gap filled to temperature insulation with glass wool 6 holes of 75 mm dia, 8 Ltr. Ready to use.	2 pieces
66.	Specific gravity bottle	MOC: Borosilicate Glass	6 nos.
67.	Pyknometer10ml	Made up of anodized aluminum	6 nos.

		or S.S.	
68.	Mechanical board for testing triangle and parallelogram of forces including all accessories		6 sets
69.	Spirit level		3 sets
70.	Different types of levers		1 set
71.	Instrument for determining 'g' (simple pendulum).		2 sets
72.	Barometer		1 no.
73.	Searle's apparatus for young's modulus		2 sets
74.	Wet and dry bulb thermometer	Made up of S.S. with water filling facility.	2 sets
75.	Apparatus for measurement of coefficient of expansion (thermal) of solid and liquid.	It will consist of a half-meter long chromium plated rod, Steam prepared in copper steam boiler of 2-liter capacity, 2 Thermometers, 1 hot plate of 1kw. Ready to use.Mounted on Suitable Frame Structure.	2 sets.
76.	Apparatus for measurement of thermal conductivity of good and bad conductor	Made up of S.S. with heater assembly of 1000 watt, 300 mm (D) test specimen, 8 J type sensors, Dimmer state, Voltmeter and Amperemeter& Temperature indicator.	2 sets
77.	Calorimeter for determining mechanical equivalent of heat and specific heat.		4 sets.
78.	Polarimeter with monochromatic light (with extra sodium lamp 35W)	Touch screen color display, temperature display, measuring mode, optical rotation, specific rotation, sugar, concentration, measuring range: - 45 deg to 45 deg, LED light source. Ready to use instrument.	2 sets
79.	Abbe refractometer (Digital)	With Range of measurement nD 1.3000 – 1.7000, Sugar scale 0.95% (+0.5%), Dispersion nD + 0.0005, LCD Display, printer	2 sets

		interface. Ready for experiment.	
80.	Equipment to study Kirchhoff's law and Electrochemical equivalent		1 set
81.	Whetstone's bridge		2 sets
82.	Resistance box	0 to 100 ohms	2 nos.
83.	Resistance box (1,2,5,10 Ω)	0 to 500 ohms.	2 nos.
84.	Rheostat0-25 Ohms	25 Ohms	2 nos.
85.	Rheostat0-100 ohms	100 Ohms	2 nos.
86.	Rheostat	500 Ohms	2 nos.
87.	Ammeter	0 to 1 Amp (DC)	2 sets
88.	Ammeter	0 to 5 Amp (DC)	2 sets
89.	Ammeter	0 to 10 Amp (AC, DC)	2 sets
90.	Ammeter	0 to 30 Amp (AC, DC)	2 sets
91.	Volt meter	0 to 1 volt (DC)	2 sets
92.	Volt meter	0 to 4 volt (DC)	2 sets
93.	Volt meter	0 to 5 volt (DC)	2 sets
94.	Volt meter	0 to 10 volt (DC)	2 sets
95.	Volt meter	0 to 25 volt (DC)	2 sets
96.	Volt meter	0 to 50 volt (DC)	2 sets
97.	Milli voltmeter	0 to 5 mV	2 nos.
98.	Milli voltmeter	0 to 50 mV	2 nos.
99.	Digital Milli voltmeter	0 to 200mv	2 nos.
100.	Resistance coils	5 Ohms, 10 Ohms, 50 Ohms, 100 Ohms	2 sets
101.	Digital Viscometer	Measuring range in mpa/Cp,LED display/LCD, with diff Measurement with 4 spindles, provided with RS 232 C interface. Ready for use instrument.	2 Nos.
102.	Comparator (Visual Colorimeter)	Measuring principle visual, Visual measurement of colour matching to determine material colour, Replaceable sample chamber liner, Transmittance and reflectance modes, Measurement range: 0.1-79.9 Red, 0.1-79.9 Yellow, 0.1-49.9 Blu, 0.1 – 3.9	02 Nos.

		Neutral, used for to measure colority of liquid, solid and powder sample.	
103.	Automatic Titration Apparatus	Display 16 character x 2 lines Alphanumeric BL LCD Ready for use instrument.	02 Nos.
104.	Gas fuming chamber with exhaust	Made up of S.S chamber min 4'x2'x2'with air exhaust and working platform of S.S. sheet, It will be designed so as to throw-out all toxic/harmful vapours & fumes, Working Table top is acid/alkali resistant, 6 mm thick Front facing door with toughened glass, the unit will be fitted with fluorescent light and a gas cock, and Drain valve.	01 No.
105.	Furnace 1200^{o} C	Range: 1100 deg Made up of M.S. 12”X6”X16” size, Muffle ovens 1100 deg. C, PID, sensor, with proper insulation.	01 No.
106.	Fire Extinguisher	Arrange all proper NOCs and equipment from municipal / competent authorities.	As per requirement
107.	LPG Cylinder		01 No.
108.	Water testing kit (all parameters)	Measuring range: Ph (0 to 14 Accuracy +/-0.01), TDS, Conductivity, Temperature And DO, read out: LCD manual with all necessary Electrodes/probes to measure above parameters, and with electrode stand with holding clamp buffers, sample containers minimum 5, semiconductor probe Instrument Will be in Ready to Use (in carrying case) Condition.	01 set
109.	Air Conditioner	2 Ton	As required
B. CONSUMABLE GLASSWARE AND MISCELLANEOUS			

110.	Desiccators	150 mm. dia.	As Required
111.	Desiccators vacuum	Borosilicate glass	As Required
112.	Extraction thimbles		As Required
113.	Glass tubes & rods of different diameter	Borosilicate glass	As Required
114.	Rubber tubes for water, gas & vacuum, stopper, rubber each glass, plastic & cork of different sizes		As Required
115.	Asbestos wire gauge		As Required
116.	Wire gauge (without asbestos)		As Required
117.	Cork rings		As Required
118.	Pipe clay Triangles		As Required
119.	Erlenmeyer flasks	250 ml.	As Required
120.	Erlenmeyer flasks	500 ml.	As Required
121.	Burettes	25 ml.	As Required
122.	Burettes	50 ml.	As Required
123.	Pipettes Volumetric	10 ml.	As Required
124.	Pipettes Volumetric	25 ml.	As Required
125.	Pipettes measuring	0 to 5 ml.	As Required
126.	Pipettes measuring	0 to 10 ml.	As Required
127.	Pipettes measuring	0 to 1 ml.	As Required
128.	Pipettes	micro 0 to 0.2 ml.	As Required
129.	Pipettes	1ml. (graduated)	As Required
130.	Each pipettes automatic	1, 2, 5, 10 ml.	As Required
131.	Flasks for distilled water	500 ml.	As Required
132.	Vacuum pipettes	Borosilicate glass	As Required
133.	Measuring cylinders	25 ml. Borosilicate glass	As Required
134.	Measuring cylinders	50 ml. Borosilicate glass	As Required
135.	Measuring cylinders	100 ml. Borosilicate glass	As Required
136.	Measuring cylinders	250 ml. Borosilicate glass	As Required
137.	Measuring cylinders	500 ml. Borosilicate glass	As Required
138.	Measuring cylinders	1000 ml. Borosilicate glass	As Required
139.	Volumetric flask	100 ml. Borosilicate glass	As Required
140.	Volumetric flask	250 ml. Borosilicate glass	As Required
141.	Volumetric flask	500 ml. Borosilicate glass	As Required
142.	Volumetric flask	1000 ml. Borosilicate glass	As Required
143.	Weighing bottles	polyethylene or glass 50 ml.	As Required
144.	Weighing bottles	polyethylene or glass 100 ml.	As Required
145.	Funnels with regular & long stem	7 cm. dia. Borosilicate glass	As Required

146.	Funnels	4 cm. dia. Borosilicate glass	As Required
147.	Funnels	9 cm. dia. Borosilicate glass	As Required
148.	Funnels Buchner different sizes	10 to 25 cm. dia. Borosilicate glass	As Required
149.	Funnels Hirsch	10 cm. Borosilicate glass	As Required
150.	Funnels separatory	50 ml. Borosilicate glass	As Required
151.	Funnels separatory	100 ml. Borosilicate glass	As Required
152.	Funnels separatory	250 ml. Borosilicate glass	As Required
153.	Funnels separatory	500 ml. Borosilicate glass	As Required
154.	Funnels for filter crucibles & Gooch crucibles with rubber rings	Borosilicate glass	As Required
155.	Beakers	100 ml. Corning Borosilicate glass	As Required
156.	Beakers	250 ml. Corning Borosilicate glass	As Required
157.	Beakers	400 ml. Corning Borosilicate glass	As Required
158.	Beakers	600 ml. Corning Borosilicate glass	As Required
159.	Beakers	1000 ml. Borosilicate glass	As Required
160.	Watch glasses	5 cm.dia.	As Required
161.	Watch glasses	7.5 cm.dia.	As Required
162.	Watch glasses	10 cm.dia.	As Required
163.	Dishes evaporating	5 cm. dia. porcelain, glass	As Required
164.	Dishes evaporating	7.5 cm. dia.	As Required
165.	Dishes evaporating	10 cm. dia. flat bottom	As Required
166.	Dishes evaporating	15 cm. dia.	As Required
167.	Dishes evaporating	20 cm. dia.	As Required
168.	Thermometers	0 to 110°C	As Required
169.	Thermometers	0 to 250°C	As Required
170.	Thermometers	0 to 350°C	As Required
171.	Thermometers for drying oven (L shape)		As Required
172.	Boiling flasks with round bottom	100ml. Borosilicate glass	As Required
173.	Boiling flasks with round bottom	250ml. Borosilicate glass	As Required
174.	Boiling flasks with round bottom	500ml. for each distilling flasks 50 ml., 100 ml., 250 ml. Borosilicate glass	As Required
175.	Boiling flasks with round bottom	500ml. for each distilling flasks 50 ml, 100 ml, 250 ml - Writz and others, Borosilicate glass	As Required
176.	Filtering flasks	250 ml. Borosilicate glass	As Required
177.	Filtering flasks	500 ml. Borosilicate glass	As Required

178.	Filtering flasks	1000 ml. Borosilicate glass	As Required
179.	Flasks soxhlet with condensers	Borosilicate glass	As Required
180.	Flasks kjeldahal	250 ml. Borosilicate glass	As Required
181.	Condensers liebig	30 mm. long, Borosilicate glass	As Required
182.	Condensers liebig	50 cm. long, Borosilicate glass	As Required
183.	Condenser bulb type	30 cm. long, Borosilicate glass	As Required
184.	Condenser spiral type	20 cm. long, Borosilicate glass	As Required
185.	Connecting tubes for khejeldahal distillation		As Required
186.	Gas generator (Kipp)	500 ml. (plastic)	As Required
187.	Gas washing bottles (Dreshsler)		As Required
188.	Drying tubes with one bulb (Calcium chloride)		As Required
189.	Crucibles porcelain	5 cm, dia, height 4 cm indigenous	As Required
190.	Crucibles quarts	5 cm, dia, height 4 cm indigenous	As Required
191.	Gooch porcelain or glass		As Required
192.	Filtering crucible	No. 0, 1, 2, 3 glass	As Required
193.	Test tube	160 mm x 15 mm.	As Required
194.	Test tube	10 mm.	As Required
195.	Gas sampling tubes		As Required
196.	Pairs nessler tubes		As Required
197.	Tubes for centrifuge		As Required
198.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis	30 ml.	As Required
199.	Bottles with droppers for indicator solutions & semi-micro qualitative analysis	50 ml.	As Required
200.	Bottles for solids	50 ml.	As Required
201.	Bottles for solids	100 ml.	As Required
202.	Bottles for solutions	100 ml.	As Required
203.	Bottles for solutions	250 ml.	As Required
204.	Bottles for solutions	1000 ml.	As Required
205.	Bottles for solutions	2000 ml.	As Required
206.	Bottles for solutions	3000 ml.	As Required
207.	Bottles for solutions	5000 ml.	As Required
C. SAFETY			
209.	Appron	White	As Required

210.	Hand Gloves (Nitrile)		As Required
211.	Acid Alkali Goggles		As Required
212.	Nose Mask (Cotton)		As Required
213.	Ear Plug		As Required
214.	Particle Size Analyzer	Capable of measuring a wide range of particle size distributions, Measurement range: 17 nm to 2500 µm, Light source: Red semiconductor laser (680 nm wavelength)	As Required
215.	Solid Analyzer	Casting: rugged all-metal with integral handles, Spectral range 3700 to 15000 cm^{-1}, Resolution better than 0.7 cm^{-1}, Frequency accuracy (@7300 cm^{-1}):< 0.06 cm^{-1}, Ethernet port for data communication.	As Required
216.	Surface Area Analyzer	Automatic calibration facility, Capable to create Automatically necessary mixtures of nitrogen and helium, Detector protection, Electronic valves, software control the unit via USB communication.	As Required

Note: -

1. Internet facility is desired to be provided in the classroom.
2. *All the tools and equipment are to be procured as per BIS specification.*

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्