AcSIR-IMP-2015 Programme Brochure

(Admission Session : August, 2015)

Integrated MTech-PhD Programme
in
High Power Microwave Devices and System Engineering
at
CSIR-CEERI, Pilani

The integrated MTech-PhD programme has two segments:

1. MTech programme of 2 years duration spread over 4 semesters.
2. PhD programme of 3 years duration after the successful completion of the MTech programme. Continuation into the PhD programme will be decided on case-by-case basis.

This full-time programme aims to provide in-depth exposure to the engineering concepts, scientific principles, research methodology and hands-on experience on advanced real-life R&D projects in different aspects of microwave devices and its system engineering. Students completing this integrated programme will be fully research-enabled and industry-ready.

The first semester of the MTech programme focuses on core subjects related to microwave system engineering as well as applications of microwave tubes and associated laboratory related to microwave tube components.

The second and third semesters offer courses related to slow-wave and fast-wave devices, CAD techniques used for the design of microwave tubes, and fabrication technologies used for microwave tubes.

The third and fourth semesters of the MTech programme provide the opportunity to the candidates to effectively utilize the knowledge acquired through the courses towards advanced R&D project work and dissertation in their specialization areas.

The medium of instruction and evaluation is English.

Number of Seats in the Programme

The total number of seats available is 6.

Admission Process and Eligibility for Admission

Please see the AcSIR website at **http://acsir.res.in/** for on-line submission of the admission form and details of eligibility.

Fellowship

Fellowship amount will depend on selection as a JRF (NET-Engg-JRF or GATE-JRF).

Programme Fee Structure

1. One-time Admission Fee (non-refundable) : Rs. 4,000.
2. One-time Security Deposit (refundable) : Rs. 6,000.
3. Semester Fees (non-refundable) : Rs. 24,000.

Students wanting to withdraw from the programme after deposit of fees and security amount will need to apply in writing for refund. If such an application is made before 7 days to the start of first semester session at CSIR-CEERI, refund of fees/other charges will be made after deducting the admission fee amount of Rs. 4,000.

No refund of fees / other charges will be made if the student leaves after joining the programme except for the security deposit / caution money amount of Rs. 6,000.

Total amount of Rs. 34,000 needs to deposited at the time of admission. Subsequently, only the semester fees of Rs. 24,000 needs to be deposited before the start of every semester for the duration of the MTech programme. The tuition fees during PhD programme is Rs. 1,000 per month.

For NEFT bank transfer, please transfer the amount to the bank account number **61033385318** of "Director, CSIR-CEERI" at SBBJ, Pilani **(IFSC code SBBJ0010398)** with appropriate narration statement. *This is the preferred mode of transaction for the depositing the amount.*

In case of Demand Draft, please get it issued in favour of "Director, CSIR-CEERI" payable at Pilani and post it by speed post or registered letter to "Director, CSIR-CEERI, Pilani – 333 031" with your name written in pencil on the reverse side of the demand draft.

Important Dates

All important dates will be announced on AcSIR website at **http://acsir.res.in/**.

The detailed academic programme calendar will be made available before the start of each semester.

Please visit the AcSIR website at http://acsir.res.in/ for more information. You should also periodically visit CSIR-CEERI's website link for AcSIR-IMP-2015 at http://www.ceeri.res.in/ for updates and news about this programme.

MTech Programme : Semester-wise Scheme :
High Power Microwave Devices and System Engineering

Semester-I

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 2-231	Electromagnetic Theory and Transmission Lines	3-0-0-3
ENG(CEERI) : 2-232	Microwave Communication	2-0-0-2
ENG(CEERI) : 2-233	Numerical Analysis and Techniques for Microwave Applications	4-0-0-4
ENG(CEERI) : 3-234	High Power Microwave Systems and Applications	3-0-0-3
ENG(CEERI) : 2-235	Lab: Microwave Components Characterization and Tube Processing Techniques	0-0-4-2
ENG(CEERI) : 1-206	Technical Communication	2-0-0-2

Semester-II

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 2-234	Microwave and Millimeter Wave Tube Technologies	3-0-0-3
ENG(CEERI) : 3-231	Slow-wave Devices : Principles and Design	4-0-0-4
ENG(CEERI) : 3-232	Fast-wave Devices : Principles and Design	3-0-0-3
ENG(CEERI) : 2-236	Lab: Microwave Devices Characterization and Tube Sub-assembly Fabrication	0-0-4-2
ENG(CEERI) : 3-233	Lab: CAD of Microwave Tubes	0-0-4-2
ENG(CEERI) : 2-206	Project Management	2-0-0-2

Semester-III

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 3-23x	Elective-I	3-0-0-3
ENG(CEERI) : 2-098	MTech Dissertation-I	0-7-14-14

Elective-I

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 3-236	Plasma-filled Microwave Sources	3-0-0-3
ENG(CEERI) : 3-237	Vacuum Microelectronic Devices	3-0-0-3

Semester-IV

Subject Code	Subject	L-T-P-C
ENG(CEERI) : 2-099	MTech Dissertation-II	0-9-18-18

MTech Programme : Brief Course Descriptions :
High Power Microwave Devices and Systems Engineering

ENG(CEERI) : 1-206 : Technical Communication : 2-0-0-2

Role and importance of technical communication; Effective written and oral communication; Ethical issues; Technical report writing; Technical / R&D proposals; Research paper writing; Letter writing and official correspondence; Emails; Oral communication in meetings and group discussions; Oral presentations; Use of modern aids.

ENG(CEERI) : 2-206 : Project Management : 2-0-0-2

Introduction; Project formulation, evaluation and initiation; Project planning and scheduling; Risk management; Project execution and implementation; Project monitoring and control; Project closure; Project documentation; Leadership and teamwork issues; Complex projects; Advances and trends.

ENG(CEERI) : 2-231 : Electromagnetic Theory and Transmission Lines : 3-0-0-3

Review of Maxwell's equations, wave equations and their solutions; Boundary conditions and their applications; Electromagnetic energy and power flow; Review of Poynting theorem; Transmission lines; Wave-guide and coaxial components; Scattering matrix representation; Propagation of electromagnetic waves through homogeneous, in-homogeneous, and anisotropic media; Surface resistance and RF resistance; Ferrite devices; Waveguides and resonators; Characteristic and interaction impedances; Quality factor (loss and diffractive). Impedance matching; Measurement of "Q", power, noise figure, S-parameters, dielectric constant and loss tangent, dispersion and impedance characteristics, and loss parameters.

ENG(CEERI) : 2-232 : Microwave Communication : 2-0-0-2

Ground/surface wave, space-wave, and sky-wave modes of communication; Tropo-spheric Communication; Line-of-sight communication and system performance; Active and passive repeaters and their design; Analog and digital communication; Mobile communication; Satellite communication system; Earth station design criteria and direct reception system; Satellite transponders and their design criteria; Phase-noise, intra-pulse and inter-pulse noises and their significance.

ENG(CEERI) : 2-233 : Numerical Analysis and Techniques for Microwave Applications : 4-0-0-4

Overview of programming fundamentals; Numerical differentiation: Taylor series, Euler method, Runge-Kutta method, predictor-corrector method, Picard method, Numerov method; Numerical integration: Trapezoidal rule, Simpson rule, Romberg method; Numerical solutions of transcendental equations: Bisection method, Secant method, Newton method, Muller method; Solving simultaneous equations: Gauss elimination method, Gauss-Jordan method, Gauss-Seidel method, over-relaxation method; FDM: iterative method; FDTD: Leap-frog method, Yee algorithm, 1-D and 2-D considerations, Boundary conditions and excitations; Introduction to PIC; FEM: discretization, element equation, mapping, assembling, boundary conditions; Introduction to MoM; Optimization techniques: golden section method, steepest descent method, genetic/evolutionary algorithm.

ENG(CEERI) : 2-234 : Microwave and Millimeter Wave Tube Technology : 3-0-0-3

Fundamentals of vacuum technology; Vacuum generation and measurement, and leak detection; Ultra-high vacuum techniques; Electron-tube grade materials and their characteristics; Design of tools, jigs, and fixtures; Engineering / mechanical design of components; Special machining techniques; Physics of electron emission, emission equation; Temperature limited and space-charge limited emission; Methods of determining work function; Oxide-coated cathodes, Dispenser cathodes, Explosive emission cathodes, Field emitters, Secondary emitters; Fabrication and characterization of cathodes; Life testing and surface analysis techniques; Trends in microwave technologies.

ENG(CEERI) : 2-235 : Microwave Components Characterization and Tube Processing Techniques Laboratory : 0-0-4-2

Laboratory practices and safety considerations; Scattering parameters; Measurement of impedance and characterization of cavities; Dispersion and impedance characterization of RF structures; RF loss measurements; UHV techniques; Heat treatment in protective atmosphere; Ceramic-to-metal sealing techniques; Chemical processing of components.

ENG(CEERI) : 2-236 : Microwave Devices Characterization and Tube Sub-assembly Fabrication Laboratory : 0-0-4-2

Laboratory practices and safety considerations; Device characterization using spectrum analyzer, scalar/vector analyzer; Break-down tests; X-ray radiography; Hot RF characterization of devices; Metal-to-metal brazing techniques; Leak detection techniques; TIG/laser welding; Vacuum processing of devices; Cathode fabrication and testing; Cathode characterization using Auger and thermal emission microscope.

ENG(CEERI) : 3-231 : Slow-wave Devices – Principles and Design : 4-0-0-4

Classification and high frequency limitations of conventional electron tubes. Formation and confinement of an electron beam. Slow-wave structures, couplers and RF windows. Beam-wave interaction mechanism. Spent beam collection. Efficiency enhancement by phase-velocity tapering and multi-stage depressed collection. Different types of devices, their operation, and characteristics, High power and wide bandwidth issues. Future trends.

ENG(CEERI) : 3-232 : Fast-wave Devices – Principles and Design : 3-0-0-3

Merits of fast-wave devices over slow-wave devices. Operating principle of a gyrotron and design of its components: magnetron injection gun, beam tunnel, RF interaction cavity, magnetic field, non-linear taper, RF window, mode converter and collector. Beam-wave interaction and mode selection criteria. Other fast-wave devices: gyro-TWT, gyro-klystron, peniotron and FEL. Applications of gyro-devices and future trends. High Power Microwave (HPM) Devices.

ENG(CEERI) : 3-233 : CAD of Microwave Tubes Laboratory : 0-0-4-2

Laboratory practices and safety considerations; Components design : electron guns, slow-wave structures, fast-wave structures, RF cavities, RF windows, collectors; Electron beam and RF wave interaction simulation; Design and simulation for electrical, thermal, and structural design of slow-wave and fast-wave microwave tubes; CAD of complete tube; Computer-aided engineering drawing.

ENG(CEERI) : 3-234 : High Power Microwave Systems and Applications : 3-0-0-3

Special EW (Radar, ECM, ECCM) systems and their requirements in respect of microwave and millimeter wave devices; Types of jamming; Linear accelerators, Microtrons, Synchrotrons, Plasma heating systems, Proton accelerators, and Thermonuclear reactors; Other applications like imaging, spectroscopy, biomedical, industrial heating, electronic power conditioners, and modulators.

ENG(CEERI) : 3-236 : Plasma-Filled Microwave Sources : 3-0-0-3

Introduction to plasma and its physical parameters; Saha equation and its relevance; Debye shielding; Conditions for plasma formation; Plasma as fluid; Waves in plasma; Equilibrium and instabilities, two-stream instability and its dispersion relation; Non-linear effects in plasma; Plasma sheath equation; Bohm-sheath criteria; Child-Langmuir law and space-charge limited current; Probe theory; Types of discharges in gases, hollow cathode discharges and other kinds of low pressure discharges; General features of electrons emission; Control and extraction of electrons and ions from plasma in DC and pulsed-mode conditions; Plasma sources for axially symmetric electron beams; Plasma cathode electron gun (PCE-Gun); Plasma-filled microwave devices: theory and applications; Trends in plasma-filled sources.

ENG(CEERI) : 3-237 : Vacuum Microelectronic Devices : 3-0-0-3

Basic semiconductor technologies like reactive ion etching, photo-lithography, oxidation, CVD, sputtering, LIGA; MEMS technologies; Design considerations in vacuum microelectronic devices; Photonic band-gap structures, folded wave guide and ladder structures; Tera Hertz devices including reflex klystrons; Micro-fabricated devices like TWT and klystrino; Combination of vacuum and semiconductor technologies in microwave devices, including microwave power module and their applications.

MTech Programme : List of Faculty Members :
High Power Microwave Devices and System Engineering

S. No.	Name	Designation	Discipline
1.	Dr. S. N. Joshi	Ex-Scientist G	Microwave Engineering & Tube Technology
2.	Dr. V. Srivastava	Chief Scientist	Microwave Engineering & Tube Technology
3.	Dr. L. M. Joshi	Emeritus Scientist	Microwave Engineering & Tube Technology
4.	Dr. V. V. P. Singh	Chief Scientist	Microwave Engineering & Tube Technology
5.	Dr. R. K. Sharma	Princ. Sc.	Microwave Engineering & Tube Technology
6.	Dr. S. K. Ghosh	Princ. Sc.	Microwave Engineering & Tube Technology
7.	Dr. A. Bera	Sr. Scientist	Microwave Engineering & Tube Technology
8.	Dr. S. Maurya	Sr. Scientist	Microwave Engineering & Tube Technology
9.	Sh. M. Alaria	Scientist	Microwave Engineering & Tube Technology
10.	Dr. H. Khatun	Scientist	Microwave Engineering & Tube Technology
11.	Dr. R. Barik	Scientist	Microwave Engineering & Tube Technology
12.	Sh. Deepender Kant	Scientist	Microwave Engineering & Tube Technology
13.	Sh. Debashis Pal	Scientist	Microwave Engineering & Tube Technology
14.	Dr. A. Roychoudhury	Scientist	Microwave Engineering & Tube Technology
15.	Dr. A. K. Bandhopadhyay	Scientist	Microwave Engineering & Tube Technology
16.	Ms. Mercy Latha	Scientist	Microwave Engineering & Tube Technology
17.	Sh. Vishant	Scientist	Microwave Engineering & Tube Technology
18.	Sh. Om Ranjan	Scientist	Microwave Engineering & Tube Technology
19.	Sh. Purushothaman N.	Scientist	Microwave Engineering & Tube Technology
20.	Sh. Sushil Shukla	Scientist	Microwave Engineering & Tube Technology
21.	Dr. Ram Prakash	Sr. Scientist	Plasma Devices
22.	Dr. U. N. Pal	Sr. Scientist	Plasma Devices
23.	Sh. Niraj Kumar	Scientist	Plasma Devices