

**CSIR**  
**Post-graduate Programme Brochure**  
**(2010-2011)**

*Two year*  
*PG Research Programme in Engineering*  
*entitled*  
*Advanced Petroleum Science and Technology*



**Indian Institute of Petroleum, Dehradun**

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## *Aims and Scope*

This PG research 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. IIP being a constituent laboratory of Council of Scientific and Industrial Research (CSIR) is involved, in Research & Technology development in the hydrocarbon sector for more than four decades. Insight about our research activities and facilities are available at [www.iip.res.in](http://www.iip.res.in). IIP is the nodal centre for conducting PG Research Training Programme in Engineering titled Advanced Petroleum Science and Technology (APST). The programme is scheduled to start in August, 2010. The first semester of the programme focuses on the core courses. The second semester offers the specialized courses in field of Petroleum Refining technologies, Process control and Renewable Energy Conversion Technologies. The third and fourth semesters give the opportunity to the candidates to effectively utilize the knowledge acquired through the courses towards advanced R&D project work and dissertation in specialized areas. The third semester is also aimed at providing Advanced Self study courses which will prepare them in specialized areas like alternate fuels, process integration, green fuels and many more under the guidance of IIP scientists. The medium of instruction and evaluation is English. The admissions will be offered on the basis of academic performance at Undergraduate level and performance in the interview. GATE scores in CH subject will be an added advantage. The essential details are available in the PGRPE common brochure 2010-2011.

## *Number of Seats*

A maximum of 10 students inclusive of sponsored candidates will be admitted in 2010. The essential qualification required for admission to APST is mentioned in the PGRPE common brochure 2010-2011.

## *Admission Process and Eligibility for Admission*

Please see the CSIR website, <http://www.csir.res.in> for announcement and online submission form. The selected candidates will be designated as “Scientist Trainee” under CSIR QHS scheme. The details are available in the PGRPE common brochure 2010-2011.

## *Fellowship*

Fellowship amount of Rs. 25,000 per month will be awarded to qualified non sponsored candidates during the two year programme as already mentioned in the PGRPE common brochure 2010-2011.

## *Programme Fee Structure*

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

Students wanting to withdraw after deposit of fees will need to apply in writing for refund of fees. If such an application is made on or before July 31<sup>st</sup>, 2010 at IIP. 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. The fees/charges need to be deposited before the start of every semester.

Total amount of Rs 34000 needs to be deposited at the time of admission. Subsequently, only the semester fee of Rs 24000 needs to be deposited before the start of every semester.

*For NEFT bank transfer, please transfer the amount to the saving account number 30266912400 of Director, IIP at SBI, IIP Branch, Mohkampur, Dehradun ( Branch code 02359) with (IFSC code SBIN0002359) with appropriate narration statement. In case of Demand Draft, please get it issued in favour of "Director, IIP Dehradun" payable at Dehradun and post it by speed post or registered letter to "Director IIP, PO Mohkampur, Dehradun – 248005" with your name written in pencil on the reverse side of the demand draft.*

## *Programme Outline*

<b>Year</b>	<b>Courses</b>	<b>Credits</b>	<b>Duration</b>
<b>First year</b>			
1 <sup>st</sup> Semester	5 courses of 3-4 credits each	16	16-18 weeks
2 <sup>nd</sup> Semester	5 courses of 3-4 credits each	16	16-18 weeks
<b>Second year</b>			
3 <sup>rd</sup> Semester	Self Study, Research Proposal and Seminar	16	16-18 weeks
4 <sup>th</sup> Semester	Thesis submission and Defense	16	16-18 weeks

## *Semester wise schedule of Advanced Petroleum Science and Technology*

### Semester I

<b>Code</b>	<b>Subject Name</b>	<b>Credits</b>	<b>Faculty</b>
APST-101	Petroleum Refining and Petrochemicals	3	Dr H B Goel
APST-102	Hydrocarbon Chemistry	3	Dr Bir Sain
APST-103	Advanced Thermodynamics	3	Dr Jasvinder Singh
APST-104	Chemical Reaction Engineering	3	Mr S K Ganguly
APST-105	Analytical methods used in Petroleum Industry	4	Dr Y K Sharma

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### Semester II

<b>Code</b>	<b>Subject Name</b>	<b>Credits</b>	<b>Faculty</b>
APST-201	Catalysis in Petroleum Refining	3	Dr A Dutta
APST-202	Advanced Separation Processes	3	Dr M O Garg Dr A N Goswami Dr S M Nanoti Dr A Nanoti
APST-203	Advanced Conversion Processes	3	Dr G Das
APST-204	Advanced Process Control	4	Dr M O Garg
APST-205	Renewable Energy Conversion Technologies	3	Dr S Kaul

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**At the end of Semester II research topics shall be displayed by faculty for dissertation.**

### Semester III

<b>Code</b>	<b>Subject Name</b>	<b>Credits</b>
APST-3xx	Advanced Self study (Elective)	3
APST-320	Seminar on Self study topic	2
APST-331	Proposal on Dissertation and Seminar	11

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### Elective Courses:

Code	Subject Name	Credits	Faculty
APST-301	Hydro-processing	3	Dr A Sinha
APST-302	Gasoline Reformulation	3	Dr N Viswanadham Dr VVDN Prasad
APST-303	Process Integration	3	Dr M O Garg
APST-304	Fluid Catalytic Cracking	3	Dr N Atheya
APST-305	Solvent Extraction	3	Dr M O Garg Dr S M Nanoti
APST-306	Adsorption and Membrane based Separation Processes	3	Dr M O Garg Dr A N Goswami Dr A Nanoti
APST-307	Techniques in Catalyst Preparation	3	Dr VVDN Prasad
APST-308	Techniques in Catalyst Characterization	3	Dr J K Gupta
APST-309	Gas to Liquid Technologies	3	Shri P Vijayanand
APST-310	Renewable Fuels	3	Dr S Kaul Dr T Bhaskar
APST-311	Applications of Biotechnology in Petroleum Refining	3	Dr D K Adhikari
APST-312	Alternate Fuels Applications	3	Dr S K Singhal
APST-313	Oxidation of Hydrocarbons	3	Dr A Datta
APST-314	Sulphur Recovery	3	Dr A Masohan

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### Semester IV

Code	Subject Name	Credits
APST-401	Dissertation Seminar and Viva voce	4
APST-402	Dissertation Report	12

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## *Course Description*

### **APST 101: Introduction to Petroleum Refining and Petrochemicals - 3 Credits**

**Faculty: Dr H B Goyal**

#### **Petroleum Refining:**

Primary operations: Gas and liquid separations; Treatment of crude oil before transportation; Transportation of crude oil; Pretreatment of Crude; Crude distillation: atmospheric operations ; vacuum operations; Secondary Operations: Catalytic cracking; hydro cracking; Visbreaking; Coking; Reforming; Hydro treating; Solvent treating

#### **Petrochemicals:**

Basic Building blocks; Gases; Liquids; C<sub>1</sub>-Chemistry; Petrochemicals from n-paraffins; Olefins production; Petrochemicals from olefins; Petrochemicals from aromatics; Polymer chemistry; Polymer products; Synthetic fibers; Synthetic rubber; Refinery - Petrochemical Integration

### **APST 102: Hydrocarbon Chemistry - 3 Credits**

**Faculty: Dr Bir Sain**

Classification of hydrocarbons; Chemistry of crude oil; Basic reactions of hydrocarbons: Isomerisation; Alkylation; Addition; Carbonylation; Acylation; Oxidation; Heterosubstitution; Hydrogenation; Metathesis; Oligomerization and polymerization; Chemistry of refinery processes: Catalytic cracking; Catalytic hydro cracking; Catalytic reforming; Hydro treating; Thermal cracking; Visbreaking; Coking; Isomerization; Alkylation; Polymerization; Hydrogen production and purification; Acid gas removal; Acid removal; Gas processing; Sulfur recovery; Effluent treatment; Chemistry of additives and specialty products



### **APST 103: Advanced Thermodynamics - 3 Credits**

**Faculty: Dr Jasvinder Singh**

Basic concepts; Solution thermodynamics ; Applications of equations of state; Multicomponent and multiphase systems; The nature of phase equilibrium; Phase rules; Chemical reaction equilibrium; Thermodynamics of flow systems

### **APST 104: Chemical Reaction Engineering - 3 Credits**

**Faculty: Mr Sudip K Ganguly**

An overview of Chemical Reaction Engineering; Basics of Reaction Kinetics; Interpretation of Batch Reactor Data; Introduction to Reactor Design: Batch, CSTR, PFR, and Semi-Batch Reactors; Design of Reactors: Single Reactions, Parallel Reactions and Multiple Reactions; Choise of Right Reactor Type: Heuristics Rules; Langmuir Hinshelwood treatment for obtaining Rate Law: Heterogeneous Systems; Residence Time Distribution Studies: RTD Theory; Axial Dispersion Model and N Tank Series Model. Concepts of DOE and parameter estimation.

### **APST 105: Analytical methods used in Petroleum Industry – 4 Credits**

**Faculty: Dr Y K Sharma**

Standard procedures: Principles, procedures and significance of ASTM/IP/UOP/IS test methods for evaluation and analysis of crude oil and its products; Atmospheric distillation (ASTM D 86); Vacuum distillation; Simulated distillation; True Boiling Point (TBP) distillation; Separation Methods: Chromatography; Gas Chromatography; Liquid Chromatography and Super Fluid Critical Chromatography (SFC); Spectroscopic techniques: Applications of ultra violet spectroscopy (UV); flourier transform infrared (FT IR); Nuclear Magnetic resonance (NMR) spectroscopy and Mass spectroscopy to petroleum products analysis; Elemental analysis: C, H,

O, N and S; Metal analysis: Microanalysis; X-ray fluorescence; plasma spectroscopy and atomic absorption spectroscopy; All the methods will be complemented with practical work in Laboratories

### **APST 201: Catalysis in Petroleum Refining - 3 Credits**

**Faculty: Dr A Datta**

Introduction to catalysis; basic definitions: adsorption and desorption; adsorption energetics; chemisorption; geometrical; electronic and energetic factors in catalysis; chemical nature of the catalyst; bulk *versus* supported catalysts; catalysis by metals; catalysis by semiconductors; catalysis by acidic solids; fundamentals of catalytic kinetics: kinetic models; diffusion in catalysis; gaseous; liquid and surface diffusion; catalytic materials: molecular sieves; zeolites; pillard clays; mesoporous materials; preparation of bulk and supported catalysts; advanced preparation techniques: catalyst characterization; role of surface science in catalysis; surface and bulk characterization techniques; catalyst deactivation and regeneration; poisoning, sintering; coke formation; important catalytic refining processes; catalytic cracking; hydrocracking; hydro treating; reforming; isomerization; alkylation; catalysis for clean fuels and utilization of renewable resources.

### **APST 202: Advanced Separation Processes - 3 Credits**

**Faculty: Dr M O Garg, Dr A N Goswami, Dr S M Nanoti and Dr Anshu Nanoti**

Fundamentals of Separation Processes; Phase Equilibrium; Binary and multi-component separation; Multi stage separation processes; Equilibrium based separation processes; Rate based separation processes; Simulation of Separation processes; Capacity and efficiency of contacting devices; Energy requirements of separation processes; Selection of separation processes with case studies; Designing of Separation Processes; Special Topics in Adsorption: Adsorbents;

Equilibrium Isotherms; PSA / TSA applications in Industry; Concepts of Simulated Moving Bed in Industrial applications; New developments in adsorbents; Adsorber simulations; Experiments in Adsorption: Hands on measurement of breakthrough curve of gas mixtures; adsorption equilibria in liquid systems: evaluation of equilibrium and kinetics data; characterization of adsorbents. Overview of Membrane Separation Processes; Gas separation membranes and Industrial applications

### **APST 203: Advanced Conversion Processes-3 Credits**

**Faculty: Dr G Das**

Technological Aspects: Isomerization; Catalytic Reforming; Hydrotreating; FCC; Hydrocracking; Thermal Conversion Processes (Visbreaking, Delayed Coking); Sweetening/Treating processes; Reactor design of conversion processes; Hydrogen production Processes; Alkylation; Light naphtha aromatization; Fischer-Tropsch Synthesis

### **APST 204: Advanced Process Control - 4 Credits**

**Faculty: Dr M O Garg**

Introduction to Process Control; Block diagram Notation; Various Inputs; Inverse Transformations; Linearization and Regulator Control; Frequency Response Analysis; Graphical Stability Criterion; Dead Time and Distributed parameters; Multi loop systems; Phase Plane Analysis; Types of Control; Unit Operation Control; Controllers

### **APST 205: Renewable Energy Conversion Technologies - 3 Credits**

**Faculty: Dr S Kaul and Dr T Bhaskar**

Introduction and Overview; Energy and Environment; Solar Energy; Wind Energy; Biomass Energy; Ocean Energy; Geothermal and Hydrogen Energy; Renewable Energy Conversion Technologies; and Energy Conservation

## *Faculty Members*

<i>S.No.</i>	<i>Faculty Name</i>	<i>Designation</i>	<i>Disciplines</i>
1.	Dr M O Garg	Director	Separation Processes Process Integration
2.	Dr A Dutta	Sc G	Catalysis
3.	Dr H B Goel	Sc G	Petrochemicals
4.	Dr A N Goswami	Sc G	Separation Processes
5.	Dr Bir Sain	Sc G	Hydrocarbon Chemistry
6.	Dr S K Singhal	Sc G	Alternate Fuels
7.	Dr S M Nanoti	Sc G	Solvent Extraction Separation Processes
8.	Dr D K Adhikari	Sc F	Biotechnology
9.	Dr Y K Sharma	Sc F	Analytical Techniques
10.	Dr G Das	Sc F	Conversion Processes
11.	Dr J K Gupta	Sc F	Catalyst Characterization
12.	Dr A. Nanoti	Sc EII	Separation Processes
13.	Dr N Atheya	Sc EII	Fluid Catalytic Cracking
14.	Mr. Sudip K. Ganguly	Sc EII	Reaction Engineering
15.	Dr Savita Kaul	Sc EI	Renewable Fuels
16.	Dr VVDN Prasad	Sc EI	Gasoline Reformulation Catalyst Preparation
17.	Shri P Vijayanand	Sc EI	Gas to Liquids
18.	Dr N Viswanadham	Sc EI	Gasoline Reformulation
19.	Dr Anil Sinha	Sc EI	Hydro processing Renewable Fuels
20.	Dr T Bhaskar	Sc EI	Renewable Fuels
21.	Dr Jasvinder Singh	TO EI	Thermodynamics

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