

Course Handbook (B.Tech-3rd yr.)
(W.e.f.2016-2017)

Department of Petroleum Engineering
School of Technology
The Glocal University
Saharanpur

Department of Petroleum Engineering

Vision

To become a center of excellence for the development of the country and mankind by providing highly competitive professionals, cutting edge technologies and effective services to the academia and petroleum/hydrocarbon industry.

Mission

- To provide education and training to the students for serving at national and global levels.
- To develop a strong R&D infrastructure for solving the technological needs of the global economy and human society.
- To develop vibrant and creative learning environment to produce technically sound, ethically strong and morally elevated human resource.

Program Educational Objectives (PEOs)

1. To train engineering graduates for serving the petroleum, hydrocarbon, chemical & petrochemical industry as well as to cope with the recent challenges of energy harnessing, utilization and management with clear emphasis on sustainable environment.
2. To create the professionals for cutting-edge research work.
3. To prepare the highly moral and ethical professional graduates to serve the society.

Program Outcomes (POs)

The program outcomes include to develop:-

a. An ability to understand the application of basic sciences such as mathematics, science and engineering principles in petroleum engineering problems.
b. An ability to identify, analyze and solve engineering problems.
c. An ability to design a system or a process to meet desired needs within realistic constraints such as techno-economic, environmental and safety.
d. An ability to design and conduct experiments, analyze & interpret data.
e. An ability to use the techniques, skills, and modern tools necessary for engineering practice.
f. An ability to recognize the impact of engineering solutions in a global, economic, environmental and societal context.
g. An ability to understand the recent challenges for sustainable development.
h. An understanding of professional and ethical responsibility.
i. An ability to work in multi-disciplinary and multi-cultural teams, both as a member and leader.
j. An ability to communicate effectively through reports, presentations & discussions.
k. An ability to understand and apply engineering and management principles.
l. An ability to engage in life-long learning.

BD Core (BC)		BD Elective (BE)	
Category	**Credits**	**Category**	**Credits**
DC	81	DE	16
BS	20	OE	16
BES	20		
HU	12		
Total	133	Total	32

The overall credits structure

Total Credits = 165

Basic Science (BS) Core			
MA-101	Engg Mathematics-I	3-1-0	4
PH-101	Applied Physics	3-0-2	4
MA-102	Engg Mathematics-II	3-1-0	4
CH-101	Applied Chemistry	3-0-2	4
MA-201	Engg Mathematics-III	3-1-0	4
	Total BS Core	15-3-4	20

Basic Engineering & Sciences (BES) Core			
CS-101	Computer Concepts & C	2-1-2	4
CE-101	Environment and Ecology	2-1-0	3
ME-102	Engg. Graphics	1-0-2	2
EC-101	Basic Electrical & Electronics Engg.	2-1-0	3
ME-104	Engineering Mechanics	3-1-0	4
ME-105	Engineering Workshop	0-0-2	1
PE-302	Chemical Thermodynamics	2-1-0	3
	Total BES Core	12-5-6	20

Humanities and Social Sciences (HU)			
HU-101	Professional Communication-I	2-0-2	3
HU-102	Professional Communication-II	2-0-2	3
HU-201	Human Values and Professional Ethics	3-0-0	3
HU-202	Cyber Security	3-0-0	3
	Total HU	10-0-4	12

Discipline Core (DC)			
PE-101	Minor Project-1	0-0-2	1
PE-102	Minor Project-2	0-0-2	1
PE-201	Applied Geology	3-1-2	5
PE-202	Fundamentals of Heat transfer	3-1-2	5
PE-203	Introduction to Petroleum Operation	3-1-0	4
PE-204	Minor Project-3	0-0-2	1
PE-205	Geophysics	3-1-2	5
PE-206	Numerical Methods for Petroleum Engineers	3-1-0	4
PE-207	Mass Transfer	2-1-0	3
PE-208	Drilling Engineering & Well Completion	3-1-2	5
PE-209	Petroleum Formation Evaluation & Well Logging	3-1-2	5
PE-210	Minor Project-4	0-0-2	1
PE-301	Petroleum Production Engineering	3-1-0	4
PE-303	Petroleum Chemistry	2-1-2	4
PE-304	Directional Drilling	3-1-0	4
PE-305	Fluid flow through porous media	3-1-0	4
PE-306	Minor Project-5	0-0-4	2
PE-307	Well Testing	2-1-0	3
PE-308	Reservoir Engineering-1	3-1-2	5
PE-309	Minor Project-6	0-0-4	2
PE-3xx	Discipline Elective-1	3-1-0	4
PE-3xx	Discipline Elective-2	3-1-0	4
PE-3xx	Discipline Elective-3	3-1-0	4
XX-3xx	Open Elective-1	3-1-0	4
PE-4xx	Discipline Elective-4	3-1-0	4
XX-4xx	Open Elective-2	3-1-0	4
PE-401	Comprehensive Viva	1-0-0	1
PE-402	Summer Internship	0-0-2	1
PE-403	Major Project – 1	0-0-6	3
XX-4xx	Open Elective-3	3-1-0	4
XX-4xx	Open Elective-4	3-1-0	4
PE-404	Enhanced Oil Recovery	2-1-0	3
PE-405	Major Project– 2	0-0-10	5
	Total DC Core	**41-15-48**	**81**

Discipline Electives (DE)			
PE-310	Latest Trends in Petroleum Engineering	3-1-0	4
PE-311	Petroleum law	3-1-0	4
PE-312	Reservoir simulation	3-1-0	4
PE-313	Petroleum Refining & Petrochemicals	3-1-0	4
PE-314	Horizontal drilling	3-1-0	4
PE-315	Unconventional Resources of hydrocarbon	3-1-0	4
PE-316	Natural Gas Engineering	3-1-0	4
PE-317	Well testing and analysis	3-1-0	4
PE-318	Petroleum Economics	3-1-0	4
PE-319	Reaction Engineering	3-1-0	4
PE-406	Reservoir Engineering -2	3-1-0	4
PE-407	Optimization Techniques	3-1-0	4
PE-408	Computational Fluid Dynamics	3-1-0	4
PE-409	Process Control	3-1-0	4
PE-410	Transport Phenomena	3-1-0	4
PE-411	Pipe Line Transportation of Oil and Gas	3-1-0	4
PE-412	QHSE	3-1-0	4
PE-413	Industrial Pollution Control	3-1-0	4
PE-414	Solid waste management	3-1-0	4
PE-415	Polymer Industries	3-1-0	4
PE-416	Coal Gasification	3-1-0	4
PE-417	Energy Technology and Management	3-1-0	4
PE-418	Fuel Technology	3-1-0	4
PE-419	Non-Conventional Energy Resources	3-1-0	4
PE-420	Total Quality Management	3-1-0	4

Third Year: 5th Semester

Subject Code	Subject Name	Scheme of Teaching				
		L	T	P	Hours	Credit
PE-301	Petroleum Production Engineering	3	1	0	4	4
PE-302	Chemical Thermodynamics	2	1	0	3	3
PE-303	Petroleum Chemistry	2	1	2	5	4
PE-304	Directional Drilling	3	1	0	4	4
PE-305	Fluid Flow Through Porous Media	3	1	0	4	4
PE-306	Minor project-5	0	0	4	4	2
PE-307	Well Testing	2	1	0	3	3
Total		**15**	**6**	**6**	**27**	**24**

Third year: 6th Semester

Subject Code	Subject Name	Scheme of Teaching				
		L	T	P	Hours	Credit
PE-308	Reservoir Engineering-1	3	1	2	6	5
PE-3xx	Discipline Elective-1	3	1	0	4	4
PE-3xx	Discipline Elective-2	3	1	0	4	4
PE-3xx	Discipline Elective-3	3	1	0	4	4
XX-3xx	Open Elective-1	4	0	0	4	4
PE-309	Minor Project -6	0	0	4	4	2
	Total	**16**	**4**	**6**	**26**	**23**

Department of Petroleum Engineering
The Glocal University

Time table for 5th Semester

Day	A3-012	A3-012	A3-012	A3-012		A3-012	A3-012	
	9:00 - 10:00	10:00 - 11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00 - 4:00	4:00 - 5:00
Mon	Petroleum Chemistry (VKS)		Drilling Engineering-2(PR/MI)	Petroleum Production Engineering -1(PR)	Lunch		Petroleum Testing Lab(MY/VKS)	
Tue	Numerical Methods for Petroleum Engineer(VKS)	Numerical Methods for Petroleum Engineer(VKS)	Drilling Engineering-2(PR/MI)	Chemical Thermodynamics(MY)		Petroleum Production Engineering -1(PR)	PDP	
Wed	Petroleum Chemistry (VKS)	Petroleum Chemistry (VKS)		Petroleum Production Engineering -1(PR)			Drilling/production laboratory(PR/New Faculty-2)	
Thu	Drilling Engineering-2(PR/MI)		Chemical Thermodynamics(MY)			Petroleum Production Engineering -1(PR)	PDP	
Fri	Numerical Methods for Petroleum Engineer(VKS)	Numerical Methods for Petroleum Engineer(VKS)	Chemical Thermodynamics(MY)			Library	Drilling Engineering - 2(PR/MI)	
Sat	Seminar/Internship/Project Presentations		Minor Project-1			Student Activity	PDP	

SEMESTER: 5th Semester

Course Title: Petroleum Production Engineering
Course Code: PE 301
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: - No
Time of examination: 2 hours and 30 mins
Objective: To get familiarized with equipment and techniques used in production and completion of oil/gas well and practices nature of difficulties and actions to be taken.

SN	Topic	No. of Lectures
PE 301	**Petroleum Production Engineering** Well Head Testing,Perforation and Well Activation, Use of Compressed Air, Liquid Nitrogen, Swabbing .Surface Layout. Production Measurement Production Testing of Wells. Choke Performance,Oil and Gas Separator. Separator System Design. Optimum Separation Scheme. Multi-Phase Flow in Tubing and Flow Lines. Tubing Sizing and Performance,Horizontal Well Performance,Gas Lifts: Continuous and Intermittent Gas Lift System, Performance and Optimization Pumping: Sucker Rod Pumping of Oil. Electric Submersible Pumps; Operation, Design and Optimization Sand Control: Sand Consolidation, Gravel Packing, Performance Design and Techniques.Work Over: Deparaffination, Water Shut off; Squeeze Cement and Polymer Injection.Conventional and Coil Tubing Use. Application of Liquid Nitrogen. Production Optimization: Nodal Analysis, Smarts Wells, Intelligent Wells	**48**

Outcome:

- Student will be able to understand the basics of oil and gas production engineering techniques
- Student will be able practice both theory and practical of different production operations in the oil and gas wells such as artificial lifts and subsurface equipment's.
- Recognise the concept of well completion and work over job for a wellbore.
- Demonstrate well completion, well services and equipment's to improve production performance of a wellbore and do problem well analysis and apply new techniques to sustain production rates.

Books:

- Ryen Caenn, H. C. H. Darley and George R. 2011, Gray, Composition and properties of Drilling and Completion Fluids, Sixth edition, Gulf Professional Publishing, 701 pp.
- Herriot-watt university production engineering-I pdf
- Thomas O. Allen and Alan P. Roberts, 1989, Production Operations: Well Completions, Workover, and Stimulation, OGCI, Tulsa, Volume 1 and 2,

SEMESTER: 5th Semester

Course Title: Chemical Thermodynamics
Course Code: PE 302
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical:- No
Time of examination: 2 hours and 30 mins
Objective: To impart knowledge to the students on the work calculation of ideal and non-ideal gases, horse power, thermodynamics of gases and liquid hydrocarbons, phase rule of single, two, three multi-component and multi-phase systems

SN	Topic	No. of Lectures
PTE 302	**Introduction:** Maxwell relation, Law of Corresponding State, Fugacity and Fugacity of Gases and Gaseous Mixtures, Lewis fugacity Rules,Third Law of Thermodynamics **Ideal & Non-Ideal Solution:** Partial Molar Properties, Chemical Potential, Activity and Activity coefficient, Vapour-Liquid Equilibria, Gibbs-Duhem Equation, **Adsorption:** Adsorption Isotherms, Chemisorption, Phase Equilibria Calculation **Chemical Thermodynamics of Petroleum Hydrocarbons:**Free energy, change, heat of reaction, Entropy change, Heat capacity, Heat of formation, fugacity, Pressure – volume diagram, Density – Temperature diagram for one and two component system.	**48**

Outcome:

- To calculate the parameters such as specific heats, vapour pressure and compressibility factor and Calculate the heat of reaction, heat of formation, etc.
- Will be able to draw the P-T, T-X-Y diagrams for single and multi-component systems.

Books:

- Karen Schou Pedersen, Peter L. Christensen, Jawad Azeem Shaikh, “Phase Behavior of Petroleum Reservoir Fluids” 2nd edition, CRC Press, 1998.
- Abbas Firoozabadi, “Thermodynamics of Hydrocarbon Reservoirs” 1st Edition, Mc Graw Hill , 1999.

SEMESTER: 5th Semester

Course Title: Petroleum Chemistry
Course Code: PE 303
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: No
Time of examination: 2 hours and 30 mins
Note for Examiner: The course schedule includes 3 lectures and 1 tutorial
Objective: The course is primarily focused on the oil and gas sector of the petroleum industry. The skills include knowledge of chemical composition and properties of petroleum (oil and gas), petroleum products and alternative fuels.

SN	Topic	No. of Lectures
PE 303	Petroleum Chemistry Unit I: Properties and General Characteristics of Hydrocarbon, Composition, Molecular types in Petroleum. Unit II: Characterization and Analytical Techniques for Crude Oil (TBP, ASTM and EFV distillation curves). Physical properties, UOP characterization factor, Thermal properties, Electrical properties, Optical properties, Chromatographic techniques, Spectroscopic methods (Principles and Applications of UV Visible, IR, and NMR Spectroscopy), Characterization of formation water. SARA Separation methods. Unit III: Additives to improve the quality of Diesel and Petrol, Catalysis and Applications of Catalysts (like Zeolite and other catalysts) in separation processes and also in petroleum industries. Unit IV: Instability and incompatibility of petroleum products.	48

Outcome: This course provide students with an understanding of Petroleum Chemistry and the skills needed for successful employment

Books

- The Chemistry and Technology of Petroleum, James G. Speight, Taylor & Francis, June 1991, INR 7,465

- Crude Oil Chemistry, V Simanzhenkov and R Idem, Marcel Dekker Inc., 2003. INR 14726

SEMESTER: 5th Semester

Course Title: Fluid Flow through porous media and Heat Transfer
Course Code: PE 305
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: Yes
Time of examination: 2 hours and 30 mins
Note for Examiner: The course schedule includes 2 lectures, 1tutorials and 1 practical.
Objective: The course will provide information on different fluid dynamics accessories like valves, pumps and compressors, theories on fluid flow through porous media, heat transfer types and heat exchanger equipment's applicable to petroleum industries.

SN	Topic	No. of Lectures
PE 305	**UNIT- I :** Introduction to fluid flow: Fluid, Types of fluid, Types of fluid flow and geometry, concept of hydraulic diameter, Hydrostatic pressure, application of pressure, pressure measuring devices, Bernoulli's equation and its application in fluid flow, Hagen pouissellie equation and its use in pipeline transportation. Introduction to fluid transportation devices: Pumps, valves, compressors and blowers. **UNIT-II:** Rheology: Newtonian and Non-Newtonian Fluids, Psuedoplastic, dilatant, Bingham, Rheopectic, Thixotropic and Visco-elastic fluids. Introduction to elements of reservoir. Rock Properties: Porosity, Porosity in upstream and downstream processes, Ergun Equation, rock compressibility, Permeability, combination of permeability in parallel and series beds, Wettability, Interfacial Tension, Capillarity, Capillary pressure and Capillary Number, Darcy's Experiment, Mobility and Mobility ratio.	48

	Unit III: Fluid potential and flow rate, Darcy's experiment, Darcy's Law and Darcy's field equation, Sign convention and units, Boundary conditions, Single and multiphase flow, Linear and radial flow, Productivity index, Radial diffusivity equation in porous media for steady state, semi steady state and unsteady state situations. **Unit IV :** Well Stimulation: Radial steady state flow, Wellbore damage, Skin Pressure, Methods to stimulate well. Drive Mechanism: Primary, Secondary and Tertiary recovery schemes, Gas and oil drive reservoirs, Reservoir efficiencies and methods to oil recovery.	

Outcome:
Student will learn the use of Darcy's Law to calculate permeability of single phase; definition of interfacial tension; use of capillary pressure to determine saturation changes in reservoir; definition of effective and relative permeability; use of drainage/imbibition curves to characterize reservoir relative permeability.

Books

- J. Bear, Dynamics of fluid in porous media, Dover, 1972.
- A. K. Jain, Fluid mechanics, Khanna publisher, 2010.
- W. L. Mccabe, J. C. Smith, Unit operation of Chemical Engineering,
- L. P. Dake, Fundamentals of Reservoir Engineering, Elsevier, 1983.

SEMESTER: 6th Semester

Course Title: Well Testing
Course Code: PE 317
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: Yes
Time of examination: 2 hours and 30 mins.
Note for Examiner: The course schedule includes 2 lectures, 1 tutorials and 1 practical.
Objective: This course is to provide a working knowledge of the current methodologies used in well production & testing and the concepts of porosity and permeability and be able to relate their respective influences on fluid flow in porous media

SN	Topic	No. of Lectures
PE 317	**Unit-1**: Well Stimulation: Method to estimate extent of Formation Damage, Causes, and Occurrence to reduce / avoid Formation Damage. **Unit-2:** Acidisation, Matrix Acidisation, Selection of Acid Formulation, Additives Selection, Procedure to carry out Acidisation Job.Fracture choice of Fluids and Additives and Selection thereof.Flow Measurement – Various methods and their selection.Demulsification and Desaltiny of Crude Oils + Heater Treaters. **Unit-3:** Storage of Oil: Design, Operation and Maintenance. Transportation of Crude Oils; Gas Pumps and Compressors. Pipelines: Construction, Maintenance, Operation and Precautions. Corrosion of Oil & Gas Equipment: Reasons & Methods to reduce/ avoid Corrosion Field Processing of Oil & Gas. **Unit-4: WELL TESTING:** Steady State and Transient Fluid and	**48**

	Flow Process in Petroleum Reservoir. Diffusivity Equation. Terminal Rate Solution. Build Up Tests. Multirate Testing, Interference and Pulse Testing. Reservoir Limit Test	

Outcome:

- Recognise the concept of well completion and work over job for a wellbore.
- Demonstrate well completion, well services and equipment's to improve production
  Performance of a wellbore.
- Acquaint with types of well completion.
- Recognize and apply application of techniques to solve well productivity related Problems.
- Illustrate various equipment and processes for the treatment on produced emulsion
- Understand mechanism and factors of oil field corrosion and methods for prevention.
- Understand and apply production logging operations

Books:

1. Oil Well Stimulation by Schechter
2. Production Engineering by Libro
3. Well Testing by John Lee
4. S. McAleese, "Operational Aspects of Oil and Gas Well Testing", Volume 1 (Handbook of Petroleum Exploration and Production) 1st Edition, 2004.
5. Horn R A, "Modern Well Test Analysis, A Computer Aided Approach", Petroway, Second edition, 1995.
6. Earlougher, R.C., "Advances in Well Test Analysis", Monograph Series, SPE,1977.
7. Bourdarot, G. "Well Testing, Interpretation Methods", 1st Edition, 1996
8. Chaudhry Amanatu, "Oil Well Testing Handbook" Gulf Professional Publishing, 2004.

SEMESTER: 6th Semester

Course Title: Reservoir Study - I
Course Code: PE 308
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: - No
Time of examination: 2 hours and 30 mins.
Note for Examiner: The course schedule includes 3 lectures, 1 tutorial.
Objective: The aim of learning this subject is that student will able to follow and understand the reservoir concepts such as reservoir behavior, rock characteristics and reservoir management.

SN	Topic	No. of Lectures
PE 308	**Unit I:** Petroleum origin and composition, Petroleum geology, Introduction to reservoir engineering, Elements of reservoir hydrocarbon migration and traps, Identification and location of reservoirs, Drilling operations and drilling fluids, Rheological behavior of drilling fluids, well completion and production. **Unit II:** Reservoir rock properties: Rock Compressibility, Porosity, Permeability determination,Relative, absolute and effective permeability, Combination of permeability in parallel and series beds, Porosity-Permeability relationship, Fluid saturation and significance, Wettability and contact angle, Boundary and Interfacial Tension, Capillary pressure,	**48**

	characteristics, measurement, imbibition, drainage and capillary number, Mobility and mobility ratio. **Unit III:** Reservoir fluid properties: Hydrocarbon classification, Phase behavior of hydrocarbon system, Ideal and Non-ideal system, Equilibrium ratio, Reservoir fluid sampling, PVT analysis for single and two component system and laboratory measurements, Gas-Oil formation volume factor, Resistivity factor and resistivity index. Reservoir drive mechanism: Primary, Secondary and tertiary recovery schemes, General material balance(MBE) in oil or combination reservoirs, Predicting primary recovery-Gas drive reservoir, Water drive reservoir and Oil reservoir. **Unit IV:** Fluid flow through porous media: Darcy's experiment, law and boundary conditions, Single and Multiphase flow, Linear and radial flow, Radial diffusivity equation in porous media for steady state, semi-steady state and unsteady state situations, Skin damage and skin pressure, Productivity Index, Methods to well stimulation. Introduction to enhanced oil recovery	

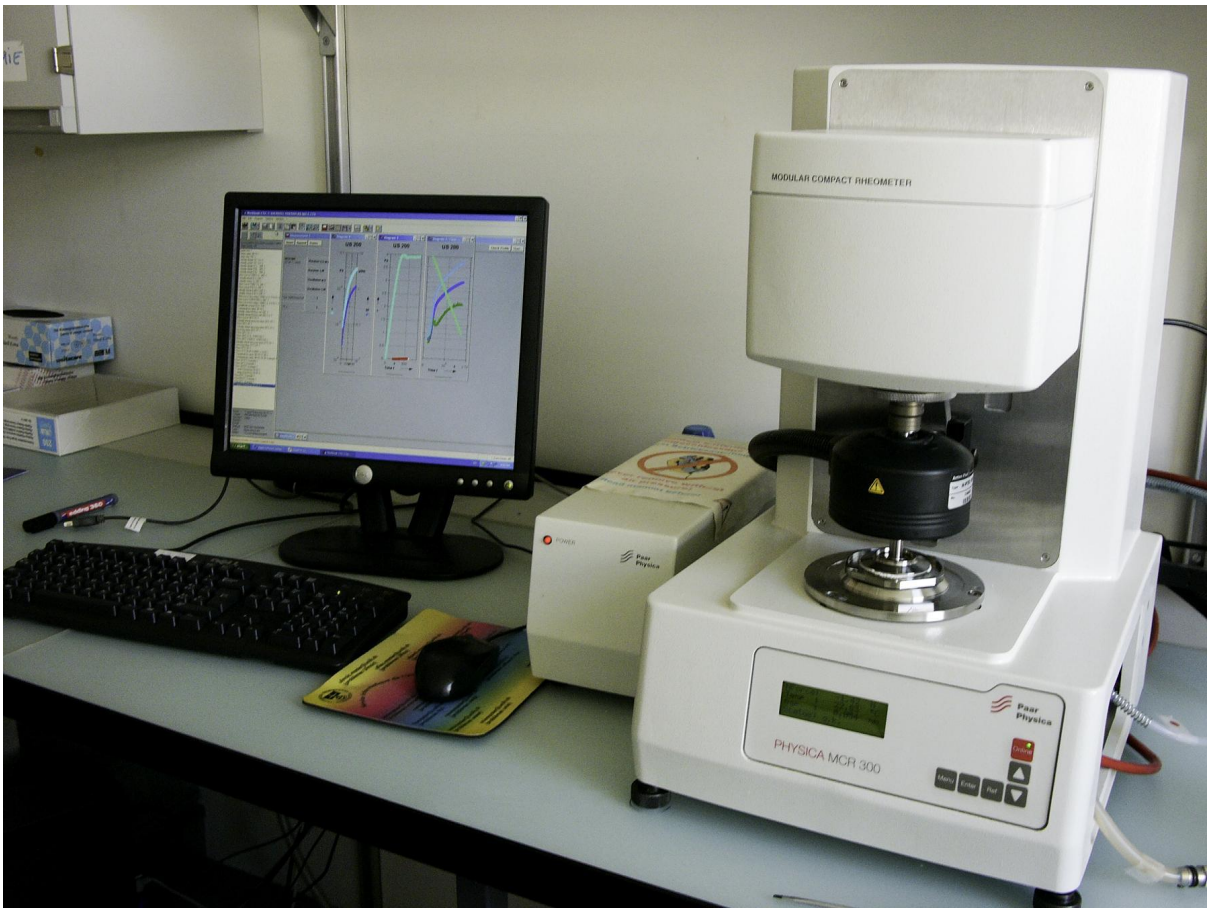
Outcome:

- Understand the rock and fluid properties of a hydrocarbon reservoir
- Describe the nature of the fluid flow and pressure distribution in a reservoir
- Understand the effects of production/ injection on recovery of reserves

Books

- Integrated Reservoir Studies (Fundamentals of Exploration and Production) Paperback – March 9, 2001 by Luca Cosentino, INR 5,280.
- Fundamentals of Reservoir Engineering (Developments in Petroleum Science) Paperback, 1983 by L. P. Dake, Elsevier Science Ltd; New impression edition, INR 4297.




MODULAR COMPACT RHEOMETER
Paar Physica
PHYSICA MCR 300

SEMESTER: 6thSemester

Course Title: Petroleum Refining & Petrochemicals
Course Code: PE 313
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: No
Time of examination: 2 hours and 30 mins
Note for Examiner: The course schedule includes 2 lectures, 1 tutorial and 1 practical
Objective: The course will described various processes used in the petroleum refining industry and will provide information to produce different petroleum products like LPG, petrol, diesel, kerosene etc. from crude petroleum.

SN	Topic	No. of Lectures
PE 313	Petroleum Refining & Petrochemicals Unit I: Fractionation of Petroleum: Dehydration and Desalting of Crudes, Distillation of Petroleum. Unit II: Hydrodesulphurization, Catalytic Reforming, Isomerization, Catalytic Cracking, Coking, Alkylation processes. Unit III: Treatment of Kerosene, Sweetening processes, Treatment of Lubes, Air Blowing of Bitumen processes, Hydrogen production. Petrochemicals: Naphtha cracking, Production of polyethylene, and Synthetic fiber. Ammonia, Nitric Acid, Ammonium Nitrate, Urea. Unit IV: Phosphate fertilizers, super phosphate, Triple super phosphate, Mono and ammonium phosphate, Nitro phosphate, Mixed Fertilizers.	48

Outcomes:

- Establish the link between the upstream and downstream petroleum industry
- Know the composition of crude oil, along with its properties and characterization methods
- Understand the purification and fractionation process of crude oil
- Get conversant the conversion processes of the various products from distillation.
- Select a good grade of lubricating oil and bitumen
- Address the issues related to pollution from refineries

Books

- Handbook of Petrochemical production process, Robert A Meyers, McGraw Hill, INR 5816.
- Petroleum Refining Technology and economics, James H Gary and Glenn E. Hardwerk, Marcel Dekker Inc., New York, 5thedn. 2007, INR 6533.

SEMESTER: 6th Semester

Course Title: Reaction Engineering
Course Code: PE 319
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: Yes
Time of examination: 2 hours and 30 mins
Note for Examiner: The course schedule includes 2 lectures, 1 tutorial and 1 practical
Objective: The course will explain different types of reactions, analysis of reaction rate, reactors and reactor design applicable to petroleum refining industries.

SN	Topic	No. of Lectures
PE 319	Reaction Engineering Unit I: Rate of Reaction, elementary and non-elementary reactions molecularity and order of reaction, thermodynamics formulations of rates, mechanism of reaction, Temperature dependency from thermodynamics, Arrhenius, collision and Activated complex theories, Introduction of industrial reactors. Unit II:Integral and differential methods for analyzing kinetics data, interpretation of constant volume batch reactor data for zero, first second and third order reactions, half-life period, irreversible reactions in parallel and series, Auto catalytic reaction, enzyme catalyzed and surface catalyzed reactions. Interpretation of variable volume batch reactor data for zero, first and second order reactions. Unit III:Design equations for batch, plug flow, back mix, flow and semi batch reactors for isothermal, adiabatic reactions, holding time and space time for flow system; Design of batch, plug flow and mixed flow reactors for first and second order single reactions. Optimum reactor size of plug flow reactors in series / parallel reactions. Unit IV: Multiple reactions, independent, parallel and series reactions; mixed reactions, instantaneous and over all fractional yield, choice of reactors for simple and complex	48

	reactions and multiple reactor system; Introduction to Residence time Distribution of fluid in Vessel.	

Outcome:

- Perform material balances to derive general reactor design equations
- Use the appropriate reaction kinetics in the reactor design equations
- Know the modelling of chemical reactors.

Books

- Levenspiel, O., Chemical Reaction Engineering, John Wiley and Sons, New York, 3/e, 1998.
- Fogler, H. S., Elements of Chemical Reaction Engineering, Prentice Hall, USA 4/e, 2005.
- Smith, J. M., Chemical Engineering Kinetics, McGraw Hill Publications, New York, 1981.

RESERVOIR ENGINEERING LABORATORY

Objectives:

To demonstrate the processes involved in operations, introduce laboratory techniques which are used to select and optimize geological interpretation and to develop interest in experimentation.

List of experiments:

- Saturation Determination, Dean-Stark Distillation Method.
- Fluid density using the Pycnometer method
- Liquid Viscosity Measurement using Capillary Type Viscometer
- Effective Porosity Determination by Helium Porosimeter Method
- Porosity Determination by Liquid Saturating Method
- Resistivity Measurements of Fluid-Saturated Rocks
- Capillary Pressure Measurement using Centrifuge Method
- Capillary Pressure Measurement using Porous Plate Method

Outcome:

- Students able to understand the equipment, Principles and operation and rock properties by analyzing data's.

List of Equipment's:

- Helium Porosimeter
- Porous Plate
- Pycnometer
- Dean-Stark Distillation
- Centrifuge
- Resistivity meter
- Capillary Type Viscometer

Career Opportunities

Petroleum Engineering offers an opportunity to join in attractive and highly paid jobs of Oil and Gas Sector. By nature of profession, Petroleum Engineers roam all over the world. Petroleum Engineering provides a chance to peer through the Continents and Oceans. Candidate who wish a bright future and to be dynamic in life can apt for Petroleum Engineering Program. A petroleum engineer is involved in nearly all of the stages of oil and gas field evaluation, development and production. Their aim is to maximize hydrocarbon recovery at minimum cost, while maintaining a strong emphasis on reducing environmental impact.

Types of petroleum engineer

Petroleum Engineers are divided into FIVE groups: Petroleum Geologists, Reservoir Engineers, Production Engineers, Drilling Engineers and Refining Engineers.

- **Petroleum geologists**: who find hydrocarbons by analysing subsurface structures with geological and geophysical methods.
- **Reservoir engineers**: who work to optimise production of oil and gas via proper well placement, production levels and enhanced oil recovery techniques. They use computer simulations to assist in the identification of risks and to make forecasts on reservoir potential.
- **Production engineers**: who manage the interface between the reservoir and the well through such tasks as perforations, sand control, artificial lift, downhole flow control and downhole monitoring equipment. They also select surface equipment that separates the produced fluids (oil, natural gas and water).
- **Drilling engineers**: who manage the technical aspects of drilling both production and injection wells. They work in multidisciplinary teams alongside other engineers, scientists, drilling teams and contractors.
- **Plant/Refining Engineers:** Assessment of products, machinery and processes involved in plant or refinery.

Responsibilities: The responsibilities of Petroleum Engineer are too many and hence opportunities for getting job and career improvement are plenty. Petroleum Engineers are known as King Engineers because Petroleum Engineers throughout the world are highest paid engineers. Upon experience and dynamic nature to take up challenging responsibilities, one can demand and aspire high and higher. With experience they can also work freelance engineers. In Digital Oil Fields, one can monitor several networks of stations from one's own sitting place. Petroleum Engineers have to develop a mindset of working in flexible/shift work. Off-shore assignments require pattern of shift work continuous for a period and then entitled to work-off of similar length of period.

The actual tasks carried out vary depending on the specific role but may include:

- liaising with geoscientists, production and reservoir engineers and commercial managers to interpret well-logging results and predict production potential;
- compiling detailed development plans of reservoir performance using mathematical models;
- selecting optimal tubing size and suitable equipment in the well for different functions;
- designing the completion - the part of the well that communicates with the reservoir rock and fluids;
- designing systems that help the well to flow, for example using submersible pumps;
- managing problems of fluid behavior and production chemistry;
- evaluating and recommending flow rate enhancement by using, for example, hydraulic fracturing (to force fluid into a well and fracture the rock) and acid treatment (to erode the rock and improve flow path);

- managing and controlling wells with branches at the bottom (horizontal and multilateral wells);
- using well and reservoir remote sensing technology and surveillance data to manage the value of the reservoir and decide on appropriate engineering interventions;
- understanding and managing how a set of wells interact;
- managing contractor relationships in relation to health, safety and environmental performance;
- supervising well-site operations personnel and managing staff at all levels, including the training and supervision of crew members, to ensure that everyone works as a team in order to meet deadlines to clients' satisfaction;
- liaising with separate departments to ensure correct progress with projects;
- taking responsibility for the maintenance of equipment;
- Liaising with clients to keep them informed of progress.

The job and employment outlook for petroleum engineers is quite good in both the streams i.e. upstream and downstream. Petroleum engineers have an option to obtain further education and training. Doing so will allow them to land higher-paying jobs. There are master's and doctoral degrees available on "*The Glocal University"* campus. Many companies send their employees for more training or formal education. The job opportunities doesn't end in India but also petroleum engineers are required worldwide. Few opportunities are mentioned below in different fields along with industries hiring in India and worldwide.

STREAMS	FIELD	INDIAN INDUSTRIES	FOREIGN INDUSTRIES

Upstream	Reservoir Engineering, Geology and Geophysics Surveying and Exploration Production Enhanced Oil Recovery	ONGC, GAIL, HOEC, IGL, ESSAR, GGCL, PETRONET LNG Ltd, MRPL, GE Oil and Gas, Cairn, OIL, Focus Energy, , etc.	Saudi Aramco, Gazprom, NIOC, Petrochina, BP, Shell, Schlumberger,Shiv-vani,sterling, , Pemex, Chevron etc.
Downstream	Drilling Engineering Crude Refining Crude Processing and Purifying Petrochemicals Fertilizers Polymers Paints and Rubber	IOCL, HPCL, BPCL, CPCL, NRL, HMEL, RIL, Bina Refinery, Petrofac, IFFCO, NFL, quipo, John Energy, Petrotel, qmax etc.	Paraguana Refinery, Ruwais Refinery, ExxonMobil, Baytown Refinery, Abadon Refinery, Samref, MB Petroleum, Dalma Energy, Abraj, NDC etc.
Higher Studies	PhD M.Tech MBA MS	ISM Dhandbad, IITs,UPES, Glocal University, PDPU, RGPT, IIMs etc. Govt. & Corporate Institutes,	METU, ITMO, Texas University, Colarado school of mines, UNSW, University of Manchaster, Curtin University etc.
IT-ES	IT companies of Corporate and MNC Status	TCS, WIPPRO, TECH MAHINDRA, L&T InfoTech,	ACCENTURE,



"Find a trap - then drill it"