ENGINEERING MATHEMATICS III [CORE]
[As per Choice Based Credit System (CBCS) Scheme]
SEMESTER-III
COMMON TO ALL BRANCHES

Subject Code	**: 15MAT31**	**IA Marks**	**: 20**
No. of Lecture Hours/Week	**: 04**	**Exam Marks**	**: 80**
Total No. of Lecture Hours	**: 50**	**Exam Hours**	**: 03**

CREDITS- 04

Course Objectives: This course enables students to

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module-1		
Module-2		
Module-3		
Module-4		
Module-5		

Course Outcomes: At the end of the course students are able

Graduate Attributes (as per NBA)

Question paper pattern:

- The question paper will have Ten questions in total
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

Reference Books:

MOMENTUM TRANSFER

Sub Code : 15CH32 IA Marks : 20
Hrs/Week : 04 Exam Hours: 03
Total Hrs : 50 Exam Marks : 80
Credits: 04

COURSE OBJECTIVES: The students will

1. Understand concepts on nature of fluids, pressure concepts and measurement of pressure by various experimental methods and by mathematical relations and enhancement of problem solving skills.
2. Learn detailed explanation on types of fluids, stress and velocity relations, type of fluid flow and boundary layer relations.
3. Understand relationship between kinetic energy, potential energy, internal energy and work complex flow systems using Bernoulli's equation with application to industrial problems.
4. Understand clear concepts on Flow of incompressible fluids in conduits and thin layers and friction factor variations with velocity and friction losses using Bernoulli's Equations and they will be demonstrated experimentally.
5. Study Flow of compressible fluids, Dimensional analysis, Dimensional homogeneity and various dimensionless numbers and their applications.
6. Understand principles and working of various types of pumps, transportation and metering of fluids using various experimental techniques and applications to industry.

Module 1	Content	Contact Hours	Blooms Taxonomy
FLUID STATICS AND ITS APPLCATIONS: Concept of unit operations, Concept of momentum transfer, Nature of fluids and pressure concept, variation of pressure with height – hydrostatic equilibrium, Barometric equation, Measurement of fluid pressure – manometers, Continuous gravity decanter, Centrifugal decanter.		**10 Hrs.**	**L-1, L-2**
FLUID FLOW PHENOMENA: Type of fluids – shear stress and velocity gradient relation, Newtonian and non- Newtonian fluids, Viscosity of gases and liquids. Types of flow – laminar and turbulent flow, Reynolds stress, Eddy viscosity. Flow in boundary layers, Reynolds number, and Boundary layer separation and wake formation.			**L-1, L2**

Module 2	Content	Contact Hours	Blooms Taxonomy
BASIC EQUATIONS OF FLUID FLOW: Average velocity, Mass velocity, Continuity equation, Euler and Bernoulli equations Modified equations for real fluids with correction factors, Pump work in Bernoulli equation, Angular momentum equation.		**10 Hrs.**	**L-2, L-3**
FLOW OF INCOMPRESSIBLE FLUIDS IN CONDUITS AND THIN LAYERS: Laminar flow through circular and non-circular conduits, Hagen			**L-2, L-3**

Poiseuille equation, Laminar flow of non-Newtonian liquids. Turbulent flow			
Module 3	**Content**	**Contact Hours**	**Blooms Taxonomy**
FLOW OF INCOMPRESSIBLE FLUIDS IN CONDUITS AND THIN LAYERS :(Contd...) Friction factor chart, friction from changes in velocity or direction, Form friction losses in Bernoulli equation, Flow of fluids in thin layers		**10 Hrs**	**L-2, L-3**
FLOW OF COMPRESSEBLE FLUIDS: Continuity equation, Concept of Mach number, Total energy balance, Velocity of sound, Ideal gas equations, Flow through variable-area conduits, Adiabatic frictional flow, Isothermal frictional flow (elementary treatment only).			**L-2, L-3**

Module 4	**Content**	**Contact Hours**	**Blooms Taxonomy**
TRANSPORTATION AND METERING OF FLUIDS: Pipes, Fittings and valves, Measurement of fluid and gas flow rates by orifice, venturi & rotameters. Pitot tube. Elementary concept of target meter, vortex-shedding meters, turbine meters, positive displacement meters, magnetic meters, coriolis meters and thermal meters, Flow through open channel-weirs and notches.		**10Hrs**	**L-2, L-3**

Module 5	**Content**	**Contact Hours**	**Blooms Taxonomy**
PUMPS: Performance and Characteristics of pumps-positive displacement and centrifugal pumps, Fans, compressors, and blowers.		**10 Hrs.**	**L-2, L-3**
DIMENSIONAL ANALYSIS: Dimensional homogeneity, Rayleigh's and Buckingham's Π- methods, Significance of different dimensionless numbers, Elementary treatment of similitude between model and prototype.			**L-2, L-3**

COURSE OUTCOMES: On completion of this course the students will be able to

1. Analyze different types of fluids and they will be able to measure pressure difference for flow of fluids.
2. Understand and analyze the relationship between kinetic and potential energy, internal energy, work, and heat in complex flow systems using Bernoulli's equation, perform macroscopic energy balances.
3. Analyze and calculate friction factor for different types of flow in various types of constructions.
4. Develop mathematical relations using Dimensional analysis by Rayleigh and Buckingham –π method.

GRADUATE ATTRIBUTES:

- Design and Development of Solutions.

- Problem Analysis

QUESTION PAPER PATTERN:

- The question paper will have ten questions. Each full is for 16 marks. There will be two full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module. The students will have to answer five full questions, selecting one full question from each module.

TEXT BOOKS:

1. McCabe, W.L., et.al., **"Unit Operations in Chemical Engineering"**, 5th edn., Mc Graw Hill, New York 1993
2. Kumar K.L., **"Engineering Fluid Mechanics"**, Eurasia Publishing House (p) Ltd., New Delhi, 3rd edn. 1984
3. Dr R K Bansal., "**A Text Book of Fluid Mechanics**" 1st edn., Laxmi Publications (P) Ltd., New Delhi. 2005.

REFERENCE BOOKS:

5. Coulson J.H. and Richardson J.F., **"Chemical Engineering"**, Vol-I, 5th edn., Asian Books (p) Ltd., New Delhi, 1998
6. Badger W.L. and Banchero J.T., **"Introduction to Chemical Engineering"**, Tata McGraw Hill, New York, 1997

CHEMICAL PROCESS CALCULATIONS

Sub Code : 15CH33 | **IA Marks : 20**
Hrs/Week : 04 | **Exam Hours : 03**
Total Hrs : 50 | **Exam Marks : 80**
Credits: 04

COURSE OBJECTIVES: The students will

1. Learn basic laws about the behavior of gases, liquids and solids and some basic mathematical tools.
2. Understand systematic problem solving skills, enhance confidence, and generate careful work habits.
3. Learn what material balances are, how to formulate and apply them, how to solve them.
4. Learn what energy balances are, and how to apply them and finally, to learn how to deal with the complexity of big problems

Module 1	Content	Contact Hours	Blooms Taxonomy
UNITS AND DIMENSIONS: Fundamental and derived units, Conversion, Dimensional consistency of equations, conversions of equations. BASIC CHEMICAL CALCULATIONS: Concept of mole, mole fraction, Compositions of mixtures of solids, liquids and gases, Concept of Normality, Molarity, Molality, ppm, Use of semi-log, log-log, triangular graphs, Ideal gas law calculations.		**10Hrs**	**L-1, L-2.**

Module 2	Content	Contact Hours	Blooms Taxonomy

MATERIAL BALANCE WITHOUT REACTION: General material balance equation for steady and unsteady state, Typical steady state material balances in distillation, absorption, extraction, crystallization,	**10Hrs**	**L-2, L3.**

Module 3	**Content**	**Contact Hours**	**Blooms Taxonomy**
MATERIAL BALANCE WITHOUT REACTION: Drying, mixing and evaporation, Elementary treatment of material balances involving bypass, recycle and purging, Psychrometry, Humidification and dehumidification.		**10Hrs**	**L-2, L3.**

Module 4	**Content**	**Contact Hours**	**Blooms Taxonomy**
STEADY STATE MATERIAL BALANCE WITH REACTION: Principles of Stoichiometry, Concept of limiting, excess reactants and inerts, fractional and percentage conversion, fractional yield and percentage yield, selectivity, related problems.		**10Hrs**	**L-2, L3.**

Module 5	**Content**	**Contact Hours**	**Blooms Taxonomy**
ENERGY BALANCE: General steady state energy balance equation, Heat capacity, Enthalpy, Heat of formation, Heat of reaction, Heat of combustion and Calorific values. Heat of solution, Heat of mixing, Heat of crystallization, determination of ΔH_R at standard and elevated temperatures, Theoretical flame temperature and adiabatic flame temperature.		**10Hrs**	**L-2, L3.**

COURSE OUTCOMES: On completion of this course the student will have

1. Clear idea of various types of unit systems and they will be able to convert units from one form of the unit to other.
2. Sound strategy for solving material and energy balance problems.
3. Adopt the tools learned from the course from the numerical problems which contain more than two unit operations.
4. Develop mathematical relations for mass balance and energy balances for any processes.

GRADUATE ATTRIBUTES:

- Design and Development of Solutions.
- Problem Analysis
- Computational Knowledge.

QUESTION PAPER PATTERN:

- The question paper will have ten questions. Each full is for 16 marks. There will be two full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module. The students will have to answer five full questions, selecting one full question from each module.

NOTE: QUESTION PAPER TO CONTAIN AT LEAST 30% THEORY

TEXT BOOKS:

1. Bhatt B.I. and Vora S.M., **"Stoichiometry (SI Units)"**, Third edition, 1996, Tata McGraw Hill Publishing Ltd., New Delhi, 1996
2. Hougen O.A., Watson K.M. and Ragatz R.A., **"Chemical Process Principles - Part I"**
3. **"Material and Energy balances"**, Second edition, CBS publishers and distributors, New Delhi, 1995

REFERENCE BOOK:

1. Himmelblau D.M., **"Basic principle and Calculations in Chemical Engineering"**, 6^{th} edn, Prentice Hall of India, New Delhi,1997

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS [D.C] [AS PER CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME] SEMESTER-III			
Subject Code	**: 15PC34**	**IA Marks**	**: 20**
No. of Lecture Hours/Week	**: 04**	**Exam Marks**	**: 80**
Total No. of Lecture Hours	**: 50**	**Exam Hours**	**: 03**

CREDITS- 04

Course Objectives: This course enables students to:
The various modern analytical techniques like IR spectroscopy, AAS, Flame photometry, Radiochemical, Electrophoretic, Polarography, different chromatographic methods and other important topics are taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to the theoretical aspects, the basic practical knowledge relevant to the analysis is also imparted.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module-1		
General Introduction To Spectroscopy - Define Spectroscopy, Types of spectroscopy, Absorption spectrum, Emission spectra, Wave length and Wave number, Electromagnetic radiation, Visible spectrum, Stokes's shift, Hypochromicity, transmittance. **Introduction, basic principles and instrumentation** - Infrared Spectroscopy, Flame Photometry, Atomic Absorption Spectroscopy and Mass Spectrometry	10	L1, L2, L3
Module-2		
Radiochemical Techniques – Define radioactivity, half life of radioactive element, radioactive isotopes, Induced radioactivity, GM Counter, Gas ionization detector, Scintillation counter, Quenching, Radiodating, Radioactive tracer, Autoradiography, Radioimmuno assay. **Electrophoretic Methods –** Principle, Types – free solution method and zone electrophoresis, Electrophoretic mobility, Factors affecting electrophoretic mobility.	10	L1, L2, L3
Module-3		

Polarography: Principles of polarographic measurements, polarograms, Description and working of dropping mercury electrode. Current and concentrations relationship. Supporting electrolyte. Limiting current, half wave potential. Factors affecting half wave potential. Migration current, Residual current and diffusion current. Modes of operation. Rapid scan polarography, differential pulse polarography, sinusoidal a.c. polarography. Applications of polarography-Identification and determination of concentration of analyte.	10	L1, L2, L3
Module-4		
Introduction to Chromatography: Classification - Theory - distribution coefficient, rate of travel, retention time, retention volume, adjusted retention volume, specific retention volume, column capacity, separation number, peak capacity, shapes of chromatic peak, column efficiency, resolution, optimization of column performance, Chromatogram, Void volume. **Thin Layer Chromatography:** Stationary phase, mobile phase, sample application, development techniques – evaluation and documentation, advantages and disadvantages of TLC.	10	L1, L2, L3
Module-5		
Gas Chromatography: Principle, carrier gas, stationery phase, instrumentation, sample injection, column detectors (TCD, FID, ECD), effect of temperature on retention, qualitative and quantitative analysis. **High Performance Liquid Chromatography:** Principle, instrumentation, column, sample injection, detectors (absorbance, refractive index, electrochemical), mobile phase selection, ion pair chromatography.	10	L1, L2, L3
Course Outcomes: At the end of the course students are able • To apply their knowledge in developing the new methods for the determination and validate the procedures. • The appreciable knowledge will be gained by the students in the Modern Analytical Techniques and can apply the theories involved in the Analysis of various bulk drugs and their formulations.		
Graduate Attributes (as per NBA) • Engineering Knowledge • Problem Analysis • Design/development of solutions (Partly) • Interpretation of data.		

Question paper pattern:

- The question paper will have Ten questions in total
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. **Spectrometric Identification of organic compounds,** R.M. Silverstein and W.P. Webster, 6th Edition, Wiley & Sons, 1999.
2. **Instrumental Methods of Analysis,** H.H.Willard, L.L. Merritt and J.A. Dean and F. A. Settle, CBS Publishers, 7th Edition, 1988.

Reference Books:

1. **Instrumental methods of Chemical Analysis**, G.W. Ewing, 5th Edition, McGraw-Hill, New York, 1988.
2. **Principles of Instrumental Analysis,** Skoog, D.A, S.J. Holler, T.A. Nilman, 5th Edn., Saunders college publishing, London, 1998.
3. **Instrumental Methods of Chemical Analysis,** Chatwal Anand, 3rd Edition ,Himalaya Publishing House,1986.
4. **Principles of Electroanalytical Methods,** T. Riley and C. Tomilinsom, John Wiley and Sons, 2008.
5. **Instrumental Methods of Chemical Analysis,** K. Sharma, Goel Publishing House Meerut 2000.

INTRODUCTION TO PETROCHEMICAL ENGINEERING [D.C] [AS PER CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME] SEMESTER-III			
Subject Code	**: 15PC35**	**IA**	**: 20**
No. of Lecture Hours/Week	**: 04**	**Exam Marks**	**: 80**
Total No. of Lecture Hours	**: 50**	**Exam Hours**	**: 03**
CREDITS- 04			

Course Objectives: This course will enable students to

- Fundamental and methodologies in the petroleum refining processes
- Concepts of petrochemicals, Testing methods, Origin of oil and gas and Oil recovery

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module-1		
Introduction to Petrochemical Engineering: History and Overview of petrochemical industry, Role of Petrochemical Engineer. Major companies in India & abroad. Prospects & Future. Composition of crude oil, Physical properties of oil. Petroleum Materials – Native Materials, Manufactured Materials, Derived Materials.	10	L1, L2
Module-2		
Origin of oil & gas – Biogenic & Abiogenic theory, Occurrence, Migration & accumulation of oil & gas. Basic Concepts of Petroleum Geology. Rocks and fluid properties: Physical properties of oil bearing rocks, Carbonate reservoirs Fracture, Anticlines etc, Type of reserves fluids.	10	L1, L2
Module-3		
Petroleum Products and Test Methods: Crude oil Analysis, Different types of fuels & their test methods (Domestic fuels, Automotive fuels, Aviation fuel, Furnace fuels, Lubricating Oil and Miscellaneous Products)	10	L1, L2
Module-4		
Oil & gas exploration methods - Geological and Geophysical methods. Drilling: Introduction to drilling operations, Basics of drilling, Drilling rig, Drilling equipment & its components. Oil Field development, Well completion fundamentals.	10	L1, L2
Module-5		
Reservoir drives & Oil Recovery - Primary oil recovery, Secondary oil recovery. Enhanced oil recovery methods: Chemical, Thermal & Others Recovery of Heavy Oil & Tar Sand Bitumen: Oil Mining & Non Mining Methods. Products and Product Quality.	10	L1, L2

Course Outcomes: At the end of the course students are able understand the unit process involved in the petroleum refining process.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design/development of solutions (Partly)
- Interpretation of data.

Question paper pattern:

- The question paper will have Ten questions in total
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. James G. Speight "The Chemistry and Technology of Petroleum", 4th edition, CD&W Inc. Laramie, Wyoming 2007.
2. Uttam Ray Chaudhuri "Fundamentals of Petroleum and Petrochemical Engineering", CRC Press, 2011.
3. B.K Bhaskar Rao "A textbook on Petrochemicals", 2/e, publishers-Delhi 1998

Reference Books:

1. M.A Mian, " Petroleum processing", handbook for practicing engineer.
2. F. Abdulin, "Production of oil gas" Mir publishers, Moscow.
3. B.G. Deshpande "The world of petroleum", Wiley Eastern Industry.
4. Richard A. Dawe " Modern petroleum technology" volume 1 sixth edition john wiley & sons limited, New York.

FUNDAMENTALS OF PETROLEUM GEOLOGY [FC]
[AS PER CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME]
SEMESTER-III

Subject Code	**: 15PC36**	**IA**	**: 20**
No. of Lecture Hours/Week	**: 04**	**Exam Marks**	**: 80**
Total No. of Lecture Hours	**: 50**	**Exam Hours**	**: 03**

CREDITS- 04

Course Objectives: This course enables students to

- Have basic understanding of broad array of tools used in the search for and production of hydrocarbon reserves
- Learn the principles of mapping a subsurface reservoir and estimating the volumetric.

Modules	Teaching Hours	Bloom's Taxonomy (RBT) Level
Module-1		
Introduction to earth science - Origin of earth. Nature and properties of minerals and rocks. Sedimentation and sedimentary environment. Stratigraphy and geological time scale. Introduction of plate tectonics.	10	L1, L2
Module-2		
Sedimentalogy of Petroleum bearing sequences - Sedimentary basins. Generation and Migration of Petroleum. Physical and Chemical properties of Petroleum.	10	L1, L2
Module-3		
Subsurface Environment – Formation fluids – Composition, temperature, pressure and dynamics. Traps and Seals. The Reservoir. Generation and Migration and Distribution.	10	L1, L2
Module-4		
Exploration Methods - Well drilling. Formation Evaluation. Geophysical. Borehole Seismic and 4D Seismic. Subsurface geology.	10	L1, L2, L3
Module-5		
Non-conventional petroleum resources and reserve estimation. – Plastic and solid hydrocarbons. Tar sands. Oil and gas shales. Coal bed methane. Assessment of reserves.	10	L1, L2

Course Outcomes: At the end of the course students are able to understand how geologists conduct the search for petroleum resources through the value chain or the life cycle of a petroleum resource.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design/development of solutions (Partly)
- Interpretation of data.

Question paper pattern:

- The question paper will have Ten questions in total
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Cox, P.A., "The Elements on Earth", Oxford University Press, Oxford 1995.

2. Wilson, M., Igneous Petrogenesis", Unwin Hyman, London 1989.

Reference Books:

1. Boggs, S., "Principles of Sedimentology and Stratigraphy", second edition, Merrill Publishing Co., Toronto, 1995.

2. Krumblein, W.C. and Sloss, L.L., "Stratigraphy and Sedimentation", second edition W.H. Freeman and Co., 1963.

MOMENTUM TRANSFER LAB

Sub Code : 15CHL37 **IA Marks : 20**
Hrs/Week : 1T + 2L **Exam Hours : 03**
Total Hrs : 42 **Exam Marks : 80**

Credits: 02

The experiments are to be conducted on the following topics,

1. Friction in circular pipes.
2. Friction in non-circular pipes.
3. Friction in helical/spiral coils.
4. Flow measurement using venturi/orifice meters (incompressible fluid).
5. Local velocity measurement using Pitot tube
6. Flow over notches
7. Hydraulic coefficients – open orifice
8. Packed bed
9. Fluidized bed
10. Study of characteristics for centrifugal , Positive displacement pump
11. Study of various pipe fittings and their equivalent lengths.
12. Compressible fluid flow
13. Reynolds apparatus.
14. Unsteady flows - Emptying of Tank

Note: Minimum of 10 experiments are to be conducted.

PETROLEUM TESTING LAB
[AS PER CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME]
SEMESTER-III

Laboratory Code	**: 15PCL38**	**IA Marks**	**: 20**
No. of Lecture Hours/Week	**1 Hr. Tutorial(Instructions) + 2 hours Laboratory**	**Exam Marks**	**: 80**
		Exam Hours	**: 03**

CREDITS- 02

Course Objectives:
On completion of the course, the students should be conversant with the theoretical principles and experimental procedures for quantitative estimation.

Laboratory Experiments: **Minimum of 10 experiments are to be conducted**	**Revised Bloom's Taxonomy (RBT) Level**
1. Testing of petroleum and its analysis	
2. Determination of acidity of petroleum	
3.Determination of smoke point and in flammability of petroleum & petroleum products	
4.Determination of Specific gravity and API gravity of petroleum and petroleum products	
5.Determination of flash point and fire point of petroleum products	
6. Determination of melting point and drop melting point of wax	
7. Determination of cloud point and pour point	
8. Carbon residue test	
9. Drop point of grease and determination of viscosity.	
10 Sediment content of grease and softening point	
11. Freezing point of aqueous engine coolant solution	
12. Corrosion testing of petroleum oils on metals	
13. Coking tendency of oil	
14. Water separately of petroleum products	

Course Outcomes:
Students would be able to understand basic principles involved in testing of Petroleum products by different techniques.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design/development of solutions (Partly)

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pic one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% marks allotted to the procedure part to be made zero.

Reference Books:

1. **Modern Petroleum Refining Processes,** Bhaskara Rao, 3rd Edition, Oxford & IBH Publication, Reprint, 1999.