

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
LUCKNOW**



Study & Evaluation Scheme with Syllabus

for

B.Tech. Second Year

Petroleum Engineering

On

Choice Based Credit System

(Effective from the Session: 2017-18)

2nd Year III-SEMESTER

S. No.	Subject Code	Subject Name	L-T-P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	ROE030 to 039/ RAS301	Science Based Open Elective/ Mathematics-III	3-1-0	70	20	10	100	4
2.	RVE301/ RAS302	Universal Human Values & Professional Ethics/ Environment & Ecology	3-0-0	70	20	10	100	3
3.	RCH301	Environmental Pollution Monitoring & Control	3-0-0	70	20	10	100	3
4.	RPE302	Chemical Reaction & Kinetics	3-0-0	70	20	10	100	3
5.	RPE303	Heat and Mass Transfer For Petroleum Engg.	3-1-0	70	20	10	100	4
6.	RPE304	Thermodynamics For Petroleum Engg.	3-0-0	70	20	10	100	3
7.	RCH351	Environmental Pollution Monitoring & Control Lab	0-0-2	50	30	20	100	1
8.	RPE351	Numerical & Statistical Methods Lab	0-0-2	50	30	20	100	1
9.	RPE352	Mass Transfer Lab	0-0-2	50	30	20	100	1
10.	RCH355	Heat Transfer Lab	0-0-2	50	30	20	100	1
11.	RME101*	Elements of Mechanical Engineering*	3-1-0	70	20	10	100*	--
12.	RCE151*	Computer Aided Engineering Graphics*	0-0-3	50	30	20	100*	--
Total							1000	24

CT: Class Test

TA: Teacher Assessment

L/T/P: Lecture/ Tutorial/ Practical

***B.Tech. IInd year lateral entry students belonging to B.Sc. Stream, shall clear the subjects RCE151/RCE251 and RME101/201 of the first year Engineering Programme along with the second year subjects.**

Science Based Open Electives:

- a. ROE030/ROE040 Manufacturing Process
- b. ROE031/ROE041 Introduction to soft computing
- c. ROE032/ROE042 Nano Science
- d. ROE033/ROE043 Laser System and Application
- e. ROE034/ROE044 Space Science
- f. ROE035/ROE045 Polymer Science & Technology
- g. ROE036/ROE046 Nuclear Science
- h. ROE037/ROE047 Material Science
- i. ROE038/ROE048 Discrete Mathematics
- j. ROE039/ROE049 Applied Linear Algebra

2nd Year IV-SEMESTER

S. No.	Subject Code	Subject Name	L-T-P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	RAS401/ ROE040 to 049	Mathematics-III/ Science Based Open Elective	3-1-0	70	20	10	100	4
2.	RAS402/ RVE401	Environment & Ecology/ Universal Human Values & Professional Ethics	3-0-0	70	20	10	100	3
3.	RCE402	Geoinformatics	3-0-0	70	20	10	100	3
4.	RPE401	Petroleum Refining and Petrochemicals	3-0-0	70	20	10	100	3
5.	RPE402	Petroleum Geology	3-0-0	70	20	10	100	3
6.	RPE404	Geophysical Prospective Methods	3-1-0	70	20	10	100	4
7.	RCE452	Geoinformatics Lab	0-0-2	50	30	20	100	1
8.	RPE451	Petroleum Testing Lab	0-0-2	50	30	20	100	1
9.	RPE452	Petroleum Geology Lab	0-0-2	50	30	20	100	1
10.	RPE453	Seminar	0-0-2			100	100	1
11.	RME201*	Elements of Mechanical Engineering*	3-1-0	70	20	10	100*	--
12.	RCE251*	Computer Aided Engineering Graphics*	0-0-3	50	30	20	100*	--
Total							1000	24

CT: Class Test

TA: Teacher Assessment

L/T/P: Lecture/ Tutorial/ Practical

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Science Based Open Electives:

- a. ROE030/ROE040 Manufacturing Process
- b. ROE031/ROE041 Introduction to soft computing
- c. ROE032/ROE042 Nano Science
- d. ROE033/ROE043 Laser System and Application
- e. ROE034/ROE044 Space Science
- f. ROE035/ROE045 Polymer Science & Technology
- g. ROE036/ROE046 Nuclear Science
- h. ROE037/ROE047 Material Science
- i. ROE038/ROE048 Discrete Mathematics
- j. ROE039/ROE049 Applied Linear Algebra

RPE302: CHEMICAL REACTION & KINETICS

UNIT I

Analysis of Noncatalytic fluid solid reaction: Kinetics of non-catalytic fluid-particle reactions, various models, application to design.

UNIT II

Catalyst preparation and characterization: Catalysis - Nature of catalyses, methods of evaluation of catalysis, factors affecting the choice of catalysts, promoters, inhibitors, and supports, catalyst specifications, preparation and characterization of catalysts, surface area measurement by BET method, pore size distribution, catalyst, poison, mechanism and kinetics of catalyst, deactivation.

UNIT III

Physical adsorption and chemical adsorption: Fluid-fluid reactions different regimes, identification reaction regime, application to design. Physical absorption with chemical reaction, simultaneous absorption of two reacting cases consecutive reversible reactions between gas and liquid, irreversible reactions, estimation of effective interfacial area in absorption equipment.

UNIT IV

Reaction kinetics, accounting porous nature of catalyst: Heterogeneous catalytic reactions - effectiveness factor, internal and external transport processes, non-isothermal reacting systems, uniqueness and multiplicity of steady states, stability analysis.

UNIT V

Modeling of chemical reactors: Modeling of multiphase reactors - Fixed, fluidized, trickle bed, and slurry reactors.

BOOKS:

1. GF Froment, K.B. Bischoff, "Chemical Reactor Analysis and Design", 2nd ed., John Wiley, New York, 1990.
2. O. Levenspiel, "Chemical Reaction Engineering", 3rd edition, Wiley Singapore, 2000.
3. JJ Carberry "Chemical and Catalytic Reaction Engineering", McGraw Hill, New York, 1976.
4. R. Aris, "Elementary Chemical Reactor Analysis", Prentice Hall, 1969.

RPE303: HEAT AND MASS TRANSFER FOR PETROLEUM ENGG.

UNIT I

Basic Concept: Introduction, mechanism of heat transfer.

Conduction: Fourier's law of conduction; Conduction through plane and composite wall, Heat losses and insulation: critical thickness of insulation, selection of insulating materials.

Convection: Natural and forced convection; heat transfer coefficients, convection in laminar and turbulent flows.

Radiation: Radiant energy-distribution, Black body, Emissive power, Exchange of energy between two surfaces, View factor. Combined heat transfer by conduction, convection and radiation.

UNIT II

Heat exchangers: Types of heat exchangers: Co-current and counter-current flows, design of double pipe heat exchanger and shell and tube heat exchanger.

Boiling and condensation: Condensation: Filmwise and dropwise condensation, various type of condenser, Evaporators: Various types of evaporator, steam economy, single effect and multi effect evaporator.

UNIT III

Diffusion and Theory of Mass transfer: Basic concept of diffusion, Fick's Law of diffusion, Film theory and penetration theory, Convective mass transfer and Mass transfer coefficients.

Distillation: Vapour-liquid equilibrium, Raoult's Law and Relative volatility, Enthalpy concentration diagrams, Principles of distillation, Batch distillation with and without reflux, Steam distillation, Fractionating columns, Calculation of number of plates by McCabe-Thiele method, Optimum reflux, Principles of azeotropic and extractive distillations.

UNIT IV

Liquid-liquid extraction: Ternary liquid-liquid equilibrium, Batch and continuous liquid-liquid extraction, Stage calculation. Solid-liquid extraction: Single and multi stage extraction, Number of equilibrium stages. Gas Absorption and stripping: packing and packed tower design.

UNIT V

Simultaneous Heat and Mass Transfer: Design of cooling towers and dehumidification systems, Drying - batch and continuous, mechanism of drying, design of batch and continuous dryers. Principal of crystallization.

BOOKS

1. Holman, J.P., "Heat Transfer", 9th Ed., McGraw Hill
2. Treybal, R.E., "Mass Transfer Operation", 3rd Ed., McGraw Hill
3. Kreith, F., Bohn M., "Principles of Heat Transfer", 6th Ed., Brooks Cole.
4. Hewitt, G.F., Shires G.L., Bott T.R., "Process Heat Transfer", Begell House.
5. Incropera, F.P., Dewitt D.P., "Fundamentals of Heat and Mass Transfer", 5th Ed., John Wiley.
6. Brown, G. G., "Unit Operations", CBS Publishers.
7. McCabe, W.L., Smith, J.C., Harriott, P., "Unit Operations of Chemical Engineering",
8. Robert, E. Tryebal "Mass transfer operations" McGraw Hill

RPE304: THERMODYNAMICS FOR PETROLEUM ENGG.

UNIT I

Basic concept and definitions in thermodynamics, first, second and third laws of thermodynamics and its application in engineering problems, energy balance for open and closed systems. Entropy and entropy balance for open systems.

UNIT II

An Introduction to Vapour-Liquid Equilibria, qualitative behaviour of the vapour-liquid equilibria (VLE), Simple models for vapour liquid equilibria: Raoult's and Henry's laws, dew point and bubble point calculations, VLE by modified Raoult's law and K-value correlations.

UNIT III

Solution Thermodynamics: Theory and Applications, fundamental property relation. The chemical potential and phase equilibria. Partial properties, equations relating molar and partial molar properties, partial properties in binary solutions, relations among partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, VLE for pure species, fugacity of a pure liquid, fugacity and fugacity coefficient for species in solution, the fundamental residual property relation, fugacity coefficients from the virial equation of state and generalized correlations, the ideal solution, the Lewis/Randall rule, excess properties. The excess Gibbs energy and the activity coefficient, nature of excess properties.

UNIT IV

Chemical Reaction Equilibria: The reaction coordinate. Multireaction stoichiometry. Application of equilibrium criteria to chemical reactions. The standard Gibbs energy change and equilibrium constant. Effect of temperature on the equilibrium constant. Evaluation of equilibrium constants. Relation of equilibrium constants to composition. Gas-phase and liquid-phase reactions. Equilibrium conversions for single reactions. Single phase reactions.

UNIT V

Topics in Phase Equilibria The gamma/phi formulation of VLE. VLE from cubic equations of state. Equilibrium and stability. Liquid-liquid equilibrium. Vapour-liquid-liquid equilibrium. Solid-liquid equilibrium. Osmotic equilibrium and osmotic pressure.

BOOKS

1. Cengel Y.A. and Boles M.A.; Thermodynamics: An Engineering Approach
2. Smith, J. M.; Introduction to chemical engineering thermodynamics.

RPE351: NUMERICAL & STATISTICAL METHODS LAB

Solution of some selected chemical process problems to develop skill for computer applications, programme writing and numerical analysis. Use of commercial software packages such as MATHCAD, MATLAB, Aspen Plus, Design II etc.

RPE352: MASS TRANSFER LAB

1. To study the effect of solvent temperature, solvent rate and particle size on the % of recovery of oil from seeds in solid- liquid extraction unit.
2. To study the Packed Distillation column under total Reflux condition column and to determine HETP.
3. To study the characteristics of Steam Distillation using Turpentine oil as a feed stock.
4. To study the Diffusion of an Organic Vapour in air and determine diffusion coefficient of a organic vapour.
5. To study the extraction of Benzoic acid from Toluene by water using packed bed in Liquid-Liquid Extraction unit.
6. To study the Drying of solid under Force Draft condition and draw the rate of drying rate curve for a Tray Dryer.
7. Differential distillation
8. Flash vaporization, vapor liquid equilibrium
9. Ion exchange and membrane separation.

RPE401: PETROLEUM REFINING AND PETROCHEMICALS

UNIT I

Origin, exploration and production of Petroleum, Types of crudes, composition, characteristics, Products Pattern, Indigenous and imported crudes. Crude heating, primary distillation principles, separation of cuts, gaps / overlaps, stripping. Desalting heat balance in distillation, energy input and recovery, vacuum distillation, types of trays, drawoffs, intermediate product, quality control.

UNIT II

Lube oil and wax processing, solvent extraction, dewaxing desilting, deasphalting, clay contacting, principles operating parameters, feed and product equalities and yields. Types and functions of secondary processing, cracking, thermal cracking and visbreaking, different feed stocks, products, yields and qualities.

UNIT III

Fluid catalytic feed stocks and product yields and qualities. Catalyst and operating parameters. Steam Reforming, Hydrogen, Synthesis gas, cracking of gaseous and liquid feed stocks, olefins, Diolofins, Acetylene and Aromatics and their separation.

UNIT IV

Unit Processes, Alkylation, oxidation, dehydrogenation, nitration, chlorination, sulphonation and isomerisation.

UNIT V

Polymerisation Models and Techniques, production of polyethylene, PVC, Polypropylene, SAN, ABS, SBR, Polyacrylonitrile, Polycarbonates, Polyurethanes, Nylon, PET.

BOOKS:

1. B.K. Bhaskara Rao, "Modern Petroleum Refining Processes" Edition 3, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
2. Groggins, "Unit Processing in Organic Synthesis" Edition 5, Tata McGraw Hill 1987
3. Nelson W.L., "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited, 1985
4. Watkins, R.N., "Petroleum Refinery Distillation, second edition, Gulf Publishing Company, Texas 1981

RPE402: PETROLEUM GEOLOGY

UNIT I

Fundamentals of basic geology ,classification of rocks , origin, migration
Introduction to earth science - Origin of earth. Sedimentation and sedimentary environment.
Introduction of plate tectonics.

UNIT II

Sedimentology of Petroleum bearing sequences - Sedimentary basins. Generation and Migration of Petroleum. Physical and Chemical properties of Petroleum.

UNIT III

Subsurface Environment – Formation fluids – Composition, temperature, pressure and dynamics. Traps and Seals. The Reservoir. Generation and Migration and Distribution.

UNIT IV

Exploration Methods - Well drilling. Formation Evaluation. Geophysical. Borehole Seismic and 4D Seismic. Subsurface geology.

UNIT V

Non conventional petroleum resources and reserve estimation. – Plastic and solid hydrocarbons. Tar sands. Oil and gas shales. Coal bed methane. Assessment of reserves.

BOOKS:

1. Cox, P.A., “The Elements on Earth”, Oxford University Press, Oxford 1995.
2. Wilson, M., Igneous Petrogenesis”, Unwin Hyman, London 1989.
3. Boggs, S., “Principles of Sedimentology and Stratigraphy”, second edition, Merrill Publishing Co., Toronto, 1995.
4. Krumblein, W.C. and Sloss, L.L., “Stratigraphy and Sedimentation”, second edition W.H. Freeman and Co., 1963.**BOOKS**
5. Barker, C, Organic Geochemistry in Petroleum Exploration, AAPG Publication
6. Biswas , S.K . (Ed.) . , Petroliferous Basins of India, Petroleum Asia Journal
7. Ellis, D.V. and Singer, G.H., WellLogging for Earth Scientists ,2nd Edition, Springer.
8. Lerorsen, A.E., Geology of Petroleum , Freeman
9. Selley, R.C ., Elements of Petroleum Geology , 2nd Ed., Academic Press
10. Singh, Lakshman , oil and Gas Fields of India, Indian Petroleum Publications
11. Tissot, B.P. and Welte ., D.H., Petroleum Formation and Occurrence, Springer
12. Nind, R.C., Principles of Oil Production , Mc Graw Hill

RPE404: GEOPHYSICAL PROSPECTIVE METHODS

UNIT I

Introduction to Geophysics: History of development of Petroleum Geophysics; Geophysical methods commonly used in oil & gas exploration (gravity, magnetic, electrical, seismic methods).

UNIT II

Gravity Prospecting: Principles; Instruments used for gravity field measurements on land and sea: Reduction of gravity data to datum using Free air, Topographic and Bouger corrections; Typical gravity anomalies of various geological features; Interpretation of gravity data.

UNIT III

Magnetic Prospecting: Principles; Instruments used for magnetic field measurement; Magnetic susceptibility of rocks; Earth's magnetism; Magnetic effect of buried magnetic bodies; Magnetic surveys on land and sea; Airborne magnetometers; Interpretation of magnetic data (vertical field, total field).

UNIT IV

Electrical Prospecting: Electrical properties of rocks; fundamental assumptions made for electrical prospecting; Point and line source relationship between their potential distribution; Self potential method, resistivity, telluric and magneto-telluric methods, CSEM; Data interpretation approximate methods, automatic iterative methods; Principles of equivalence and suppression in data interpretation; Use of electrical prospecting for oil exploration.

UNIT V

Seismic Prospecting: Seismic waves, their characters and laws governing their reflection, refraction, attenuation and scattering; Elastic character of solids; Sources of seismic energy – Explosives impact, vibroseis and air gun and their main characteristics; Recording of seismic signals, geophones and their response characteristics, principle of digital recording of seismic signals; Seismic refraction surveys, head waves, critical and crossover distance; Seismic refraction from flat and dipping refractors; 2D and 3D seismic reflection data acquisition on land and water covered area; Principles of CDP shooting, noise surveys; Coherent and incoherent, grouping of geophones, uphole surveys; Multiplexing.

BOOKS:

1. Telford, WM, Geldart, LP, and Sheriff, RE, Applied Geophysics, Cambridge University Press.
2. Dobrin, M.B and Savit, CH, Introduction to Geophysical Prospecting, McGraw-Hill.
3. Gadallah, M.R and Fisher, RL, Applied Seismology: A Comprehensive Guide to Seismic Theory and Applications, McGraw- Hill.
4. Yilmaz, O., Seismic Data Analysis, Society of Exploration Geophysicists.
5. Catuneanu, O., Principles of Sequence Stratigraphy, Elsevier.
6. McQuillin, R., Bacon, M. and Barclay, W., An Introduction to Seismic Interpretation: Reflection Seismic in Petroleum Exploration, Kluwer Academic Publication.

RPE451: PETROLEUM TESTING LAB

1. Determine the API Gravity by Hydrometer.
2. Determine the cloud and POUR point of petroleum Products.
3. Determine the Flash and Fire point of a given Crude Oil by Pensky Martens apparatus.
4. Find out the smoke point of given Petroleum product.
5. Determine the ANILINE point of given substance.
6. Estimation of Kinematics Viscosity by SAYBOLT Viscometer.
7. Conduct experiment on ORSAT Gas analysis.
8. Estimation of Net and Gross Calorific value of Coal sample using BOMB Calorimeter.
9. Determine the melting point of Wax and Grease.
10. Estimation of Carbon Residue.

RPE452: PETROLEUM GEOLOGY LAB

1. Mechanical Analysis of Sediments and estimation of grain size parameters
2. Determination of roundness of grains
3. Determination of sphericity of grains
4. Determination of packing of sedimentary grains
5. Determination of porosity of rock samples
6. Determination of permeability of earth mass.
7. Preparation of Burial History Curves
8. Preparation of Isopach Map
9. Preparation of stratum contour map
10. Paleo currents and Depositional environments
11. Industrial/ Field visit

RPE453: SEMINAR

The purpose of this course is to prepare our students for better communication skill and discussions.