Faculty of Engineering & Technology
P.K. University
Shivpuri (MP)

Evaluation Scheme & Syllabus for
M.TECH- PETROCHEMICALS ENGINEERING
(I to IV Semester)

(Effective from session 2019-20)

EVALUATION SCHEME

M.TECH- PETROCHEMICALS ENGINEERING

Semester-I

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT .(25)	
MPE-101	ENGINEERING MATHEMATICS	30	70	NA	NA	100
MPE -102	PROCESS MODELING & SIMULATION	30	70	NA	NA	100
MPE -103	ANALYTICAL METHODS IN PETROLEUM INDUSTRY.	30	70	NA	NA	100
MPE -104	PETROCHEMICALS	30	70	NA	NA	100
MPE -105	COMPUTER APPLICATION IN CHEMICAL INDUSTRIES	NA	NA	25	25	50
MPE -106	PETROCHEMICAL TECHN. LAB- I	NA	NA	25	25	50

Semester-II

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT. (25)	
MPE-201	OPTIMIZATION	30	70	NA	NA	100
MPE-202	REACTION ENGINEERING & CATALYST TECHNOLOGY	30	70	NA	NA	100
MPE-203	REFINERY ENGINEERING	30	70	NA	NA	100
MPE-204	HIGH PRESSURE TECHNOLOGY	30	70	NA	NA	100
MPE-205	PETROLEUM TECHNOLOGY LABORATORY II	NA	NA	25	25	50
MPE-206	SEMINAR-I	NA	NA	25	25	50

Semester-III

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT .(70)	SESS. (25)	EXT. (25)	
MPE -301	DISSERTATION PHASE-I	NA	NA	300	300	600
MPE -302	SEMINAR-II	NA	NA	25	25	50
						650

Semester-IV

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT. (70)	SESS. (25)	EXT. (25)	
MPE 401	DISSERTATION PHASE-II	NA	NA	300	300	600
						600

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I Year I Semester
MPE 101 - ENGINEERING MATHEMATICS

Module-I

Differentiation; Integration; Maxima and minima; First and second order differentiation; Linear equation with constant and variable coefficient. Probability- Axiomatic definition; Addition theorem; Conditional probability; Bayes' theorem; Random variable; Mathematical expectation; Theoretical distribution- Binomial, Poisson, Normal and Standard normal distribution

Module-II

Statistics- Measures of central tendencies and distribution; Coefficient of variation; Sampling parameter; Static and standard error; Census and Sample methods; Method of sampling

Module-III

Testing of hypothesis; Null and alternative hypothesis; TypeI and typeII errors; Level of significance; Large sample test; Test of significance of single and two sample means; Test of significance of single and two proportion. Small sample tests- F test; T test (Paired, unpaired); Chi square test goodness of fit.

Module-IV

Correlation (Partial and Multiple correlation); Regression (Sample linear, nonlinear and multiple regression); Analysis of variance (One way and Two way).

Module-V

Mole concept, Determination of mole wt. by gram molecular volume relationship, problems based on mole concept, Solutions, colligative properties, Methods of expressing concentrations, strength, Normality, Molarity & Molality, ppm. Standardization of solutions, Colloids, pH, buffer systems, dissociation constant, pK value, Preparation of standard solution of acids and bases, problems related to acid base titrations, volumetric experiments-acidimetry, alkalimetry, permanganometry, dichrometry, iodometry., Methods of plotting Enzyme Kinetics Data, Effects of pH and temperature on Enzyme stability and activity.

Books & References :

1. Jerrold H. Zar. Bio Statistical Analysis, Tan Prints (I) Pvt. Ltd., New Delhi, New Edition.
2. B.S. Grewal. Higher Engineering Mathematics, Khanna publishers, New Edition.
3. A.S.Negi & S.C.Anand. A Text Book of Physical chemistry, New Edition.
4. Operation Research by Phillips & Ravindran

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I Year I Semester
MPE 102 - PROCESS MODELING & SIMULATION

Module 1:
Mathematical Modeling Fundamentals: Art of modeling, laws, assumptions, degrees of freedom, consistent modeling, synthesis, analysis and optimization. General purpose modeling, specific purpose modeling, scientific modeling, engineering modeling.

Module 2:
Models of equipment, unit operation/unit process; material & energy balance, property relations, Constraints, steady state and unsteady state models. Specific Equipment Design models: Batch reactor, continuous tank reactor, Continuous tubular, catalytic reactor, heat exchanger, Distillation column.

Module 3:
Plant modeling, stream variable and stream properties, tear stream and tear variable, modular approaches: sequential, simultaneous and equation solving approaches. Sequencing and ordering of solving equations. Plant modeling: A plant with/without a recycle stream, plant with controlling elements.

Module 4:
Solution algorithm and flow chart development for various mathematical models. Computer simulation: Programming languages, sequences and algorithm development. Specific simulators: Binary distillation column, Heat exchanger, reactor, flasher. Plant flow sheeting: Three CSTR in series, Propylene dimerization plant, sulfuric acid plant, etc.

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I Year I Semester
MPE 103- ANALYTICAL METHODS IN PETROLEUM INDUSTRY

Module 1:
Chromatography – Principle, Classification, Techniques, Application, GLC

Module 2:
Emission and Atomic Absorption Spectroscopy, Infrared, Ultraviolet, Visible and Raman Spectroscopy, Nuclear magnetic and Electron Spin Resonance Spectroscopy.

Module 3:
Light Scattering and X-Ray methods

Module 4:
Mass Spectrometry – Principle, techniques, application;

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I Year I Semester
MPE 104 –PETROCHEMICALS

Module 1:
Definitions of Petrochemicals, feed stocks, intermediates and finished products. Major petrochemicals and their uses. Comparison of gas based and naphtha based petrochemicals manufacture.

Module 2:
Naphtha cracking, operating conditions for cracking, the products streams, fractionating the products. Pyrolysis gasoline and other by products. Flow sheet diagram of a typical naphtha cracking plant.

Module 3:
Synthesis processes for polyethylene, polypropylene, Polyvinyl chloride, polyethylene terepthalate, Polystyrenene, poly butadiene, ABS, SBR, Poly methyl Metha Acrylate, PTFE, Nylons, Formaldehyde resins, Polyurethane, silicone

Module 4:
Typical synthetic fiber, plastic, resin and rubber manufacturing processes. Moulding methods of plastics, vulcanization of rubber.

BOOKS
1. B.K. BhaskaraRao "Modern Petroleum Refining Process" 4th Edition,OXFORD & IBH Publishing Co. Pvt. Ltd.,
2. Dr. B.K. BhaskaraRao "A Text on Petro Chemicals" 1st Edition, Khanna Publishers.
3. Bhagan Sahay "Petroleum Exploration and Exploitation Practices" Allied Publishers Ltd., Chennai, 1994.
4. W.L Nelson "Petroleum Refinery Engineering", 4th Edition, McGraw Hill.
5. G.D.Hobson and W.Rohl Modern Petroleum Technology, Applied Science.

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I Year I Semester
MPE-105: COMPUTER APPLICATION IN CHEMICAL INDUSTRIES

Writing computer program to solve complex design and modeling problems like heat exchangers, flashers, reactors, distillation columns, plant simulation problems etc.

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I Year I Semester
MPE-106: PETROLEUM TECHNOLOGY LAB- I

Analysis of Petroleum products – ultimate analysis, molecular analysis, structural analysis (n-dM).

Standard (ASTM/IP) analytical techniques : FIA and other chromatographic methods, Sulphonation etc.

Application of UV,IR,Mass spectroscopy, AAS, XRD in petroleum analysis.

Catalyst preparation and characterization.

Interpretation of data from laboratory experiments and design elements for some reactor types used in petrochemical industries.

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I Year II Semester
MPE-201: OPTIMIZATION

Module 1:
Indroductory concepts : Objective function, single valued function, multivalued function, non-linear function, linear function, stationary point, relative and absolute extreme, convex, concave and unimodal functions, gradient reduction method, jacobian and hessian matrix.

Module 2:
Optimization of univariate system using analytical method. Search techniques, quadratic interpolation, cubic interpolation. Optimization of multivariate unconstrained system using.

Module 3:
Search techniques. First order methods and second order methods. Optimization of multivariate constrained systems using Lagrange multipliers, penalty function, linear programming and non-linear programming.

Module 4:
Computer programming of optimization of specific problems related with chemical industry

<u>Books:</u>
1. Operations Research, H.A. Taha, Prentice Hall
2. Engg. Optimization, S.S. Rao, New Age Publication

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I Year II Semester
MPE-202: REACTION ENGINEERING & CATALYST TECHNOLOGY

Group A: Reaction Engineering

Module 1:
Mechanism of catalytic and non-catalytic reaction, mathematical analysis of rate expressions used in flow and non-flow reactors. Introduction to chemical and physical rate processes, determinations of controlling steps in overall rate. Residence time distributions : Residence time functions and relation amongst them. Modelling of real systems. Non-ideality parameters. Prediction of reactor performance.

Module 2:
Thermal characteristics of reactors. Isothermal, adiabatic and non- adiabatic conditions.Principles of reactor stability and optimization. Design of chemical reactors, comparison of performances, optimum operation analysis of reactors, detailed consideration of the design of reactors with emphasis on mass and momentum transport. Momentum, mass and heat transport in fixed and fluidized bed reactors.

Group B: Catalyst Technology

Module 3:
Catalysts: Catalyst preparation techniques, catalyst activity and the factors which influence it. The effect of physical properties such as surface area and pore size etc. on catalyst activity, method of determination of their physical properties. Catalyst poisoning.

Module 4:
The mechanism of heterogeneous catalytic reactions, adsorption isotherms, kinetics of solid catalyzed fluid reactions, interpretation of chemisorptions and surface catalysis based on modern solid state theories, reaction types and mechanism of selected reactions. Methodology of catalyst selection and development. Promoters and supports. Catalysts for various industrial processes executed in petroleum and petrochemical industries.

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I Year II Semester
MPE-203: REFINERY ENGINEERING

Module 1:
Origin of Crude oil, exploration and production. Composition of crude oil and its products. Specifications and testing methods.

Module 2:
Various major Refinery operations: desalting, atmospheric and vacuum distillation, solvent extraction, thermal cracking , catalytic cracking, reforming, hydrocrcaking, hydroisomerization,etc.

Module 3:
Offsites, power and utilities, start-up and shut down operations, trouble shooting operations.

Module 4:
Crude oil and product quantity measurement and pricing methods. Automatic plant control instrumentation, logic and strategies. Maintenance and safety measures in a refinery. Management procedure of refining operations.

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I Year II Semester
MPE-204: High Pressure Technology

Module 1:
Behaviour of metal under high pressure and temperature, stress and strain distribution in thick-walled cylinder pressure reactors.

Module 2:
High pressure equipment used in measurement of high pressure, closures, connections, valves, compressors, liquid pumps etc.

Module 3:
P-V-T relationships, phase equilibrium, specific heat, viscosity under high pressure.

Module 4: Design aspects of high pressure reactors used in petroleum and petrochemical industries.

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I Year II Semester
MPE-205: PETROLEUM TECHNOLOGY LABORATORY II

Catalytic reactions in petroleum and petrochemical industries. Suspension and Emulsion polymerization.