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

Department of Chemical Engineering

Evaluation Scheme & Syllabus for

B.Tech. Second Year

(III & IV SEM)

(Effective from session 2025-26)

EVALUATION SCHEME

B.TECH –CHEMICAL ENGINEERING 3RD SEMESTER

STUDY AND EVALUATION SCHEME FOR B.TECH IN CHEMICAL ENGINEERING

YEAR 2nd/SEMESTER-III

SUBJECT CODE	SUBJECTS NAME	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	T	P		Th	Pr	Tot	Th	Pr	Tot	
UENGICH301	ENGINEERING MATHEMATICS-III	3	1	0	4	30	-	30	70	-	70	100
UENVICH302	ENVIRONMENTAL POLLUTION MONITORING & CONTROL	3	0	0	3	30	-	30	70	-	70	100
UMECHCH303	MECHANICAL OPERATION	3	0	0	3	30	-	30	70	-	70	100
UMATECH304	MATERIAL & ENERGY BALANCE	3	0	0	3	30	-	30	70	-	70	100
UCHEMCH305	CHEMICAL ENGG. FLUID MECHANICS	3	1	0	4	30	-	30	70	-	70	100
UENVICH306	ENVIRONMENT & ECOLOGY	3	0	0	3	30	-	30	70	-	70	100
UENVICH307	ENVIRONMENTAL POLLUTION MONITORING & CONTROL LAB	0	0	2	1	-	25	25	-	25	25	50
UMECHCH308	MECHANICAL OPERATION LAB	0	0	2	1	-	25	25	-	25	25	50
UCHEMCH309	CHEMICAL ENGG. FLUID MECHANICS LAB	0	0	2	1	-	25	25	-	25	25	50
Total		18	2	6	23	180	75	255	420	75	495	750

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-III

L	T	P
3	1	0

UENGICH301:ENGINEERING MATHEMATICS-III

UNIT - I

Numerical Techniques – **I**: Zeroes of transcendental and polynomial equations, Bisection method, Regula-falsi method, Newton-Raphson method, Rate of convergence of above methods.

Interpolation: Finite differences, Newton‟s forward and backward interpolation. Lagrange‟s and Newton‟s divided difference formula for unequal intervals**.**

UNIT- II

Numerical Techniques –**II**: Solution of system of linear equations, Matrix Decomposition methods, Jacobi method, Gauss- Seidal method.

Numerical differentiation & Integration: Trapezoidal rule, Simpson‟s one third and three- eight rules, Solution of ordinary differential equations (first order, second order and simultaneous) by Euler‟s, Picard‟s and fourth-order Runge- Kutta methods.

UNIT- III

Statistical Techniques: Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves, Correlation, Linear, non – linear and multiple regression analysis, Binomial, Poisson and Normal distributions. Tests of significations: Chi-square test, t-test.

UNIT- IV

Function of Complex variable: Analytic function, C-R equations, Harmonic Functions, Cauchy‟s integral theorem, Cauchy‟s integral formula, Derivatives of analytic functions, Taylor‟s and Laurent‟s series, Singularities, Zeroes and Poles, Residue theorem.

UNIT -V

Integral Transforms: Fourier integral, Complex Fourier transform, Inverse Transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations, Z- Transform and its application to solve difference equation.

Text Books:

1. Peter V. O‟Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi
3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.
4. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers

Reference Books:

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House.
2. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, New Delhi.
4. E. Balagurusamy, Numerical Methods, Tata McGraw-Hill Publishing Company Limited, New Delhi
5. T. Veerajan & T. Ramchandrandran, Theory & Problems in Numerical Methods, TMH, New Delhi

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-III

L	T	P
3	0	0

UENVICH302:ENVIRONMENTAL POLLUTION MONITORING & CONTROL

UNIT I

Introduction: Ecology & Environment, Biodiversity, Interaction of man and environment, Overall picture of Environmental pollution, Ambient air and water quality criteria, Standards and Acts-Indian, EPA& EURO, Effects and control of noise, thermal and radioactive pollution.

UNIT II

Air Pollution: Types of pollutants, Dispersion of pollutant in the atmosphere, Gaussian dispersion model, Meteorological factors, Stability and inversion of atmosphere, Plume Behaviour, Control of air pollution from stationary and mobile sources, Methods of measuring and sampling of gaseous and particulate pollutants in ambient air and industrial waste gases, measurement of smoke density and visibility .Control of gaseous pollutants-SOx, NOx, H2S, VOCS, Auto exhaust. Stack design, Classification, selection and design of equipment‟s like cyclones, electrostatic precipitators, bag filters, wet scrubbers, settling chambers.

UNIT III

Water Pollution: Waste water characteristics – Physical and chemical composition, Biochemical oxygen demand (BOD), Pathogenic bacteria and chemical toxicity. Types of pollutants in waste water of chemical industries, Methods of sampling, preservation of samples and analysis. Methods for the treatment of liquid wastes to control pollution, Classification viz. physical, chemical and biological methods, Selection and design of equipment like hydrocyclone, settling tanks, filters, ion- exchange.

UNIT IV

Solid Wastes Management: Characterization of solid wastes, Problems of collection and handling, Various processing techniques used in solid waste management such as compaction, incineration, Composting, landfills and biological Processing, Solid waste as resource material.

UNIT V

Pollution abatement in important chemical industries like fertiliser, petroleum refineries and petrochemicals, Pulp and Paper, Pharmaceuticals, Tannery, Sugar, Distillery, food processing , cement and electroplating.

Text Books

1. Howard S. Peavy, DR Rowe & C. Tchobonoglous “Environmental Engineering”, McGraw Hill (1984).
2. Metcalf & Eddy, “Waste Water Engineering Treatment, Disposal & Reuse”, Tata McGraw Hill (2003).
3. Werner Strauss, „Air Pollution Control: Measuring and monitoring air pollutant‟, Wiley (1978).
4. Werner Strauss, „Air Pollution Control part -II, Wiley (1978).
5. Pandey, GN and Carney, GC, "Environmental Engineering", Tata McGraw Hill (1991).

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-III

L	T	P
3	0	0

UMECHCH303:MECHANICAL OPERATION

UNIT I
Types of Mechanical Operations, screen analysis, particle size distribution, particle size measurement, Surface area measurements, statistical mean diameters, relevant equations and problems.

UNIT II
Laws of crushing and grinding. Classification of crushing and grinding equipment. Construction and working principle of crushers and grinders.

UNIT III
Classification of conveyors, Storage of solids in bulk protected and unprotected piles, bines, silos, hoppers, mass flow and funnel flow Bins, Flow assisting devices, feeders. Mixing of solids, blending, kneading. Weighing of bulk solids, batch and continuous weighing techniques.

UNIT IV
Rare and dense medium separation, classifiers, magnetic separation, electrostatic separator, floatation and elutriation, continuous thickeners, decantation, centrifugal separation, Gravity settling, cyclone separators, bag filters, scrubbers.

UNIT V
Classification of filters, theory of filtration, cake resistance. Fluidization with and without carryover of particles, minimum fluidization, terminal velocity of particles, entrainment, pressure drop in fluidization.

BOOKS:

1. Momentum transfer operation: S.K. Gupta, TMC, 1979.
2. Unit Operations of Chemical Engineering: McCabe and Smith, TMC
3. Chemical Engineering Vol. I: Coulson & Richardson, Pergamon, 1979

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-III

L	T	P
3	0	0

UMATECH304:MATERIAL & ENERGY BALANCE

UNIT I
Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions, Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II
Stoichiometric principles, application of material balance to unit operations like distillation, evaporation, crystallization, drying etc., Material balance with chemical reaction, Limiting and excess reactants, recycle, bypass and purging

UNIT III
Unsteady state material balances, calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, use of humidity in condensation and drying, Humidity chart, dew point.

UNIT IV
Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels, calculation of excess air from orsat technique and problems, heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

UNIT V
Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction, effect of pressure and temperature on heat of reaction, Energy balance for systems with and without chemical reaction, unsteady state energy balances. Introduction to Computer aided calculations-steady state material and energy balances.

BOOKS:

1. Bhatt, BL, VORA, S.M., “Stoichiomentry", Tata McGraw-Hill, 1976.
2. Hougen, OA, Watson, K.M and Ragatz, RA, "Chemical Process Principles Part-I", John Wiley and Asia Publishing, 1970.
3. Himmelblau, D.M., “Basic Principles and Calculations in Chemical Engineering ", Fourth Edition, Prentice Hall Inc., 1982.
4. Whitwell, JC, Tone, RK, “Conservation of Mass and Energy", McGraw-Hill, 1973.
5. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, IIT Madras, 1981.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-III

L	T	P
3	1	0

UCHEMCH305:CHEMICAL ENGG. FLUID MECHANICS

UNIT I
Properties of fluids, fluid statics, Forces on fluids, pressure depth relationship for compressible and incompressible fluids, Forces on submerged bodies, Rigid body motion, pressure measurements, Euler‟s equation, Bernoulli‟s theorem.

UNIT II
Kinematics of flow, Description of velocity field, Stream functions, Angular velocity, Fluids in circulation, Irrotational flow, Dimensional analysis, Buckingham Pi Theorem, Dimensionless numbers and their physical significance, Similitude Criteria.

UNIT III
Fluid flow: Laminar and turbulent flows, Pressure drop in pipes, pipe fittings and pipe network, friction factor, Conservation of mass, momentum and energy, Mechanical engineering Bernoulli‟s equation .

UNIT IV
Flow measuring devices for chemical plants, venturimeter, orifice meter, nozzle, Rotameter, pitot tube and v-notch.

UNIT V
Pumping and compressing of chemicals and gases, reciprocating pumps, rotary pumps, centrifugal pumps and blowers, NPSH and calibrations, mixing and agitation, types of mixers and their selection, power requirement, compressible fluid flow, introductory concepts of two-phase flow.

BOOKS:

1. Gupta, Vijay and SK Gupta, “Fluid Mechanics and its Applications”, Wiley Eastern, New Delhi (1984).
2. Rajput, RK, “Text Book of Fluid Mechanics”, S. Chand and Co., New Delhi (1998).
3. Jain, AK, “Fluid Mechanics including Hydraulic Machines”, Khanna Publishers, Delhi (2007).
4. Bansal, RK, “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications (P) Ltd., New Delhi (2005).
5. Gupta, SK, “Momentum Transfer Operations”, Tata McGraw Hill, New Delhi (1982).

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-III

L	T	P
3	0	0

UENVICH306:ENVIRONMENT& ECOLOGY

UNIT-I

Definition, Scope & Importance, Need For Public Awareness• Environment definition, Eco system - Balanced ecosystem, Human activities - Food, Shelter, Economic and social Security. Effects or human activities on environment Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact Assessment. Sustainable Development

UNIT-II

Natural Resources• Water Resources· Availability and Quality aspects. Water borne diseases, Water Induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material cycles-- Carbon, Nitrogen and Sulpher Cycles.

Energy - Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources – Hydro-Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio.gas. Hydrogen as an alternative future source of Energy.

UNIT-Ill

Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management, e-waste management

Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution. Acid Rain Ozone Layer depletion, Animal Husbandry,

UNIT-IV

V Environmental Protection- Role of Government, Legal aspects, initiatives by Non-Governmental organizations (NGO), Environmental Education, Women Education,

Text Books

l. Environmental Studies -Benny Joseph- Tata Mcgraw Hill-2005
1. Environmental Studies- Or. D.L. Manjunath, Pearson Education-2006.
2. Environmental studies - R, Rajagopalan -Oxford Publication • 2005.
3. Text book of Environmental Science & Technology- M. Anji Reddy- US Publication .

Reference Books

l. Principles of Environmental Science and Engineering -P. Venugoplan Rao, Prentice Hall of India.
2. Environmental Science and Engineering- Meenakshi, Prentice Hall India

L	T	P
0	0	2

Department of Chemical Engineering
(Faculty of Engineering & Technology)

P.K. University, Shivpuri (MP)
II Year Semester-III

UENVICH307: ENVIRONMENTAL POLLUTION MONITORING & CONTROL LAB

1. To determine the Biochemical Oxygen Demand of a Given Sample of Wastewater
2. To determine Dissolved Oxygen in a Given Sample by Azide Modification Method
3. To find Alkalinity of Water Sample by Indicator Method
4. To determine Suspended Solids of Given Water Sample
5. To determine the Total Hardness of Water using EDTA Method
6. To determine the Turbidity of Water Sample using Nephelometric Method
7. To determine pH Value of a Given Water Sample
8. To determine the COD of Waste Water Sample by using Close Reflux Method.
9. To determine the COD of Waste Water Sample by using Open Reflux Method

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-III

L	T	P
0	0	2

UMECHCH308: MECHANICAL OPERATION LAB

1. Determination of average particle size of a mixture of particles by sieve analysis.
2. Study and operation of Jaw crusher and thereby verification of Ritinger‟s constant.
3. Determination of reduction ratio, maximum feed size and theoretical capacity of crushing rolls.
4. Study of Ball mill and comparison of its critical speed with the operating speed.
5. Study and operation of a Hammer mill thereby finding its reduction ratio.
6. Study and operation of a cyclone separator and thereby finding its efficiency of separation.
7. Study and operation of a Magnetic separator and thereby finding its efficiency of separation.
8. Study and operation of a Gyratory Crusher and thereby finding its reduction ratio
9. To find the cake and filter medium resistance of Plate and Frame Filter press.
10. To find the filter medium resistance of a Vacuum Leaf Filter.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University,Shivpuri(MP)
II Year Semester-III

L	T	P
0	0	2

UCHEMCH309:CHEMICAL ENGG. FLUID MECHANICS LAB

1. To find the flow rate using a V notch
2. To find the friction losses in a Straight pipe and in a Bend pipe.
3. Study of Pipe fittings and Valves
4. To study the working principle of a centrifugal pump and determine its efficiency experimentally.
5. Determination of coefficient of velocity, coefficient of resistance, coefficient of contraction.
6. To determine the pressure drop in a packed bed.
7. Determination of discharge coefficient with Reynolds Number in case of an orifice meter and a venturi meter.
8. Study and verification of the flow pattern in a Bernoulli‟s apparatus
9. To determine the minimum fluidization velocity in a fluidized bed.
10. Determination of the fluidization index, segregation index in a fluidized bed.

EVALUATION SCHEME

B.TECH –CHEMICAL ENGINEERING 4th SEMESTER

STUDY AND EVALUATION SCHEME FOR B.TECH IN CHEMICAL ENGINEERING

YEAR 2nd/SEMESTER-4TH

SUBJECT CODE	SUBJECTS NAME	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	T	P		Th	Pr	Tot	Th	Pr	Tot	
UNANOCH401	NANO SCIENCE	3	0	0	3	30	-	30	70	-	70	100
UPROCCH402	PROCESS INSTRUMENTATION	3	0	0	3	30	-	30	70	-	70	100
UHEATCH403	HEAT TRANSFER	3	0	0	3	30	-	30	70	-	70	100
UMASSCH404	MASS TRANSFER-I	3	1	0	4	30	-	30	70	-	70	100
UCHEMCH405	CHEMICAL ENGINEERING THERMODYNAMICS	3	1	0	4	30	-	30	70	-	70	100
UUNIVCH406	UNIVERSAL HUMAN VALUE & PROFESSIONAL ETHICS	3	0	0	3	30	-	30	70	-	70	100
UHEATCH407	HEAT TRANSFER LAB	0	0	2	1	-	25	25	-	25	25	50
UMASSCH408	MASS TRANSFER-I LAB	0	0	2	1	-	25	25	-	25	25	50
UPROCCH409	PROCESS INSTRUMENTATION LAB	0	0	2	1	-	25	25	-	25	25	50
Total		18	2	6	23	180	75	255	420	75	495	750

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
3	0	0

UNANOCH401: NANO SCIENCE

UNIT I

Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano- Technology.

Quantum Theory for Nano Science: Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box (Traped particle in 3D: Nanodot).

Physics of Solid State Structures: Size dependence of properties, crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations.

Energy Bands: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

Localized Particles: Acceptors and deep taps; mobility; Excitons.

UNIT II

Quantum Nanostructure: Preparation of quantum wells, Wires and Dots, Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Single electron Tunneling, Infrared detectors; Quantum dot laser superconductivity.

Properties of Individual Nano Particles: Metal nano clusters; Magic numbers; Theoretical modeling of nano particles; geometric structure; electronic structure; Reactivity, Fluctuations, Magnetic clusters; Bulk to nanostructure, semiconducting nanoparticles, Optical Properties, Photo fragmentation, Coulombic Explosion. Rare Gas & Molecular clusters; Inert gas clusters; Superfluid clusters; Molecular clusters.

UNIT III

Growth Techniques of Nanomaterials: Litho and Nonlithograpahic techniques, RF Plasma, Chemical methods, Thermolysis, Pulsed laser method, Self-assembly, E-beam evaporation, Chemical Vapour Deposition, Pulsed Laser Deposition.

UNIT IV

Methods of Measuring Properties: Structure: X-ray Diffraction Technique, Particle size determination, surface structure. Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy(TEM). Spectroscopy: Infra red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luminescence.

UNIT V

Carbon Nano Materials: Bucky Ball and Carbon Nano- Tubes: Nano structures of carbon (fullerene), Fabrication, Structure. Electrical, Mechanical and Vibrational properties and applications. Nano Diamond, Boron Nitride Nano-tubes, Single Electron Transistors, Molecular Machine, Nano-Biometrics, Nano Robots.

Text/Reference Books:

1. CP Poole Jr, FJ Owens, “Introduction to Nanotechnology”.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
3	0	0

UPROCCH402: PROCESS INSTRUMENTATION

UNIT I
Importance of measuring of Instruments in Process Control, Classification of Instruments, Elements of an Instruments, Static & Dynamic Characterization of Instruments, Errors in measurements & Error Analysis, Selection of instrument for a particular Measurement, transducers.

UNIT II
Measurement of Temperature: Thermocouples, Resistance Thermometer, Expansion Thermometers, Pyrometers.

UNIT III
Measurement of Pressure & Vacuum, Hydrostatic type , Elastic Element type, Electrical Type and other type of instruments like McLeod Gauge, Thermocouple gauge, Knudson Gauge, Ionization Gauge.

UNIT IV
Instruments for Measurement of Flow rate & level: Variable Area & variable head flow meters, Volumetric and Mass flow rate meters, Linear velocity measurement systems, Anemometers, Pressure type, Resistance & Capacitance type, Sonic & Ultrasonic, Thermal type Level meters.

UNIT V
Instruments for Measurement of Viscosity: Redwood, Saybolt, Engler, Cup & Cone type, Rheo & other types of viscometers.

Books:
1. Eckman, D.P., Industrial Instrumentation, Wiley Eastern Ltd., New York 1990.
2. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
3	0	0

UHEATCH403: HEAT TRANSFER

UNIT I
Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation, Conduction: Basic concepts of conduction in solids, liquids, gases, steady state temperature fields and one dimensional conduction without heat generation e.g. through plain walls, cylindrical and spherical surfaces, composite layers, etc. Insulation materials, critical and optimum insulation thickness. Extended surfaces, fins and their applications. Introduction to unsteady state heat transfer.

UNIT II
Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside and outside tubes. Determination of individual and overall heat transfer coefficients, heat transfer in molten metals.

UNIT III
Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchhoff‟s law, solar radiations, combined heat transfer coefficients by convection and radiation.

UNIT IV
Heat transfer with phase change: Condensation of pure vapors, film wise and drop wise condensation, loading in condensers and basic calculation on condensers. Heat transfer in boiling liquids, boiling heat transfer coefficients. Evaporation: Elementary principles, types of evaporators, Single and multiple effect evaporators and their calculations.

UNIT V
Heat transfer equipment: Classification, principles and design criteria, types of exchangers, viz. double pipe, shell and tube, extended surface. Furnaces and their classification and application.

BOOKS :

1. Holman, JP, “Heat Transfer”, 9th ed. McGraw Hill (1989).
2. Coulson, JM & Richardson, JF, “Chemical Engineering: Vol-1”, 6th ed. Butterworth-Heinemann
3. McAdams, W. H., “Heat Transmission”, 3rd ed., McGraw-Hill (1954).
4. Kern, DQ, “Process Heat Transfer”, McGraw Hill Book (1950).
5. Badger, WL & Bancharo, JT, “Introduction to Chemical Engineering”, Tata McGraw Hill.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
3	1	0

UMASSCH404: MASS TRANSFER-I

UNIT I

Diffusion: Molecular and turbulent diffusion, diffusion coefficient, Fick‟s Law of diffusion, dependence of diffusion coefficient on temperature, pressure and composition; measurement and estimation of diffusivity. Diffusion in multi-component gas mixtures. Diffusion in Solids: Molecular, Knudsen &surface diffusion; Inter- phase mass transfer: Mass transfer coefficients, Diffusion between phases, Equilibrium solubility of gases in liquids, Mass transfer theories, Mass transfer in fluidized beds, Flow past solids and boundary layers, Simultaneous heat and mass transfer.

UNIT II

Absorption and Stripping: Equipments, Gas-liquid equilibria, Henry‟s law, Selection of solvent, Absorption in tray column, Graphical and analytical methods, Absorption in packed columns, HTU, NTU & HETP concepts, Design equations for packed column, Absorption with chemical reaction and mass transfer.

UNIT III

Humidification and Dehumidification: Vapour liquid equilibrium and enthalpy for a pure substance, vapour pressure temperature curve, Vapour gas mixtures, Definition and derivations of relationships related with humidity Fundamental concept of humidification, Dehumidification and water cooling, Wet bulb temperature, Adiabatic and non-adiabatic operations, Evaporative cooling ,Classification and design of cooling towers.

UNIT IV

Drying: Solid-gas equilibria, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying, Design of continuous dryers.

UNIT V

Crystallisation: Equilibrium yield of crystallization ,Heat and mass transfer rates in crystallization, Theories of crystallization, Factors governing nucleation and crystal growth rates, Controlled growth of crystal., Classification and design of crystallizers.

Text Books

1. Treybal, R “Mass Transfer Operations”, 3rd ed. NewYork:McGraw-Hill, (1980).
2. Sherwood T. K., Pigford R. L. and _ilkeP. “Mass Transfer”McGrawHill (1975).

Reference Books

1. Foust, AS et.al., “Principles ofUnit Operations” John Wiley (1980).
2. Geankoplis, CJ, “Transport Processes and Unit Operations”, 3rd ed. Prentice Hall.(1993)

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
3	1	0

UCHEMCH405: CHEMICAL ENGINEERING THERMODYNAMICS

UNIT I

Basic concept and definitions in thermodynamics, first, second and third laws of thermodynamics and it 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. Cenjel Y.A. and Boles M.A.; Thermodynamics: An Engineering Approach
2. Smith, J. M.; Introduction to chemical engineering thermodynamics.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

UUNIVCH406: UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS

L	T	P
3	0	0

UNIT 1:

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration–what is it? - its content and process; „Natural Acceptance‟ and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

UNIT 2:

Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient „I‟ and the material „Body‟
8. Understanding the needs of Self („I‟) and „Body‟ - Sukh and Suvidha
9. Understanding the Body as an instrument of „I‟ (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of „I‟ and harmony in „I‟
11. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Swasthya - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 3:

Understanding Harmony in the Family and Society- Harmony in HumanHuman Relationship

13. Understanding Harmony in the family – the basic unit of human interaction
14. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
15. Understanding the meaning of Vishwas; Difference between intention and competence
16. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
17. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals
18. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family! - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 4:

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence 19. Understanding the harmony in the Nature

20. Interconnectedness and mutual fulfillment among the four orders of naturerecyclability and self-regulation in nature
21. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
22. Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 5:

Implications of the above Holistic Understanding of Harmony on Professional Ethics
23.Natural acceptance of human values
24.Definitiveness of Ethical Human Conduct
25.Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
26.Competence in professional ethics:
a) Ability to utilize the professional competence for augmenting universal human order

b) Ability to identify the scope and characteristics of people-friendly and ecofriendly production systems,

c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

27. Case studies of typical holistic technologies, management models and production systems
28.Strategy for transition from the present state to Universal Human Order:
a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
b) At the level of society: as mutually enriching institutions and organizations

Books and References:

1.R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

2. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow, Reprinted 2008.

3. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
0	0	2

UHEATCH407: HEAT TRANSFER LAB

1. To find out the thermal conductivity of liquids.
2. To find out the thermal conductivity of a metal rod.
3. Find out the Heat Transfer Coefficient during drop wise and film wise condensation.
4. Find out the Heat Transfer Coefficient in a vertical and a horizontal condenser.
5. To find out the emissivity of a surface.
6. To find out the overall thermal conductance and plot the temperature distribution in case of a composite wall.
7. To find out the average heat transfer co-efficient of vertical cylinder in natural convection.
8. To find out the Stefan Boltzman's constant and compare with the theoretical value.
9. To find out the relation between insulation thickness and heat loss.
10. To find out the overall heat transfer co-efficient of a double pipe heat exchanger.
11. To find out the overall heat transfer co-efficient of 1-2 shell & tube heat exchanger.
12. Study and operation of a long tube evaporator.

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
0	0	2

UMASSCH408: MASS TRANSFER-I LAB

1. Study the performance and determination of Equilibrium relationships
2. Mass transfer coefficients
3. Diffusion coefficients
4. Separation factors of the experiments with differential distillation
5. Flash vaporization, vapor liquid equilibrium
6. Liquid-liquid extraction
7. Solid-liquid extraction.
8. Ion exchange and membrane separation

Department of Chemical Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)
II Year Semester-IV

L	T	P
0	0	2

UPROCCH409: PROCESS INSTRUMENTATION LAB

1. Calibration of thermocouple/Bimetallic thermocouple/Resistance thermocouple.
2. Calibration of Pressure gauge/ Pnuematic pressure recorder/ Differential pressure recorder.
3. Calibration of Orificemeter/ Venturimeter / Rotameter/ Gas flow meter.
4. Estimation of viscosity by Redwood/ Saybolt/ Ostwald viscometer.
5. Calibration of pH meter.
6. Calibration of Conductivity meter.