

Syllabus of
UNDERGRADUATE DEGREE COURSE

Chemical Engineering



Rajasthan Technical University, Kota
Effective from session: 2018 – 2019



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH2-01: Numerical Methods in Chemical Engineering

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA:30, ETE:120)
End Term Exam: 3 Hours

| SN | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, scope and outcome of the course. | 1 |
| 2 | Introduction, Approximation and Concept of Error & Error Analysis Linear Algebraic Equations: Methods like Gauss elimination, LU decomposition and matrix inversion, Gauss-Siedel method, Chemical engineering problems involving solution of linear algebraic equations | 8 |
| 3 | Root finding methods for solution on non-linear algebraic equations: Bisection, Newton-Raphson and Secant methods, Chemical engineering problems involving solution of non-linear equations Interpolation and Approximation, Newton's polynomials and Lagrange polynomials, spline interpolation, linear regression, polynomial regression, least square regression | 8 |
| 4 | Numerical integration: Trapezoidal rule, Simpson's rule, integration with unequal segments, quadrature methods, Chemical engineering problems involving numerical differentiation and integration | 7 |
| 5 | Ordinary Differential Equations: Euler method, Runge-Kutta method, Adaptive Runge-Kutta method, Initial and boundary value problems, Chemical engineering problems involving single, and a system of ODEs | 8 |
| 6 | Introduction to Partial Differential Equations: Characterization of PDEs, Laplace equation, Heat conduction/diffusion equations, explicit, implicit, Crank-Nicholson method. | 8 |
| Total | | 40 |

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH1-03/3CH1-03: Managerial Economics And Financial Accounting

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA:20, ETE:80)
Term End Exam: 2 Hours

| SN | Contents | Hours |
|----|--|-----------|
| 1 | Introduction: Objective, scope and outcome of the course. | 1 |
| 2 | Basic economic concepts- Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement. | 3 |
| 3 | Demand and Supply analysis- Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply. | 5 |
| 4 | Production and Cost analysis- Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation. | 5 |
| 5 | Market structure and pricing theory- Perfect competition, Monopoly, Monopolistic competition, Oligopoly. | 4 |
| 6 | Financial statement analysis- Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques. | 8 |
| | TOTAL | 26 |

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH1-02/3CH1-02: Technical Communication

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA:20, ETE:80)

Term End Exam: 2 Hours

| SN | Contents | Hours |
|----|---|-----------|
| 1 | Introduction: Objective, scope and outcome of the course. | 1 |
| 2 | Introduction to Technical Communication- Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication. | 3 |
| 3 | Comprehension of Technical Materials/Texts and Information Design & development- Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media. | 6 |
| 4 | Technical Writing, Grammar and Editing- Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings. | 8 |
| 5 | Advanced Technical Writing- Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles. | 8 |
| | Total | 26 |

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH3-04: Material Science and Technology

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA:30, ETE:120)
End Term Exam: 3 Hours

| SN | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, scope and outcome of the course. | 1 |
| 2 | Introduction to materials: Atomic structure, bonding aggregates of atom. Crystals Structure: crystal structure, periodicity in crystal, types of structures: SC, BCC, FCC and HCP Crystals system, crystal lattice, unit cell, crystal direction, crystal planes, Miller indices, inter planar spacing, X-ray analysis, Crystals Defects: classifications and impact on the properties of engineering materials | 7 |
| 3 | Phase Equilibria – phase rule phase changes in pure Iron, binary systems, solid solution, Eutectic, Eutectoid, Peritectic and Peritectoid reactions. General principles of heat treatment: Annealing, normalizing, hardening, tempering and age hardening | 8 |
| 4 | Corrosion: Types of Corrosion in Industries, corrosion of materials in construction, pipe line and in equipments and its control | 6 |
| 5 | Materials and their properties: Mechanical properties: Hardness, Strength, Toughness, Stiffness, Ductility, Malleability, Hardenability, Creep fatigue and Rheology. Electrical properties: Conductors, Semiconductors and insulators, dielectric materials. Optical properties: Absorption, Reflection, Transmission and Refraction, optical fibers and lasers. Magnetic properties: various types of magnetic materials, Diamagnetic, Paramagnetic, Ferromagnetic, Ant ferromagnetic and Ferromagnetic materials, Domain theory, Hard and soft magnetic materials. Thermal Properties: Thermal expansion, Heat capacity, Thermal Conduction, Thermal Stresses. Criteria for selection of materials for special applications in Industries such as smart materials. Smart materials. | 10 |
| 6 | Characterization of Material: Principle, Construction and Procedure for characterization of material using Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), EDS/EDX, Atomic force microscopy (AFM), Dielectric spectroscopy, Fluorescence spectroscopy. | 8 |
| Total | | 40 |

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH4-05: Heat Transfer

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA:30, ETE:120)
End Term Exam: 3 Hours

| SN | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, scope and outcome of the course. | 1 |
| 2 | Conduction: Heat transfer modes, laws; General heat equation; Steady state problems in plane and composite systems; Thermal resistance; Insulation and critical radius; unsteady state heat conduction; Extended surfaces as Fins. | 7 |
| 3 | Convection: Principle Heat balance Equation in laminar flow; Natural convection heat transfer from plate and cylinder. Principles, Dimensional analysis of Heat Transfer by Forced, Principles, Dimensional analysis of Heat Transfer by Natural, Laminar and Turbulent Boundary layers; Laminar and turbulent flow heat transfer in a circular pipe. Dimensional groups in Heat Transfer | 6 |
| 4 | Condensation and Boiling: Types of condensation: Drop and Film condensation, Condensation on a vertical plate, vertical tube and horizontal tubes. Effect of superheated vapor and non-condensable gases. Types of boiling: Pool and forced boiling; boiling curves; Simplified relations for boiling heat transfer with water; Critical Flux. | 6 |
| 5 | Radiation: Basic concepts; Emission characteristics and laws of black body radiation; Radiation incident on a surface; Solid angle and radiation intensity. Heat exchange by radiation between two black surface elements; Heat exchange by radiation between two finite black surfaces; shape factor; Radiation shields. | 10 |
| 6 | Heat Exchangers Classification of heat exchangers; Overall heat transfer coefficient, fouling factor calculations; Analysis of Heat Exchangers: Logarithmic Mean temperature difference, Effectiveness – NTU Method. Evaporator: Evaporators, types of evaporator method of feeding steam consumption, economy. | 10 |
| Total | | 40 |

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH4-06: Mass Transfer-I

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA:30, ETE:120)
End Term Exam: 3 Hours

| SN | Contents | Hours |
|--------------|--|-----------|
| 1 | Introduction: Objective, scope and outcome of the course. | 1 |
| 2 | Fundamentals of Mass Transfer: Individual and film coefficients, overall mass transfer Coefficient and their inter relationships; Analogies in transfer processes, determination of mass transfer coefficient. | 7 |
| 3 | Diffusion Phenomenon: Molecular and eddy diffusion in gases, liquids and solids, Interface mass transfer. Mass transfer theories: film theory Penetration theory and surface renewal theory. | 6 |
| 4 | Humidification and Dehumidification: Humidification: General Theory, psychometric chart. Fundamental concepts in humidification & dehumidification, wet bulb temperature. Adiabatic saturation temperature, measurement of humidification calculation of humidification operation, cooling towers and related equipments. | 6 |
| 5 | Drying: Equilibrium mechanism theory of drying, drying rate curve. Batch and continuous drying for tray driers, Drum dryers, spray and tunnel dryers. | 10 |
| 6 | Absorption: Introduction to Adsorption, Absorption and Extraction in continuous contact columns; co-current, counter current and cross current contacting Absorption, calculations of NTU and HTU, Concept of HETP, Two phase flow in packed beds, co-current and counter current Processes Flooding loading, column internals: types of trays/ plates and packing, point and plate efficiency. | 10 |
| Total | | 40 |

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH-4-07: Thermodynamics – II

(Common with Petroleum Engineering & Petrochemical Engineering)

Credit: 3
3L+0T+0P

Max. Marks: 150 (IA:30, ETE:120)
End Term Exam: 3 Hours

| SN | Contents | Hours |
|--------------|---|-----------|
| 1 | Introduction: Objective, scope and outcome of the course. | 1 |
| 2 | Review of first and second law of thermodynamics. | 7 |
| 3 | Vapor-liquid equilibrium: phase rule, simple models for VLE; VLE by modified Raoult's law; 1 VLE from K-value correlations; Flash calculations. | 10 |
| 4 | Solution Thermodynamics: fundamental property relationships, free energy and chemical potential, partial properties, definition of fugacity and fugacity coefficient of pure species and species in solution, the ideal solution and excess properties. Liquid phase properties from VLE, Models for excess Gibbs energy, heat effects and property change on mixing. UNIFAC and UNIQUAC models. Liquid-Liquid Equilibria; Vapor-Liquid-Liquid Equilibria; Solid-Liquid Equilibria; Solid-Gas Equilibria. | 12 |
| 5 | Chemical reaction equilibria: equilibrium criterion, equilibrium constant, evaluation of equilibrium constant at different temperatures, equilibrium conversion of single reactions, multi-reaction equilibria Introduction to molecular/statistical thermodynamics. | 10 |
| Total | | 40 |

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH4-21: Heat Transfer Lab

Credit: 2
OL+OT+4P

Max. Marks: 100 (IA:60, ETE:40)

1. To determine the thermal conductivity of Liquid.
2. To determine the equivalent thermal conductivity of composite wall.
3. To determine heat transfer coefficient in force convection and natural convection
4. Study of Unsteady state Heat Transfer Unit
5. To determine heat transfer coefficient with the help of Stefan Boltzmann Apparatus.
6. To calculate emissivity of the test plate by emissivity measurement apparatus.
7. To determine heat transfer coefficient in double pipe heat exchanger.
8. To study the heat transfer characteristics of a shell and tube heat exchanger.
9. To measure determine the heat transfer coefficient and heat transfer rate of film wise and drop wise condensation of pure water vapor.
10. To determine rate of evaporation through single effect evaporator.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH4-22: Mass Transfer – Lab I

Credit: 2
OL+OT+4P

Max. Marks: 100 (IA:60, ETE:40)

1. To determine diffusion coefficient of solid vapour in air
2. To determine diffusion coefficient of Liquid vapour in air
3. To study the rate dissolution of a rotating cylinder and then to calculate the mass transfer coefficient. (Mass Transfer with and without chemical Reaction)
4. To investigate the mass transfer characteristic of a wetted surface column unit.
5. To investigate the characteristics of cooling tower.
6. To study the drying characteristics of a wet granular material using natural and forced circulation in tray dryer.
7. To prepare the drying rate curve for force draft tray dryer.
8. To study the characteristics of spray dryer.
9. To study Absorption of gas in absorption column



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH4-23: Numerical Methods in Chemical Engineering Lab

Credit: 2
OL+OT+4P

Max. Marks: 100 (IA:60, ETE:40)

| | |
|----------|---|
| 1 | <p>1. Numerical solution of non-linear algebraic and transcendental equation by bisection, iteration, false position, secant and Newton Raphson methods.</p> <p>2. Numerical solution of system of linear simultaneous equations by Gauss elimination and Gauss Seidel methods.</p> <p>3. Interpolation by Lagrange's interpolation formula</p> <p>4. Numerical evaluation of definite integral by Trapezoidal, Simpson's 1/3rd, Simpson's 3/8th, Weddle and Gaussian quadrature formulae.</p> <p>5. Numerical solution of first order ordinary differential equation by Euler's, Modified Euler's, second and fourth order Runge-Kutta, Adams-Moulton and Milne's method</p> |
| 2 | <p>B. Scope of practice sessions:</p> <p>Computation of raw moments, central moments, coefficient of variation, coefficients of skewness and kurtosis; Fitting of straight line, second degree polynomial (parabola), power curve and exponential curve; Computation of product moment correlation, multiple and partial correlation coefficients; Regression coefficients and regression lines, plane and regression. Application of tests of significance based on numerical data</p> |



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-IV Semester: B.Tech. (Chemical Engineering)

4CH9-00: Environmental Science (Mandatory Non-credit Course)

B. Tech. (CH) 4th Sem.

Max. Marks: 100

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

1. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
2. Slogan making event
3. Poster making event
4. Cycle rally
5. Lectures from experts

(b) Actual Activities:

1. Plantation
2. Gifting a tree to see its full growth
3. Cleanliness drive
4. Drive for segregation of waste
5. To live some big environmentalist for a week or so to understand his work
6. To work in kitchen garden for mess
7. To know about the different varieties of plants
8. Shutting down the fans and ACs of the campus for an hour.