CURRICULUM OF CHEMICAL ENGINEERING
RGUKT BASAR

III YEAR
I SEMESTER

S.No	Subject Code	Subject Name	(L-T)-P	C
1	BM3001	Managerial Economics and Financial Analysis	4-0	3
2	CH3101	Mass Transfer Operations-II	4-0	4
3	CH3104	Chemical Reaction Engineering-I	4-0	4
4	CH3102	Instrumentation & Process Control	4-0	4
5	CH3103	Environmental Pollution and Control Engineering	4-0	4
6	BM3101	Personality Development	2-0	1
7	CH3701	Mass Transfer Operations Lab	0-3	2
8	CH3702	Instrumentation & Process Control Lab	0-3	2
9	CH3901	Seminar – II	0-2	1
Total Credits				**25**

L-Lectures, T-Tutorials, P-Practicals, C-Credits.

BM3001 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-3**

UNIT I: Introduction to Managerial Economics:

Definition, Nature and Scope of Managerial Economics-Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting.

UNIT II: Theory of Production and Cost Analysis:

Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs. Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.
Cost Analysis: Cost concepts, Opportunity cost. Fixed vs. Variable costs, Explicit costs Vs. Implicit costs. Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

UNIT III: Markets & Pricing Policies:

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing.

UNIT IV: Introduction to Financial Accounting: Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with simple adjustments).

UNIT V: Capital and Capital Budgeting:

Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

1. Aryasri: Managerial Economics and Financial Analysis, TMH,2009.
2. Varshney & Maheswari : Managerial Economics, Sulthan Chand,2009.
3. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis,

Scitech. 2009.
4. V.Rajasekarn & R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
5. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

CH3101 MASS TRANSFER OPERATIONS-II

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-4**

Objectives:

- Study of the stage wise mass transfer operations, principles of various stage wise contact processes like Distillation, extraction, adsorption, leaching and drying
- Design aspects of the equipment utilized for the above mentioned operations
- Attain practical knowledge of separation processes, conduct experiments and submit the report.

Unit-1

Distillation: Vapor liquid equilibrium, Relative volatility concept, Ideal solutions-Raoult's law: Positive deviation from ideality, Negative deviation from ideality. Enthalpy-concentration diagrams. Azeotropy, Single Stage operation-Flash Distillation, Differential or Simple Distillation: Rayleigh equation. Batch Distillation, Introduction to Fractional Distillation.

Unit-2

Continuous Rectification-Binary system:the method of Ponchon-Savarit andMcCabe-Thiele analysis of binary distillation. Minimum reflux ratio and optimum reflux ratio. Continuous – contact equipment (Packed towers): the transfer unit. Extractive Distillation and Azeotropic Distillation, low pressure distillation: Molecular distillation.

Unit-3

Liquid-Liquid Extraction: Liquid equilibria, Ternary diagram, lever rule, system of three liquids, Choice of solvent. Stage wise contact: single stage extraction, multi-stage cross current extraction: insoluble liquids, continuous countercurrent multi-stage extraction with and without reflux. Stage wise extractors: Sieve tray towers. Differential extractors.

Unit-4

Adsorption and Ion Excahnge:Types and nature of adsorption, adsorption equilibria and isotherms: The Freundlich equation. Adsorption operation: stage wise, multi stage cross current operation and multi stage countercurrent operation. Continuous adsorption: the adsorption wave, chromatography. Fixed bed adsorption, ion-exchange: principles, techniques and application.

Unit-5

Leaching: Introduction, single and multi-stage operations, countercurrent multiple contact: the shanks system, continuous countercurrent decantation equipment for leaching.
Crystallization: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth, ΔL law, crystallization equipment including MSMPR crystallizers.

Text Books:

1. Mass Transfer Operations, 3rd ed., R. E. Treybal, McGraw-Hill, New York.
2. Principles of Mass Transfer and Separation processes, Binary K. Dutta PHI Learning Pvt. Ltd., New Delhi, 2012

Reference Books:

1. Unit operations in chemical engineering, W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill, 7th ed. 2001.

CH3104 CHEMICAL REACTION ENGINEERING-I

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-4**

Objectives:

- The emphasis of this course is on the fundamentals of chemical reaction kinetics and chemical reactor operation.
- The overall goal of this course is to develop a critical approach toward understanding complex reaction systems and elucidating chemical reactor design.
- Integrate concepts from science & engineering to constitute a basis for the design of chemical reactor, a key element in the design of chemical process.
- Provide a foundation on deriving rate expressions for series, parallel, reversible reactions and the knowledge about product distribution in multiple reactions, recycle reactors and auto catalytic reactions.
- Understand effect of temperature and pressure on reacting systems

Unit-1

Introduction. Classification of chemical reactions; single, multiple, elementary and non-elementary homogeneous reactions; reaction rate, order and Molecularity; Collision theory and Transition-state theory, Arrhenius relation. Reaction Mechanisms.

Unit-2

Interpretation of Batch reactor data :

Constant volume batch reactor; Integral analysis and differential Analysis of batch reactor data. Half-life period, fractional life period. Reversible and irreversible reactions. Autocatalytic reactions. Variable volume batch reactor. Analysis of Variable volume batch reactor

Unit-3

Introduction to Reactor design for homogeneous isothermal reactions;

Ideal Batch rector; Ideal CSTR reactor design; Ideal plug flow Reactor Design.

Design for single reactions:

Comparison of Ideal Reactors for single reaction. Reactors in series, Reactors of different types in series, Design of Recycle reactor, Optimum recycle ratio, Best reactor system setup for given conversion. Best reaction system for autocatalytic reactions.

Unit-4

Design for Parallel reactions-Introduction to multiple reactions, Product distribution, quantitative treatment of product distribution-instantaneous yield, Overall yield, Selectivity, various contacting patterns.

Design for Series reactions –irreversible series first order reactions-yield analysis in batch reactor, plug flow reactor and mixed flow reactor,

Design for reactions with change in order; Design considerations for Reversible reactions in series.
Design considerations for Series-Parallel reactions; Denbigh reactions

Unit-5

Temperature and pressure effects:
Equilibrium constant and effect of temperature on equilibrium conversion-exothermic and endothermic reactions, General graphical design procedure, Optimum temperature progression,
Adiabatic operation and Non-adiabatic operation; Exothermic reactions in Mixed flow reactor. Multiple reactions-product distribution, choosing the right kind of reactor.

Text Books

1. Chemical Reaction Engineering, Octave Levenspiel, Wiley Eastern, 3rd ed., Tata McGraw Hill.

Reference:

1. Elements of Chemical Reaction Engineering, H S Fogler, 4th Edition, PHI.

The Engineering of Chemical Reactions, 2nd ed., L.D. Schmidt, Oxford University Press, New Delhi, 2010

CH3102 INSTRUMENTATION AND PROCESS CONTROL

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-4**

Objectives:

- Develop mathematical and transfer function models for dynamic processes.
- Analyze and characterize different process.
- Analyze process stability and dynamic responses.
- Empirically determine process dynamics for step response data.
- Development of block diagrams, reading block diagrams, process and instrumentation diagrams
- Familiarity with different types of feedback controllers.
- Develop different advanced control strategies.
- Knowledge of real time applications of process control implementation.
- Knowledge and working principles of different instruments used in Industry.

Unit 1

Mathematical Modeling, Development of mathematical models, modeling considerations for control purposes.

Unit 2

Dynamic Behavior of Chemical Processes, Brief of Laplace transforms, Transfer functions and the input-output models, Dynamics and analysis of first, second and higher order systems- Multiple capacitance systems, Dead time, Inverse Response

Unit 3

Feedback Control Schemes, Concept of feedback control, Dynamics and analysis of feedback-controlled processes, Stability analysis- Routh Hurwitz criterion, Root Locus analysis, Controller design- control valve characteristics.

Unit 4

Frequency response analysis-Bode plots, polar plots Bode stability criterion, controller tuning. Advanced Schemes- Dead time compensator, Inverse response compensator, Cascade controller, Split range controller, Over-ride controller and Feed forward controller.

Unit 5

Characteristics Of Measurement System; Pressure Measurement; Temperature Measurement; Flow Measurement; Measurement-Instruments For Analysis

Text Books:

1. Patranabis D. - Principles of Industrial Instrumentation - 2nd Edition - Tata McGraw Hill Publishing Company, New Delhi (1999)

2. Chemical process control by G. Stephanopolous, PHI,1998

References Books

1. Industrial instrumentation by Donald P. Eckman, Wiley eastern.
2. Process systems analysis and control by D.R. Coughanowr, 2nd ed. Mc Graw Hill
3. Process Control by Wayne Bequette, PHI.

CH3103 ENVIRONMENTAL POLLUTION AND CONTROL ENGINEERING

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-3**

Objective:
The aim of this course is that the students will learn the essential principles used in industrial pollution abatement and and pertinent environmental legislations.

Unit-1

Engineering, ethics and environment.Ecological systems and pollution.Fundamental definitions of pollution parameters – air and water quality criteria, standard and legislation EIA, EIS and EMP. Air and water pollution management through waste minimization.

Unit-2

Industrial air pollution management: air pollution meteorology, industrial plume behavior, types of plumes, Gaussian Plume model.

Unit-3

Outlines of industrial air pollution control. Section, design and performance analysis of air pollution control equipment: gravity settling chambers, air cyclones, electro-static precipitators, filters and scrubbers.

Unit-4

Industrial water pollution management: waste water treatment processes: Pre-treatment, primary and secondary treatment processes. Advanced waste water treatment processes

Unit-5

Design of sedimentation tanks and biological treatment processes.Solid waste management.

Text Books:

1. Environmental pollution and control management, Rao C.S. – Wiley Eastern Limited, India.
2. Pollution control in process industries by S.P. Mahajan TMH, 1985.

BM3101 PERSONALITY DEVELOPMENT

External Examination: 60 Marks **L-T-P-C**
Internal Examination: 40 Marks **4-0-0-1**

Guidelines: Learning approach is based on Real time case studies with class room activities

Course Objectives:

1. To develop interpersonal skills and be an effective goal oriented team player.
2. To develop professionals with idealistic, practical and moral values.
3. To develop communication and problem solving skills.
4. To re-engineer attitude and understand its influence on behavior.
5. To enhance holistic development of students and improve their employability skills.

UNIT – I
SELF ANALYSIS **(6 hours)**
SWOT Analysis, Who am I, Personality Traits, Importance of Self Confidence, Self Esteem.

UNIT – II
GOALS SETTINGS **(6 hours)**
Short term, Long term goal settings, SMART concept
Diversifying Risk and Optimizing Opportunities

UNIT – III
TEAM DYNAMICS WITH INTERPERSONAL SKILLS **(8 hours)**
Team Dynamics, Team Work, Interpersonal Skills

Behavioral Skills GD, PI, Body Language Public Speaking, Verbal, Non Verbal Communications

UNIT – IV
CREATIVITY AND RATIONALITY **(8 hours)**

Out of Box thinking, Idea Generation with creativity

Brain Storming, Effective group meetings, Rationalization of ideas and way to effective implementation

- **Class room and team activities coupled with group tasks depending upon time availability**

CH3701 MASS TRANSFER OPERATIONS LAB

Externals: 60 Marks **L-T-P-C**

Internals: 40 Marks **0-0-3-2**

Note: Any 8 experiments out of given set of experiments

Objectives:

- This lab gives an overall idea of various mass transfer operations used in the industry.

List of experiments:

1. To study the performance of a bench top cooling tower
2. Solid liquid extraction
3. Absorption
4. Adsorption
5. The drying curve of a solid under constant drying conditions
6. Separation of two miscible liquids in a sieve plate distillation column
7. Liquid-liquid extraction
8. Estimation of binary gas diffusivity
9. Packed bed distillation column
10. Simple distillation
11. Steam Distillation.

CH3702 INSTRUMENTATION AND PROCESS CONTROL LAB

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **0-0-3-2**
Note: Any 8 experiments out of given set of experiments.

Objectives:

- To evaluate response of fist and higher order characteristics.
- Study the installed characteristics of the valve.
- Study if there is a hysteresis in the control valve and sensor.
- Evaluate the tuning of a PID control via manual and automatic tuning.
- Evaluate the effect controller on the control system

List of Experiments

1. Study of Flow control trainer
2. Study of Level control trainer
3. Study of Pressure control trainer
4. Study of Temperature control trainer
5. Control valve characterization
6. Characterization of thermocouples
7. Study of Flapper nozzle
8. Differential pressure transmitter
9. Study of I/P and P/I Converter
10. Interacting and Non interacting system

CH3901 Seminar-II

Externals: 100 Marks **L-T-P-C**

0-0-2-1

Objectives:

- To improve the presentation skills
- To prepare PPT more effectively

Student has to chose a topic related socio-economic matter to give a power point presentation.