CM - 801 (A) – Process Piping Design

Unit I Classification of pipes and tubes IS & BS codes for pipes used in chemical process industries and utilities.

Unit II Pipes for Newtonian and non-Newtonian fluids, sudden expansion and contraction effects, Pipe surface roughness effects, Pipe bends, Shearing characteristics.

Unit III Pressure drop for flow of Newtonian and non-Newtonian fluids through pipes, resistance to flow and pressure drop, effect of Reynolds and apparent Reynolds number.

Unit IV Pipes of circular and non-circular cross section-velocity distribution, average velocity and volumetric rate of flow. Flow through curved pipes (Variable cross sections), effect of pipe-fittings on pressure losses.

Unit V Non-Newtonian fluid flow through process pipes, Shear stress, Shear rates behavior, apparent viscosity and its shear dependence, Power law index, Yield Stress in fluids, Time dependant behavior, Thixotropic and rheopetic behavior, mechanical analogues, velocity pressure relationships for fluids, line.

Unit VI Pipe line design and power losses in compressible fluid flow, Multiphase flow, gasliquid, solid - fluid, flows in vertical and horizontal pipelines, Lockhart Martinelli relations, Flow pattern regimes.

References:
1. Coulson JM and Richardson J.F; Chemical engineering - Vol I, Butterworth, Oxford;
2. Govier, G.W. and Aziz K; Flow of complex mixtures in pipe; Krieger Pub, Florida
3. Green DW and Malony, Perrys; Chemical engineers Handbook;TMH

CM - 801 (B) – Cryogenic Engineering

Unit I Introduction to cryogenics and cryogenic systems, thermodynamic principles of cryogenic systems, thermodynamic foundation for cryogenics, analysis of real systems with thermodynamics.

Unit II Properties of cryogenic fluids: Fluid properties, fluid behavior at cryogenic temperatures, structural properties at low temperature, thermal properties at low temperature, Electrical properties at low temperatures, superconductivity.

Unit III Production of low temperature, refrigeration and liquefaction, cryogenic refrigeration cycle work, J T cycles and expander cycle and difference, use of cycle analysis on real systems, cryo-coolers operation

Unit IV Cryogenic Environment : Storage vessels, Dewars - both large and small, compressors, expanders, heat exchanges, selection of transfer lines and values, Insulation principles, separation and purification system, Helium and natural gas systems separation, gas purification, storage and transfer systems.

Unit V Cryogenic Instrumentation and Measurements, strain, pressure flow and liquid level, measurement of low temperatures, optimization of tank designs, Details of liquefied natural gas, purification of natural gas, storages and insulation of Liquefied Natural Gas, its transportation through pipelines.

Unit VI Safety in cryogenic systems, Hydrogen, Oxygen and Nitrogen, Handling of high pressure cylinders, safety in liquid nitrogen and high pressure gas systems, safety in hydrogen and oxygen systems, critical safety for H2 and 02, cleaning of H2 and 02 equipments.

References:

1. R.H. Perry, D.W. Green; Perry's Chemical Engineers Handbook; McGraw Hill.
2. Thomas M, Flynn, Dehher; Cryogenic Engineering; Marcel-Decker, Colorado P, Florida.
3. Mukhopadhyaya; Fundamentals of cryogenic Engg; PHI

CM - 801 (C) – Energy management in Processes

Unit 1 Energy Management & Audit: Definition, need and types of energy audit, Energy management (audit) approach-understanding energy costs, bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel & energy substitution, Energy audit instruments.

Unit 2 Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques -energy consumption, production, cumulative sum of differences (CUSUM).
Global environmental concerns: United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon fund (PCF).

Unit 3 Energy Efficiency: Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings.
Insulation and Refractory: Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractory, heat loss.

Unit 4 Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential.
Energy efficiency in Electrical Utilities: Electrical system, electric motors, HVAC and refrigeration system, fans and blowers, pumps and pumping system, cooling tower, lighting system.

Unit 5 Heat Exchanger Networks

References:
1. Howe & Feinberg; The Energy Source Book; Am Institute of Physics
2. Johnson & Kelly; Renewable Energy Source for Fuel & Electricity;

CM – 802- Entrepreneurship Management and Economics

Unit-I: **System:** System and subsystem in process engineering, system analysis, economic degree of freedom, various algorithms, synthesis of processes, flow-sheeting, mathematical representation of steady-state flow-sheet

Unit-II: **Management:** Importance, definition and functions; schools of theories, knowledge driven learning organization and e-business; environment, uncertainty and adaptability; corporate culture, difficulties and levels of planning, BCG matrix, SWOT analysis, steps in decision making, structured and unstructured decision; dimensions of organizations, size/specialization, behavior formalization, authority centralization, departmentalization, span and line of control, technology and Minzberg organization typology, line, staff & matrix organization, coordination by task force, business process reengineering and process of change management, HR planning placement and training, MIS; attitudes and personality trait, overlap and differences between leader & manager, leadership grid, motivation, Maslow□s need hierarchy and Herzberg two factor theory, expectation theory, learning process, team work and stress management.

Unit-III Plant Economics: Interaction between design and cost equations for optimal design of equipments, inflation, energy conservation and environmental control, economic design criteria, terms involved in profitability analysis, Gross income, depreciation, net profit.

Unit-IV: Finance: Nature and scope, forms of business ownerships, balance sheet, profit and loss account, fund flow and cash flow statements, breakeven point (BEP) and financial ratio analysis, pay-back period, NPV and capital budgeting.

Unit V: Entrepreneurship: Definition and concepts, characteristics, comparison with manager, classification, theories of entrepreneur, socio, economic, cultural and psychological; entrepreneur traits and behavior, roles in economic growth, employment, social stability, export promotion and indigenization, creating a venture, opportunity analysis competitive and technical factors, sources of funds, entrepreneur development program.

References:
1. Peter MS, Timmerhaus KD; Plant design and economics for chemical engr; TMH
2. Schwery HE; Process engg economics; TMH
3. Daft R; The new era of management; Cengage.
4. Bhat Anil, Arya kumar; Management: Principles ,Processes Practices; Oxford H Ed
5. Khan, Jain; Financial Management;
6. Mohanty SK; Fundamental of Entrepreneurship; PHI.
7. Kuratko, Hoolgetts; Entrepreneurship; Theory Process practice; Cengage.

CM – 803- Bioprocess Technology

Unit I Introduction to Bio-Chemical Engineering: Aspects of microbiology, cell theory structure of microbial cells, classification of microorganism, Essential chemicals of life lipids, Sugars and Polysaccharides, RNA and DNA, Amino acids and proteins.

Unit II Metabolism and Energetic: Assimilatory and dissimilatory process, metabolic mechanism of the cells; Biochemical Kinetics: Simple enzyme kinetics with one or two substrates, modulation and regulation of enzymatic activity, enzyme reactions in heterogeneous systems.

Unit III Growth cycle, phases for Batch cultivation, mathematical modeling of batch growth, roducts synthesis Kinetics, overall kinetics and thermal death kinetics of cells and spores.

Unit IV Unit Operations in Biochemical Process: Agitation and aeration, gas liquid mass transfer, determination of oxygen transfer rates, determination of Kga and KLa scaling of mass transfer equipment, heat balance and heat transfer correlation for biochemical systems, sterilization, filtration and drying.

Unit V Design and Analysis of Bio-Reactors: Classification and characterization of different bioreactors, batch and continuous reactors, tubular, CSTR and tower reactors, aerobic and anaerobic fermentation-process, design and operation of typical aerobic and anaerobic fermentation processes, manufacture of microbial products e.g. antibiotics alcohol/ wine etc; use of immobilized enzyme and whole cells for industrial processes.

References:

1. Baily, J .E. and Ollis D.F; Biochemical Engineering Fundamentals; Mc. Graw Hill
2. Coulson and Richardson; Chemical Engineers;
3. Shuler, Kargi; Bioprocess Engineering basic concepts.; PHI Learning
4. Rao ; Introduction to Biochemical Engineering; TMH

List of Experiments(Please Expand It)

Bio-Process Technology CM 803:

1. To carry out the isolation and identification of microorganism from a soil sample.
2. To examine & study effectiveness of various techniques for preserving microorganism
3. To study the kinetics of ethanol fermentation.
4. To determine the kinetic constants l.1max and Km for the growth of microorganisms.
5. To identify bacterial species using Gram staining tests.
6. To determine the biochemical oxygen demand of the given wastewater sample.
7. To determine the chemical oxygen demand of the given wastewater sample.
8. To study BOD kinetics of given wastewater sample and to determine the kinetic constant.
9. To determine the dissolved oxygen content of the given sample by Winkler method.
10. To determine the reducing sugar in the given fermentation medium.
11. To determine the protein in the given fermentation medium.
12. To determine the total sugar content in the given fermentation medium.
13. To study the kinetics of methane fermentation.
14. To study the kinetics of an enzyme catalyzed reaction.
15. To study the activity of enzymes in free and immobilized States.
16. To study the activity of whole cell enzymes in free and immobilized States.

Note: Each student should perform at least eight experiments out of the above list.

CM – 804- Chemical Process modeling and Simulation

Unit I The role of analysis: chemical engineering problems, basic concepts of analysis; the analysis process, simple example of estimating an order, source of the model equations, conservation equations, constitutive equations, control volumes, dimensional analysis, system of units, dimensional consistency in mathematical descriptions, dimensional analysis and constitutive relationships, final observations.

Unit II Non-Reacting Liquid Systems: Introduction, equation of continuity, simple mass balance, application of the model equations, component mass balances, model behavior: steady state behavior, un-steady state behavior, density assumption, numerical integration methods of ordinary differential equation; Reacting Liquid Systems: Introduction, basic model equations for a tank-type reactor, reaction rate, batch reactor, pseudo first-order reactions, reversible reactions, multiple reactions; consecutive reactions, parallel reactions, complex reactions, constant density assumption, order and stochiometry.

Unit III Treatment of experimental data: Introduction, criteria for Best Fit, Best Slope-I, Best Slope-II, Best straight line, physical property correlations, fitting a quadratic, simulation examples of gravity fluid flow, heat and mass transfer, Monte-Carlo simulation.

Unit IV Dynamic modeling of simple processes, sequential, simultaneous modular and equation oriented approaches, partitioning and tearing.

Unit V Computer programming of various iterative convergence methods such as Newton-Ralphson, false position, Wegstein, Muller methods.

References:
1. Russell TWF; Introduction to Chemical Engineering Analysis - John Wiley & Sons
2. Luyben W.L; Process Modeling, Simulation And Control For Chemical Engineers; TMH
3. Jana ; Chemical process modeling and computer simulation; PHI Learning

List of Experiments (Please Expand It) Process Modeling & Simulation **CM 804:**
1. Process dynamics experiments like flow of incompressible fluids at a variable flow rate.
2. Dynamics of a tank draining through an orifice in the bottom. Differential equation formulation and verification with the experimental data.
3. Mass balance in a tank filling at certain rate and emptying at another rate. Rectangular and wedge-shaped tank and incompressible fluid.
4. Modeling a batch reactor-verification of 151 and 2nd order rate kinetics.
5. Counter current double pipe heat exchanger modeling-data analysis by iterative methods.
6. Simulation of a distillation column-binary systems, equi-molal overflow, constant relative, volatility.
7. Input-Output response study in non-ideal flow reactors.
8. Simulation of a perfectly mixed reactor with heat transfer. Derivation of a mathematical model and solving for study state heat transfer.

Note: Each student should perform at least six experiments out of the above list.

CM- 805 Major Project

Objectives of the course Minor/Major Project are:

- To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
- To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
- To give students an opportunity to do some thing creative and to assimilate real life work situation in institution.
- To adapt students for latest development and to handle independently new situations.
- To develop good expressions power and presentation abilities in students.

The focus of the Major Project is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any)

Working schedule The faculty and student should work according to following schedule:
Each student undertakes substantial and individual project in an approved area of the subject and supervised by a member of staff.The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty.

Action plan for Major Project work and its evaluation scheme #(Suggestive)

Task/Process	Week	Evaluation	Marks For Term Work#
Orientation of students by HOD/Project Guide	1st	-	-
Literature survey and resource collection	2nd	-	-
Selection and finalization of topic before a committee*	3rd	Seminar-I	10
Detailing and preparation of Project (Modeling, Analysis and Design of Project work	4th to 5th	-	10
Development stage			
Testing, improvements, quality control of project	6th to 10th 11th	-	25
Acceptance testing	12th	-	10
Report Writing	13th to 15th	-	15
Presentation before a committee (including user manual, if any)	16th	- Seminar-II	30

* Committee comprises of HOD, all project supervisions including external guide from industry (if any)

\# The above marking scheme is suggestive, it can be changed to alternative scheme depending on the type of project, but the alternative scheme should be prepared in advance while finalizing the topic of project before a committee and explained to the concerned student as well.

NOTE: At every stage of action plan, students must submit a write up to the concerned guide: