RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Chemical Engineering, VIII-Semester

CM 8001- 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.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Chemical Engineering, VIII-Semester

CM 8002- 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.

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Credit Based Grading System

Chemical Engineering, VIII-Semester

Elective-V CM-8003 (1) Process Piping Design

Unit I

Classification of Pipes and Tube:

IS & BS codes for pipes used in chemical process industries and utilities. Pipes of circular and non-circular cross section-velocity distribution, average velocity and volumetric rate of flow. Flow through curved pipes (Variable cross sections). Pressure drop for flow of Newtonian fluids through pipes. Resistance to flow and pressure drop. Effect of Reynolds and apparent Reynolds number. Recommended design methods.

Unit II

Non-Newtonian Time Independent/Dependent Fluid Flow:

Flow through Process pipes, Shear stress, Shear rates behavior, apparent viscosity and its shear dependence, Power law index, Yield stress in fluids. Recommended design methods.
Time dependant behavior, Mechanical analogues, and velocity pressure relationships for fluid, line.
Recommended design methods.

Unit III

Pipe line Design and Power Losses in vertical Flow:

Flow of gas-liquid, liquid- liquid, gas-solid and liquid-solid mixtures in pipes, flow pattern, holdup, pressure gradients and empirical overall correlations, bubble flow pattern, slug flow pattern, annular mist flow pattern Recommended design methods.

Unit IV

Pipe Line Design and Power Losses in Horizontal Flow:

Flow of gas-liquid, liquid- liquid, gas-solid and liquid-solid mixtures in pipes, flow pattern, holdup, pressure gradients and empirical overall correlations, bubble flow pattern, slug flow pattern, annular mist flow pattern, Lockhart Martinelli relations, Flow pattern regimes. Recommended design methods, Case studies.

Unit V

Introduction to software (Casesuse-II, Caepipe), Case studies in real problem from industries.

Suggested Readings:

1. Govier, G.W. an Aziz K.- THE FLOW OF COMPLEX MISTRUES IN PIPE- Krieger Publication, Florida, 1982.
2. McKetta. John .J ,Piping Design Hand Bood, Marcel Drekker
3. Mohinder L Nayyar, Piping Hand Book, McGraw Hill Book Co.
4. Rip Weaver , Process Piping Design Vol. 1, Gulf Publishing Co.
5. Coulson JM and Richardson J.F. – CHEMICAL ENGINEERING – Vol I, VI Edition, Butterwoth Heinemann, British Library, Publication, Oxford, 1999.

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Credit Based Grading System

Chemical Engineering, VIII-Semester

Elective-V CM-8003 (2) Nano Technology

Unit – I Supramolecular Chemistry:

Definition and examples of the main intermolecular forces and in supramolecular chemistry. Self-assembly process in organic systems. Main supramolecular structures.

Unit- II Physical Chemistry of Nano Materials:

Students will be exposed to the very basics of nanomaterial; A series of nonmaterial that exhibit unique properties will be introduced.

Unit – III Synthesis of Nonmaterial:

Methods of Synthesis of Nonmaterial. Equipment and processes needed to fabricate nano devices and structures such as bio-chips, power devices, and opto-electronic structures. Bottom-up (building from molecular level) and top-down (breakdown of microcrystalline materials) approaches.

Unit IV Biological Nanotechnology:

Biologically- Inspired Nanotechnology, basic biological concepts and principles that may lead to the development of technologies for nano engineering systems. Coverage will be given to how life has evolved sophisticatedly, molecular nano scale engineered devices, and discuss how these nano scale biotechnologies are far more elaborate in their functions than most products made by humans.

Unit – V Nano Instrumentation:

Instrumentation for nano scale Characterization. Instrumentation required for characterization of properties on the nano meter scale. The measurable properties and resolution limits of each technique, with an emphasis on measurements in the nano meter range.

Reference:

1. Supramolecular Chemistry by Jean-Maric Lehn,
2. Supramolecular Chemistry by Jonathan Steel & Jerry Atwood
3. Intermolecular and Surface Forces by Jacob Israelachvili.

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Credit Based Grading System

Chemical Engineering, VIII-Semester

Elective-VI CM-8004 (1) Chemical Process Optimization

Unit- I Formulation and Optimization:

Formulation of the objective function. Unconstrained single variable optimization: Newton, Quasi- Newton methods, polynomial approximation methods.

Unit-II Unconstrained Optimization:

Unconstrained multivariable optimization: Direct search method, conjugate search method, steepest descent method, conjugate gradient method, Newton's method.

Unit-III Linear Programming:

Linear Programming: Formulation of LP problem, graphical solution of LP problem, simplex method, duality in Linear Programming, two-phase method.

Unit-IV Non linear Programming:

Non linear programming with constraints: Necessary and sufficiency conditions for a local extremum, Quadratic programming, successive quadratic programming, Generalized reduced gradient (GRG) method.

Unit-V Applications:

Applications of optimization in Chemical Engineering.

Suggested Readings:

1. Edgar, T.F., Himmelblau, D. M., Lasdon, L. S., "Optimization of Chemical Process", 2nd ed. McGraw- Hill, 2001.
2. Rao, S. S., "Optimisation Techniques", Wiley Eastern, New Delhi, 1985.
3. Gupta, S. K., "Numerical Methods for Engineers", New Age, 1995.
4. Beveridge, G. S. and Schechter, R. S., "Optimization Theory and Practice", McGraw-Hill, New York,1970.
5. Rekllaitis, G.V., Ravindran, A. and Ragsdell, K. M., "Engineering Optimization-Methods and Applications", John Wiley, New York, 1983

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Credit Based Grading System

Chemical Engineering, VIII-Semester

Elective-VI CM-8004 (2) Industrial Pollution Abatement

Unit- I Introduction:
Legislation, standards for water and air. Effects of air pollutants on human health, vegetation and materials.

Unit - II Wastewater Treatment:
Characterization of Industrial wastewater, primary, secondary and tertiary treatment, segregation, screening, equalization, coagulation, flocculation, precipitation, flotation, sedimentation, aerobic treatment, anaerobic treatment, absorption, ion exchange, membrane filtration, electro dialysis, sludge dewatering and disposal methods.

Unit - III Air Pollution Control:
Sources and classification of air pollutants, nature and characteristics of gaseous and particulate pollutants, pollutants from automobiles. Air pollution meteorology, plume and its behavior and atmospheric dispersion,

Unit- IV Control of Particulate and Gaseous Emissions:
Control of particulate emissions by gravity settling chamber, cyclones, wet scrubbers, bag filters and electrostatic precipitators. Control of gaseous emissions by absorption, adsorption, chemical transformation and combustion.

Unit- V Solid Waste Management:
Hazardous and non-hazardous waste, methods of treatment and disposal, land filling, leachate treatment and incineration of solid wastes.

Suggested Readings:

1. Metcalf & Eddy, Inc., “Wastewater Engineering: Treatment and Reuse”, 4th ed., Tata McGrawHill, New Delhi, 2003.
2. Modi, P. N., “Sewage Treatment and Disposal and Waste Water Engineering,” Vol. II, Standard Book House, Delhi , 2001.
3. Peavy, H. S., Rowe, D. R. Tchobanoglous, G. “Environmental Engineering” ; McGraw Hill, 1995.
4. De Nevers, N., “Air Pollution Control Engineering”, 2nd ed., McGraw-Hill, 2000.
5. Bhatia, S.C., “Environmental Pollution and Control in Chemical Process Industries,” Khanna Publishers, Delhi, 2001.
6. Mahajan, S. P., “Pollution Control in Process Industries,” Tata McGraw-Hill, New Delhi, 1998

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Credit Based Grading System

Chemical Engineering, VIII-Semester

CM- 8005 Project II

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: