Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in Chemical Engineering
(Applicable from the academic session 2018-2019)

Semester-VII

Environmental Pollution and Control
CHE-PE701
3L: 0T: 0P
3 credits

Contents:
Introduction (types of pollution, water standards for potable and agricultural streams, air standards); Air pollution - air pollutants and interaction products, preventive and control measures; Water pollution-waste water sampling and analysis, primary, secondary and tertiary treatment methods; Solid waste management- collection, storage and transport, processing and transformation, incineration, composting and sanitary landfilling; Pollution control in chemical process industry.

Total 45L

Books:

1. Elements of Environmental Pollution Control, OP Gupta, Khanna Publishing House

2. Environmental Pollution Control Engineering, C.S. Rao, New Age Publications

Advanced Separation Processes
CHE-PE702
3L: 0T: 0P
3 credits

Contents:
Fundamentals; membrane based separation processes; external field induced membrane separation processes for colloidal particles; gas separation; surfactant based separation processes; centrifugal separation processes ; ion exchange and chromatographic separation processes; supercritical fluid extraction.

Total 45L

Books:

1. Process Design of Equipments, Dawande, S.D., Central Techno, Nagpur

Biotechnology & Biochemical Engineering
CHE-OE703
3L: 0T: 0P
3 credits

There shall be one compulsory objective type question comprising 10 Nos. spread over the entire syllabus and each carrying one mark.
Two questions are to be set from each module out of which five questions are to be answered taking at least one from each module. All questions carry equal marks

Module I: 15L
Basic Biochemistry & Microbiology:Introduction, microbial diversity, viruses, procaryotes, eubacteria, archaebacteria, eucaryotes, cell construction, gram staining technique, general discussion on and structure of amino acids and proteins, carbohydrates and polysaccharides, lipids, fats and steroids, nucleic acids, RNA and DNA, cell nutrients, macro and micro nutrients.
Different culture techniques, preparation of media and observation of characteristics, aseptic technique, obtaining bacterial colonies, counting bacteria .Metabolic regulation, DNA replication, transcription, translation, metabolic pathway control, mechanism to transport across cellular membranes, cell receptors and cellular differentiation.

Module II : 10L

Enzyme Kinetics and Protein Engineering. Example of material balance of bioprocess, Enzymes and substrates, Standard proteins, mechanistic models for simple enzyme kinetics, derivation of Michaelis-Menten equation, Briggs-Haldane assumption, experimental determination of rate parameters: Lineweaver-burk, Eadie-Hofstee and Hanes-Woolf plot, interpretation of Km and Vm,

Model for complex enzyme kinetics: Allosteric enzymes, Principles of enzyme inhibition – Competitive, nonco Effects of pH and temperature, insoluble substrates Immobilized Enzyme systems: Methodology – entrapment, surface Immobilization, diffusional limitations: surface-bound enzymes on nonporous and materials.

Module III : 10L

Bioseparation Technology Separation of insoluble biomolecules and products: filtration, centrifugation, coagulation and flocculation.Cell disruption:Mechanical and non-mechanical methods.Separation of soluble products, precipitation, Salt precipitation: modification of solvent and solute properties, pH change, iso-electric precipitation.
Application of Chemical Engineering principles in Bio-separation, aqueous two-phase extraction, adsorption, dialysis, microfiltration and Ultrafiltration, Reverse osmosis.Chromatographic separation: Classification of chromatographic processes, affinity chromatography: inhibitors: their preparation and uses, method of linkages, elusion chromatography, molecular sieving chromatography, HC and HPLC.Column chromatography: material balance, numerical examples.
Electrophoresis: General principles, SDS-PAGE, experimental methodologies, iso-electric focusing.
Industrial aspects of separation of bio-molecules, Material balances, mathematical analysis and modeling: Case studies.

Module IV: 10L
Biochemical Reaction Engineering

Cell growth kinetics, Substrate limited growth, the logistic equation, rate loss, stoichiometry, mass balances, design equations,numerical problems, wash out, oxygen limited fermentation, scale up concepts of bio-reactors, chemostat and its applications,continuous culture devices, case studies on penicillin production.

Books:

1.Bioprocess Engineering—Basic Concepts, second ed. Schuler & Kargi, PHI, 2002

2.Microbiology-5ed (Paperback) Pelczar, N R K M J Tata Mgraw Hill, 2005

References:

1.Bioprocess Engineering Principles (Paperback) Doran, PM Elsevier India (2009)

2.Chemical Engineering, V2, 5ed. Coulson Richardson, Elsevier

3.Practical Biochemistry: Principles & Techniques, Wilson & Walker, 5ed. Cambridge Univ. press

4.Process Biotechnology Fundamentals 2nd/ed by S N Mukhopadhyay, Viva books, 2005

Operations Research
CHE-OE704
3L: 0T: 0P
3 credits

Module I: 15L
Definition of O.R., Characteristics of O.R., Necessity of O.R. in industry, O.R. and Decision making , Scope of O.R. in management, Objectives of O.R. , Types of mathematical models, Role of computer in O.R., Requirements for linear programming problem (L.P.P.), Examples on the application of L.P.P., Graphical solution of Two Variables L.P.P., Canonical and standard Forms of L.P.P., Development of Simplex Method with examples, The Big-B Method with examples.

Module II 10L

Transformation Model with examples, Assignment Model with examples, Duality in L.P.P. with problems, Sensitivity Analysis with problems.

Module III 10L

Dynamic Programming, its need and problems, Decision Theory with problems, Game Theory with problems.

Module IV 10L

Queuing Models With Problems (Model I, II, III only), PERT &CPM with problems.

Text Books

1. Optimization Theory & Applications- S.S.Rao, Wiley Eastern Ltd.

2. Operations Research- An Introduction-7th edition, -H.A.Taha (EEE) PHI.

3. Operations Research with C Programs- S. Kalavatty- Vikas Publishing House Pvt. Ltd.

4. Operations Research- K.Swarup, P.K.Gupta, &Man Mohan –Sultan Chand & Sons.

Design & Simulation Lab
CHE-PC791
1L:0T: 4P
3 credits

Pre-requisites: Numerical Methods, Material and Energy Balance
Objectives

To introduce students to use of software packages such as ASPEN, MATLAB, FLUENT for simulation, and also analysing flow sheets

Contents :

1. Introduction to Software Packages (3 lectures)
2. Setting up models for simulation (3 lectures)
3. Steady State simulation using ASPEN, Flow sheeting concepts (sequential modular, equation oriented) (3 lectures)
4. Dynamic simulation using MATLAB (3 lectures)
5. CFD simulations using FLUENT, geometry & meshing (3 lectures)
   Total 15 lectures

Practical

Practical Description (examples may be drawn from Fluid Flow, Heat Transfer, Reaction Engineering, Process Control) [No. of turns 3-4 hrs.]

ASPEN based calculations (3 practical turns)

Dynamic simulations using MATLAB (3 practical turns)

CFD computations using FLUENT (3 practical turns)

Make up slots/Exam slots (3 practical turns)

Total 60(P)

Outcomes

Students will be able to

• Solve chemical engineering problems using advanced programming softwares.

• Use simulation softwares like ASPEN and FLUENT.

• Analyse the techno-economic feasibility of chemical manufacturing facility.

Instrumentation & Control Lab
CHE-PC792
1L:0T:4P
3 credits

Pre-requisites : Process Control
Objectives

Objective of the course is to introduce the basics of instrumentation and process control through a hands-on practical experience. Principles of operation of different measuring devices for temperature, level, pressure, flow, pH, humidity, density, and viscosity will be introduced to impart knowledge of transmitters, transducers, converters, control valves, digital and analog components related to PLC, DCS, SCADA systems.

Contents:

1. Basics of control system components, signals and standards (2 contact hrs.)
2. Pressure measuring instruments/sensors (1 contact hr.)
3. Level measurement (1 contact hr)
4. Flow measuring instruments (1 contact hr.)
5. Temperature measuring devices (1 contact hr)
6. Humidity, density, viscosity and pH measuring devices (2 contact hrs.)
7. Pressure controllers: regulators, safety valves (1 contact hr)
8. Flow control actuators: different types of valves (1 contact hr.)
9. Electrical and pneumatic signal conditioning and transmission(1 contact hr)
10. Computer process control, PLC, DCS, SCADA(4 contact hrs.)

Total 15 lectures

Laboratory Modules

Experiment Description [Number of turns (3-4 hours)]

1. Control valves (1 turn)

2. Temperature and pressure measuring devices (2 turns)

3. Level and flow measuring devices (2 turns)

4. Viscosity and pH measuring devices (2 turns)

5. Transmitters and transducers (1 turn)

6. Open loop systems: lagged thermometer, stirred-tank heater (2 turns)

7. Temperature, level, and pressure control trainers (3 turns)

8. Flow-level cascade control (2 turns)

Total 60(P)

Suggested Text Books

1. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, Mc-GrawHill (2005).
2. D.C. Sikdar, Instrumentation Process Control, Khanna Publishing House, (2018).
3. S.K. Singh, Industrial Instrumentation and Control, 3rd edition, McGraw-Hill (2008).
4.

Suggested References Books

1. Seborg, D.E., Edgar, T.F., Mellichamp, D.A. "Process Dynamics and Control", 2nd edition, John Wiley (2003).
2. Stephanopoulos, G. "Chemical Process Control: An Introduction to Theory and Practice", Pearson Education (1984).

Outcomes

Students will be well-familiar with instrumentation and automation as relevant to modern chemical plant operation.

Note: Choice of Core electives for VII semester for UG course in Chemical Engineering has been taken by the BOS members in their subsequent meeting and discussion.