COURSE PLAN

Course Code: CHE502B
Course Title : Advanced Process Dynamics & Control
Semester : 2nd
Branch /Year : M.Tech- Chemical Engineering/1st year
Course Time : August-November
Credits : 4

Objective : This course introduces (1) Process dynamics and various forms of mathematical models to express them, including differential equations, Laplace transfer functions, and frequency response plots, and (2) Analysis and design of advanced control systems(3)Control system design for MIMO system and Design of digital controllers.

Interenal Assesment details:
Minor-1-7.5 marks
Minor-II- 7.5 marks
Assignments: 5 marks
Surprise/Quiz Test: 5 marks

Total Internal marks = 25 marks

Final = 75 marks

Total = 100 marks

Tentative lesson plan:

Lecture No.s	Topics Covered
1-10	Closed-Loop Systems-First and Higher order systems, response to various inputs. Linear Closed-Loop Systems. Controllers and Final Control Elements. Control Valve – Valve Sizing, Valve Characteristics
11-20	Stability and Frequency response-Routh Hurwitz method, Root locus method, Frequency response, design of control system, Bode diagrams, Bode stability criterion, Zigler-Nichols and Cohen-Coon tuning methods, Process Identification
21-30	Advanced Control Systems-Feedback- control of systems with Large Dead Time, Feed-forward and Ratio Control, Adaptive and Inferential Control Systems.
30-40	Multi-loop and Multivariable Control-Control Loop Interactions, Bristol's Relative Gain Array Method, Singular Value Analysis. Sampled data control systems: Sampling Continuous Signals, Basic review of z-Transforms, Discrete-Time response of dynamic system, Design of digital controllers.

TEXT/REFERENCE BOOKS:

1. Process Systems Analysis and Control, D. R. Coughanour-McGrawHill
2. Chemical Process Control, G. Stephanopoulos-PHI
3. Process Dynamics and Control, Seborg D. E., Edgar T. F., Mellichamp D. A.-John Willey and Sons

LECTURE PLAN

Subject Code : CHE504B **Semester: II**

Subject Title : ADVANCED SEPARATION PROCESSES **Credits : 4**

Branch/Year : M.Tech-Chemical Engineering/ 1st year

S. No.	Contents	No. of Lectures
1	Membrane separation-Characterization of membranes	04
2	Transport through porous and non-porous membranes	04
3	Reverse osmosis, electro dialysis, gas permeation; pervaporation, concentration, pressure.	04
4	Electrically and thermally driven membrane processes; membrane reactors; polarization; fouling.	04
5	Modules; energy requirements. Adsorptive separation-Definition.	04
6	Types of adsorption; adsorbent types, their preparation and properties; adsorption isotherms and their importance.	04
7	Equipment types for commercial processes; mathematical modeling with suitable initial and boundary conditions for different cases such as thermal swing, pressure swing and moving bed adsorption.	05
8	Chromatography.	03
9	Other techniques-Reactive distillation; supercritical fluid extraction	04
10	Surfactant based separations; cryogenic separation; ionic separation.	04
	Total Lectures	40

COURSE HANDOUT

Program & Semester: M.Tech. (Chemical Engineering); II
Course Title and Code: Advanced Heat Transfer (CHE-506B)

Lecture Plan:

No of Lectures	Topics
9	UNIT-I: Analysis of convective heat transfer-Convective heat transfer, boundary layer fundamentals, conservation of mass, momentum & energy for laminar & flow over a flat plate, boundary layer equations & similarity parameters, dimensional analysis, integral equations of the laminar boundary layer, analysis between momentum & heat transfer over a flat surface; turbulent flow & turbulent boundary layers analysis, analysis for turbulent flow over a flat surface.
12	UNIT-II: Heat transfer by natural convection-Temperature a velocity distribution in thermal boundary layers, governing equations of mass, momentum & energy for natural convection past vertical plane surface, approximate integral boundary layer analysis for natural convection, working correlations for various shapes, natural convection from finned surface, natural convection in enclosed spaces, mixed free & forced convection.
13	UNIT-III: Forced convection inside tubes & ducts- Analysis of laminar forced convection in long tube, correlations for laminar forced correction, analogy between heat & momentum transfer in turbulent flow, working correlations for turbulent forced convection, forced convection in non-circular sections. Forced convection over exterior surfaces: Flow over bluff bodies, local heat transfer coefficient distribution around cylinders, effect of various parameters on local heat transfer coefficient, heat transfer from tube bundles in cross flow, heat transfer from non-circular sections.
7	UNIT-IV: Heat transfer- heat transfer in fixed bed, heat transfer in fluidized bed, heat transfer in cyclone heat exchanger. Heat transfer by combined conduction, convection & radiation: Thermocouple lead error in surface temperature measurements, heat transfer from radiating fins, flat plate solar collector, the heat pipe.

TEXT / REFERENCE BOOKS:

1. Kays, W M., & Crawford, M E., 'Convective Heat Transfer & Mass Transfer', 3rd Edition; McGraw Hill International Editions, 1993.
2. Kreith, F. & Bohn, M.S., 'Principles of Heat Transfer', 6th Edition; Asian Books Private Limited, 2001.
3. Ghosdastidar, P.S., 'Heat Transfer'; Oxford University Press, 2004..

Evaluation scheme:

- Credits = 4
- Internal marks = 25

Component	*Weightage*
Minor test-I	30%
Minor test-II	30%
Assignment / class performance	20%
Surprise quiz / tutorial tests (2+2)	20%

- External marks = 75
- Total marks = 100

LECTURE PLAN (M.Tech. Chemical Engineering)

Subject Code: CHE554B **Semester: II**

Subject Title: PETROLEUM ENGINEERING (ELECTIVE-I)

S. No.	Contents	No. of Lectures
1	Scope and Purpose of Refining: Global and Indian refining scenario, Petroleum refining industry in India practice and prospects	04
2	An overview of the entire spectrum of the refinery products, refinery configuration development, Physical-chemical characteristics of Petroleum and Petroleum products	04
3	Refinery Feedstock: Nature and effect of different types of refinery feedstock and their impurities on refinery configuration and operation	04
4	Refinery Distillation Processes: Desalting and Stabilization of crude, Process description of typical simple distillation, Fractional distillation, crude oil distillation, vacuum distillation etc	04
5	Degree of separation (5-95 gap) and degree of difficulty of separation (Δt 50), Packie charts, ASTM, TBP and EFV Distillation.Refinery Gas Processing-Process description of typical light ends unit, acid gas removal using gas treating processes.	04
6	Fuel Refining: Cracking, coking, reforming, alkylation, isomerisation polymerization, sweetening, visbreaking.	04
7	Lube Refining- Solvent extraction, de-waxing propane de-asphalting. Wax Refining- De-oiling of crude wax, crystallization, catalytic, sweating microcrystalline and petroleum wax applications	04
8	Hydro processing-Hydro cracking, hydro treating, hydro finishing	04
9	Two Phase Oil and Gas Separation equipment-Types, their description, vessel sizing. Theory of separation and separator design	04
10	Three Phase Oil Gas and Water Separators: Types of separators, their description. Various control and vessel internals, theory and sizing of three phase separator.LACT units	04
	Total Lectures	**40**

COURSE HANDOUT

Program & Semester: M.Tech. (Chemical Engineering); II
Course Title and Code: Renewable Energy Technologies (CHE-562B)

Course Objective: This is an elective subject that gives an insight to the upcoming technology of fuel cells. This course covers the fundamentals involved and reasons for lowered performance than the estimated output from fuel cells.

Lecture Plan:

No of Lectures	Topics
4	UNIT-I: Principles of renewable energy, Energy utilization, Fundamentals, scientific principles, technical implications and social implications. Renewable Energy resources and their potential, New Energy Sources, Energy Conversion technologies.
5	Wind Energy, Wind mill and turbine, Wind Power plant, classification and principles of power generation, wind mill/turbine design, operation and control, site selection, Wind energy applications and new developments.
4	UNIT-II: Solar radiation: Extraterrestrial solar radiation, measurement and estimation of solar radiation. Solar heating devices: Solar water heater: sheltered and unsheltered heaters, systems with separate storage, selective surfaces.
2	Solar ponds, solar concentrators and other devices.
5	Principles of photovoltaic generation of electricity; silicon cell, photon absorption, cell efficiency, solar cell construction, types and usage of photovoltaic systems.
5	UNIT-III: Biomass and Biofuels: Biofuel classification, combustion, pyrolysis, biomass gasification and other thermo-chemical processes, production of alcohol and biogas, biogas plants and types.
5	Trans-esterification of vegetable oils for biodiesel production, characterization of biodiesel, economics, current trends, and future prospects in usage of biodiesel.
4	UNIT-IV: New Energy Sources: Geothermal energy, tidal energy, Wave energy, Ocean thermal energy, Peat, Oil shale, small hydel power, agriculture residues, Draught animals.
6	Hydrogen Energy: Hydrogen energy system and analysis, hydrogen production: Electrolysis, thermo-chemical, Hydrogen from fossil fuel. Hydrogen storage: Carbon storage materials: cryogenic hydrogen storage, hydrogen fuel cells.

TEXT / REFERENCE BOOKS:

1. Dr R K Singhal," Non-conventional energy sources", S K Kataria & Sons, Darya Ganj, New Delhi
2. D S Chauhan, S K Srivastava, "Non-Conventional energy resources", New Age International (P) limited.
3. D Mukherjee, S Chakrabarti, "Fundamentals of Renewable Energy", New Age International (P) limited.

Evaluation scheme:

- Credits = 4
- Internal marks = 25

Component	*Weightage*
Minor test-I	30%
Minor test-II	30%
Assignment / class performance	20%
Surprise quiz / tutorial tests (2+2)	20%

- External marks = 75

COURSE HANDOUT

Program and Semester: M.Tech. (Chemical Engineering); II
Course Title and Code: **PROCESS DYNAMICS AND CONTROL** Lab (CHE512B)
Faculty In-Charge Name and Designation: S K Sharma; Assistant Professor

Lab plan:

Lab	Topics
1.	Pressure control system trainer.
2.	Temperature control system trainer.
3.	Level control system trainer..
4.	Flow control system trainer.
5.	Ratio control system trainer
6.	Analysis of Valve.
7.	Interacting and Non-Interacting System
8.	Multi-process control system Trainer
9.	Cascade Control Systeem
10.	PLC Trainer

TEXT / REFERENCE BOOKS:

1. Process Systems Analysis and Control, D. R. Coughanour-McGrawHill
2. Chemical Process Control, G. Stephanopoulos-PHI
3. Process Dynamics and Control, Seborg D. E., Edgar T. F., Mellichamp D. A.-John Willey and Sons

Note:

The students will be required to perform the 08 experiments/exercises from the above list and any other two experiments designed by the department based on the theory course (CHE 502B: Advanced Process Dynamics And Control).

Evaluation scheme (available in M.Tech. Ordinance):

- Credits = 1.5
- Internal marks = 40

Component	*Weightage*
Viva-Voce/ Test	30%
Laboratory Record/Project Report/Seminar	40%
Objective Tests/Multiple Choice Questions	30%

- External marks = 60
- Total marks = 100

Attendance record:
Attendance report (in case of less than 75%) is sent to the parents of the concerned ward every month.