University School of Chemical Technology
Guru Gobind Singh Indraprastha University

Syllabus of Examination

B.Tech/M.Tech Dual Degree (Chemical Engineering)

(5th Semester)

(w.e.f. August 2004 Batch)

SCHEME AND SYLLABI FOR
B.TECH/M.TECH DUAL DEGREE (CHEMICAL ENGINEERING)

L	T	P	Credits
16	**5**	**6**	**25**

FIFTH SEMESTER SCHEME

Code No.	Paper	L	T	P	Credits
Theory Papers					
14301 CT-301	**Chemical Engineering Thermodynamics II**	**2**	**1**	**0**	**3**
14303 CT-303	**Chem. Reaction Engineering I**	**3**	**1**	**0**	**4**
14305 CT-305	**Heat Transfer II**	**2**	**1**	**0**	**3**
14307 CT-307	**Mass Transfer**	**3**	**1**	**0**	**4**
14309 CT-309	**Process Control-I**	**3**	**1**	**0**	**4**
14311 CT-311	**Chemical Process Industries-I**	**3**	**0**	**0**	**3**
Practical/Viva Voce					
14351 CT-351	**Mass Transfer Lab**	**0**	**0**	**3**	**2**
14353 CT-353	**Heat Transfer Lab**	**0**	**0**	**3**	**2**
Total		**16**	**5**	**6**	**25**

CT-301 Chemical Engineering Thermodynamics II

L	T	P	Credits
2	1	0	3

Solution Thermodynamics: chemical properties, partial properties, ideal gas mixture, fugacity, fugacity coefficient for a pure species and for species in solution and correlation for the fugacity coefficients, excess properties. Liquid phase properties from vapour liquid equilibrium data. Models for the excess Gibb's energy. Change of properties due to mixing, heat effect of mixing process

Phase Equilibria: Phase rule. Vapour-liquid equlibria at low to moderate pressures. High pressure vapour-liquid equilibria. Liquid-liquid equilibria. Osmotic equilibria and Osmotic pressure.

Chemical Reaction Equilibrium: Chemical equilibrium in homogenous and heterogeneous chemical reactions. Combined chemical and phase equilibrium. Balance equation for Tank-type and Tubular reactors.

Thermodynamic Analysis of Processes: Work and energy functions, availability, heat exchange, mixing and separation processes.

Books & References :

1. Introduction to Chemical Engineering Thermodynamics, Smith J.M , Van Ness H.C., Abbott M. M, Mac Graw Hill, Inc., USA, 5th Ed., 1996.
2. Chemical Engineering Thermodynamics, Sandler S.I. John Wiley and Sons, Inc., New York, 3rd Ed., 1999.
3. Chemical Engineering Thermodynamics, Balzheiser R.D, Samuels M.R. and Eliassen J.D., Prentice Hall, Englewood Cliffs, 1972.
4. Introductory Chemical Engineering Thermodynamics, Elliott J. R. and Lira C. T., Prentice Hall, 1999.
5. Applied Thermodynamics for Engineering Technologists, Eastop T. D. and McConkey A., Addison Wesley Longman Ltd., England, 5th Ed., 1999.

CT-303 Chemical Reaction Engineering I

L	T	P	Credits
3	1	0	4

Review of kinetics for homogeneous reactions.

Classification of reactors, design equations for batch, flow and semi batch reactors and their performance. Collection and interpretation of rate data using batch and flow reactors. Residence time distribution concepts and modeling of non-ideal reactors.

Energy balance and design of ideal, single phase flow reactors with heat effects.

Books & Reference:

1. Chemical Reaction Engineering, Levenspiel O., John wiley & Sons (Asia), 3rd Ed., 2000.
2. Chemical Engineering Kinetics, Smith J.M., , McGraw Hill 3rd Ed., 1980.
3. Elements of Chemical Reaction Engineering, Fogler H.S, Prentice Hall of India, 2nd Ed., 1999.

CT-305 Heat Transfer II

L	T	P	Credits
2	1	0	3

Conduction: Two-dimensional steady State Conduction: Analytical & Numerical Methods. Unsteady State unidirectional Heat Conduction.

Boiling and Condensation: Dropwise and film Condensation, Horizontal & vertical Condensers, condensation of a vapour from a non-condensable gas.

Reboiler: Natural Circulation & Forced Circulation reboiler arrangement.

Evaporation: Evaporator types, Single and multiple effect evaporators. Calculation of surface area requirements.

Heat transfer to fluidized and packed beds: Heat transfer to the containg wall, Heat transfer within a packed bed, Determination of effective thermal conductivity of a packed bed of solid particles. Heat transfer between the bulk fluid and external surface of solid particles.

Books & References :

1. Heat Transfer, Chapman A. J., Macmillan, New York, 2nd Ed. 1967
2. Heat Transfer, Holman J. P., McGraw Hill, New York, 8th Ed 1997.
3. Process Heat Transfer, Kern D. Q., Tata McGraw Hill Edition, 1997.
4. Fundamentals of Heat and Mass Transfer, Dewitt et al., John Wiley & Sons, 4th Ed. 1998.
5. Fundamentals of Momentum, Heat and Mass Transfer, Welty J.R., Wilson R.E., and Wicks C.E., John Wiley & Sons, Inc. New York, 4th Ed., 2000.

CT-307 Mass Transfer

L	T	P	Credits
3	1	0	4

Distillation : Fundamentals of vapor liquid equilibrium, Henery's, Raoult's and Dalton's laws, x-y and T-x-y diagrams, partial vaporization/condensation, performance evaluation of distillation column including reboiler and condenser, flash, differential and steam distillation. Number of plate's calculation using McCabe-Thiele and enthalpy-concentration diagram. Relation of HTU to HETP.

Liquid-Liquid Extraction: Extraction process and equipment, equilibrium diagram, choice of solvent, single and multistage co-current, countercurrent extraction.

Solid - Fluid Operations: Adsorption. Nature of adsorbents- silica gel, activated alumina, molecular sieves, activated carbon. Structure of adsorbents – surface area, pore size etc.. Adsorption equilibria. Multi-component adsorption. Isotherms – Langmuir, BET, Gibb's. Potential theory. Design of fixed bed and moving bed adsorbers.

Ion Exchange & Leachinng: Theory and operation.

Books & References :

1. Unit Operations of Chemical Engineering, McCabe W.L., Smith J.C. and Harriott P. McGraw Hill, Singapore, 5th Ed., 1993.
2. Principles of Unit Operations, Foust A.S. John Wiley & Sons, Singapore, 2nd Ed.,1994.
3. Chemical Engineering, Vol. I and II, Coulson J.M. and Richardson J.F. Butterworth Heinemann, Oxford, 6th Ed., 1999.
4. Mass Transfer Operations, Treybal, R. E., McGraw Hill
5. Separation Processes, King C.J., Tata McGraw Hill
6. Transport Processes and Unit Operations, GeanKoplis, C.J. Prentice Hall

CT-309 Chemical Process Control I

L	T	P	Credits
3	1	0	4

Concept of measurement: error, accuracy, sensitivity.

Instrumentation for process variables such as pressure, temperature, level and flow of fluids.

Concept of automatic control, feed back control, control loop and its components.

Dynamic behavior of first order and second order, interacting, non interacting & higher order systems. Distance velocity lag. Transfer function. Response of distributed systems.

Laplace domain analysis of closed loop systems, Routh stability and Root Locus Diagrams.

Frequency response analysis. Bode and Nyquist stability criterion.

Choice of controller and controller settings.

Simple cases of single variable control system design.

Books & References :

1. Process Dynamics & Control, Seborg D. E., T. F. Edger and D. A. Mellichamp, John Wiley & Sons, 1989..
2. Process Systems Analysis and Control, Coughanowr D.R., McGraw Hill, 2nd Ed., 1991.
3. Chemical Process Control-an introduction to theory and practice, Stephanopoulos, G. Prentice Hall of India, 1984.
4. Process Control, Harriott P., McGraw Hill.

CT-311 Chemical Process Industries I

L	T	P	Credits
3	0	0	3

Salient features of manufacture of commodity chemicals.
Status of chemicals and chemical industry in India.
Engineering aspects of the manufacture of basic inorganic chemicals such as sulphuric acid, caustic soda , chlorine, hydrogen, soda ash, ammonia, nitric acid and urea.
Solid, liquid and gaseous fuels. Carbonisation and gasification of coal.

Books & References :

1. Chemical Process Industries, Shreve, R.N. and Brink, J.A.McGraw Hill
2. Chemtech I, II, III, and IV, Indian Institute of Technology, Madras
3. Outlines of Chemical Technology, Dryden, C. Rao, M.G. and Sitting, M., Affiliated East West Press Pvt. Ltd., New Delhi

CT-351 Mass Transfer Laboratory

L	T	P	Credit
0	0	3	2

1. Absorption in a bubble column.
2. Absorption in packed column.
3. Packed column extraction.
4. Spray extraction column.
5. Studies on leaching.
6. Studies on ion-exchange.

CT-353 Heat Transfer Laboratory

L	T	P	Credits
0	0	3	2

1. Heat transfer in agitated vessel.
2. Heat transfer in shell & tube heat exchanger.
3. Heat transfer in double pipe heat exchanger.
4. Heat transfer in plate type heat exchanger.
5. Heat transfer in finned tube heat exchanger.
6. Heat transfer in vertical condenser.
7. Heat transfer in horizontal condenser.
8. Triple effect evaporator.