

**University School of Chemical Technology**  
**Guru Gobind Singh Indraprastha University**

**Syllabus of Examination**

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

**(6<sup>th</sup> Semester)**

**(w.e.f. August 2004 Batch)**

**SCHEME AND SYLLABI FOR**  
**B. TECH. (CHEMICAL ENGINEERING)**

L      T      P      Credits  
17    5      8      27

**SIXTH SEMESTER SCHEME**

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<b>Code No.</b>	<b>Paper</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b><u>Theory Papers</u></b>					
14302 CT-302	Chemical Process Control II	3	1	0	4
14304 CT-304	Chemical Reaction Engg II	3	1	0	4
14306 CT-306	Computational Methods for Chemical Engineers	2	1	0	3
14308 CT-308	Chemical Process Industries II	3	0	0	3
14310 CT-310	Safety, Hazards and Environment	3	0	0	3
39312 MS-312	Organization Behavior and Industrial Management	3	0	0	3
<b><u>Practical/Viva Voce</u></b>					
14352 CT-352	Chemical Reaction Engg. Lab	0	0	3	2
14354 CT-354	Process Control Lab	0	0	3	2
14356 CT-356	Seminar	0	2	0	2
14358 CT-358	Computational Lab	0	0	2	1
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<b>Total</b>		<b>17</b>	<b>5</b>	<b>8</b>	<b>27</b>

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**CT-302                      Chemical Process Control II**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Complex control system:** Multiple loop control systems; Cascade control; Ratio control; Feed forward control

**Multivariable process control:** Design of controllers for interactions, Loop interaction, Decoupling of interacting loops.

**Tuning of feed back controllers** — Quarter Decay Ratio Response, Minimum error Integral Criterion, IAE, ISE, ITAE, ITSE

Design strategies for common industrial processes such distillation, heat exchangers, etc.

**Batch Process:** Introduction to advanced control strategies, use of microprocessors in process control.

**Books & References:**

1. Industrial Instrumentation, Eckman. D.P,Wiley Eastern Ltd.
2. Process Instrumentation and Controls Handbook, Considine,D.N.,McGraw Hill.
3. Process System Analysis and Control, Coughanowr, D.R. and Koppel, L.B.,McGraw Hill.
4. Chemical Process Control- An introduction theory and practice, Stephanopolous, G., Prentice Hall of India.
5. Principals and Practice of Automatic Process Control, Carlos A. Smith and Armando B. Corripio, John Willy & Sons, 2<sup>nd</sup> Ed.

**CT-304                      Chemical Reaction Engineering II**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Introduction to heterogeneous reactions**

Gas-solid catalyzed reactions, rate equations, laboratory reactors, collection and interpretation of rate data.

Diffusion in porous catalysts.

Kinetics of fluid-fluid and fluid solid non catalytic reactions.

Modeling and Design of gas-solid catalytic reactors.

**Books & Reference:**

1. Chemical Reaction Engineering, Levenspiel O., John wiley & Sons (Asia), 3<sup>rd</sup> Ed., 2000.
2. Chemical Engineering Kinetics, Smith J.M., , McGraw Hill 3<sup>rd</sup> Ed., 1980.
3. Elements of Chemical Reaction Engineering, Fogler H.S, Prentice Hall of India, 2<sup>nd</sup> Ed., 1999.
4. Chemical Reactor Analysis and Design, Froment G.F. & Bischoff, John Wiley & Sons, 2<sup>nd</sup> Ed 1990.

**CT-306                      Computational Methods for Chemical Engineers**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

Mathematical formulation of the physical problem. Formulation of the differential equation

Application of law of conservation of Mass;

Application of law of conservation of Momentum;

Application of law of conservation of energy;

Solution of simulation differential equations;

Mathematical formulation of finite difference equation

Finite difference methods in analysis of stage wise processes, numerical solution of partial differential equation: linear parabolic P.D.E, Elliptic equation:

- Crank Nicolson method, tri - diagonal matrix and the Thomas algorithm.
- Relaxation method.

Analytical solution of linear and non linear O.D.E. using Laplace Transform-espically for chemical engineering problems.

**Books & References :**

1. Applied Mathematics in Chemical Engineering, Mickley, H.S., Sherwood, T.K., and Reed, C.E., McGraw Hill, N.Y.
2. Numerical Methods for Engineers, Gupta, S.K., New Age Publishers, 1995.
3. Applied Numerical Methods, Carnahan, B., Luther, H.A and Wilkes, J.O. Wiley N.Y 1969.

**CT-308**

**Chemical Process Industries-II**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

Engineering aspects of the manufacturing of cement, sugar, vegetable oil and pulp & paper.

Engineering aspects of the manufacture with consideration for alternative routes of basic organic chemicals, such as ethylene, propylene and other olefins. Acetylene, butadiene, benzene and alkyl benzenes, vinyl chloride, styrene, phenols, amines, alcohols (methanol), aldehydes (formaldehyde), ketones, carboxylic acid, esters, ethylene oxide, phthalic anhydride, terephthalic acid.

**Books & References:**

1. Chemical Process Industries, Shrive, 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-310                      Safety Hazards and Environment

L	T	P	Credits
3	0	0	3

Types of Ecosystems, Factors responsible for the distribution on Hydrologic cycles, Nutrient cycles (carbon, nitrogen, phosphorous, sulfur).

Introduction to ISO standards (ISO 14001) with reference to chemical industry.

Industrial hygiene and safety aspects related to toxicity, noise, radiation: Identification, Evaluation, Control

Fires and Explosions: Flammability Characteristics of liquids & vapors, minimum oxygen concentration (MOC), Ignition Energy, Ignition sources, Explosions: Detonation & Deflagration, combined explosions, BLEVE, Blast Damage due to overpressure.

Hazard identification: Various Techniques, HAZOP.

Consequence analysis: Flow of liquid/vapors through hole, flashing liquid, Pool evaporation.

Design to prevent fire & explosions: Inerting, controlling static electricity, explosion proof equipments & instruments, ventilation, sprinkler systems.

Hazards / Risk Assessment: Event trees, fault trees, reliability, probability

Emergency planning: Elements of emergency planning, on-site/ off-site emergency plans.

Case studies: Bhopal Tragedy, Flixborough Disaster, Mexico Disaster

### **Books & References:**

1. Chemical Process Safety Fundamentals with Applications: Daniel A Crowl, Joseph F. Lovvar, Prentice Hall Inc, U.S.A
2. Safety in Process Plant Design, Wells, G.L. Godwin, London (1980)
3. Loss Prevention in Process Industries, Lees, F.P. Butterworth, Oxford
4. Environmental Protection, Chanlett, E.T. Mc Graw Hill
5. Strategy of Pollution Control, Berthouex, P.M., and Rudd, D.F. Willey (1977)
6. Safety for Chemical Engineers, A.I.Ch.E. Publications (1976-77).

**CT-352      Chemical Reaction Engineering Lab**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

- (1) Batch Reactor
- (2) Tubular flow reactor
- (3) C S T R
- (4) P F R
- (5) Residence time distribution.
- (6) Flow Analogy for series and parallel reactors.
- (7) Kinetics of non catalytic Gas-Solid reaction.
- (8) Performance of non ideal reactor.
- (9) Kinetics of gas liquid reaction.



**CT-354      Chemical Process Control Lab**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Flow control system.
2. Air pressure control system
3. Temperature control system.
4. Level control system.
5. Dynamics of a first order system.
6. Dynamics of a second order system.
7. Dynamics of distributed parameter system.

**CT-356 Seminar**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>

Student will be required to prepare a critical review of selected topic in Chemical Engineering and allied subjects and submit it in the form of a standard typed report. The student will also be required to make an oral presentation of the review

**CT-358                      Computational Lab.**

<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

Exercises and practice problems on topics covered in the theory course CT-309, Computational Methods for Chemical Engineers. Students will be required to write computer program as well as gain experience in the use of commercially available software such as MATLAB.