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

*Syllabus of Examination*

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

## (4th Semester)

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

**w.e.f. 2004**

## SCHEME OF EXAMINATION
## B.TECH/M.TECH DUAL DEGREE (CHEMICAL ENGINEERING)

| L | T | P | Credits |
|---|---|---|---|
| **16** | **6** | **10** | **28** |

## FOURTH SEMESTER EXAMINATION

| Code No. | Paper | L | T | P | Credits |
|---|---|---|---|---|---|
| **Theory Papers** | | | | | |
| **99212 BA-212** | **Applied Mathematics- IV** | **3** | **1** | **0** | **4** |
| **99214 BA-214** | **Material Science** | **3** | **1** | **0** | **4** |
| **99216 BA-216** | **Physico Organic Chemistry** | **3** | **1** | **0** | **4** |
| **14202 CT-202** | **Chem. Engg. Thermodynamics- I** | **2** | **1** | **0** | **3** |
| **14204 CT-204** | **Unit Operations-II** | **3** | **1** | **0** | **4** |
| **14206 CT-206** | **Heat Transfer-I** | **2** | **1** | **0** | **3** |
| **Practical/Viva Voce** | | | | | |
| **99262 BA-262** | **Chemistry Lab** | **0** | **0** | **4** | **2** |
| **14252 CT-252** | **Fluid Mechanics Lab** | **0** | **0** | **3** | **2** |
| **14254 CT-254** | **Unit Operations Lab-II** | **0** | **0** | **3** | **2** |
| **Total** | | **16** | **6** | **10** | **28** |

## CT-202 Chemical Engineering Thermodynamics I

| L | T | P | Credits |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**The first law and other basic concepts**: dimensions, units, work, heat, energy, the first law of thermodynamics, enthalpy, equilibrium, phase rule, heat capacity, PVT behavior of pure substances, ideal gas, real gas, heat effects.

**The second law and Entropy**: statements, heat engines, Kelvin-Planck and Clausious statements and their equality, reversible and irreversible processes, Carnot cycle, thermodynamic temperature scale, entropy, entropy calculations, T-S diagrams, properties of pure substances, use of steam tables and Mollier diagram.

**Refrigeration and liquefaction**: the Carnot refrigerator, the vapor–compression cycle, comparison of refrigeration cycles, liquefaction processes, heat pump. Rankine power cycle.

**Thermodynamic properties of fluids**: property relations for homogenous phases, thermodynamic diagram, generalized property correlation for gases.

**Thermodynamics of flow processes**: flow of compressible fluids through ducts, compression processes, turbines.

**Books & References** :

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

**CT-204 Unit Operations-II**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**Fundamentals of Mass Transfer**: Molecular diffusion, mass transfer coefficient and interface mass transfer, steady state theories of mass transfer, analogy.

**Absorption**: Solubility, Choice of solvent, Co-current and counter current multistage operation, Absorption equipment design and performance evaluation. Concept of ideal stage, stage efficiency, operating line. Concepts of HTU and NTU.

**Humidification/Dehumidification and Cooling Tower**: Use of Psychrometric chart - temperature/humidity, enthalpy/humidity chart. Method of changing humidity. Estimation of air quality. Design of cooling towers. Mass and heat balances in bulk and at interface - counter current, co-current and cross current.

**Drying**: Wet bulb, dry bulb and adiabatic saturation temperatures, humidity, drying mechanism, drying rate curves, estimation of drying time and process design of dryers e.g. spray, rotary, tunnel, tray, fluid bed and thin film, performance evaluation of dryers

**Books & References** :

1. Unit Operations of Chemical Engineering, McCabe W.L., Smith J.C. and Harriott P. McGraw Hill International edition, Singapore, 5th Ed., 1993.
2. Principles of Unit Operations, Foust A.S. John Wiley & Sons, Singapore, 2nd Ed.,1994.
3. Introduction to Chemical Engineering, Badger W.L. and Banchero J.T., Tata McGraw Hill Edition, 1997.
4. Chemical Engineering, Vol. I, Coulson J.M. and Richardson J.F. Butterworth Heinemann, Oxford, 6th Ed., 1999.

**CT-206 Heat Transfer I**

| L | T | P | Credits |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Steady State Conduction:** Fourier law, Concepts of resistance to heat transfer, Heat transfer coefficient, Insulation, Critical radius, Extended surfaces of uniform thickness, Fin effectiveness and efficiency.

**Radiation**: Stefan Boltzman law, Kirchoff's law and applications.

**Convection**: Convection boundary layer. Heat transfer in laminar & turbulent flow in circular pipe, Boundary layer analogy, Mechanism of heat flow by natural convection.

**Heat Transfer Equipment**: Heat exchangers, Unsteady state heat transfer in agitated vessels, Heat transfer fluids, Process Design and Performance Evaluation of Double Pipe and Shell and Tube Heat Exchanger.

**Books & References** :

1. Heat Transfer, Chapman A. J., Mac millan , 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 Mc Graw Hill Edition, 1997.
4. Fundamentals of Heat and Mass Transfer, Dewitt et al., John Willey & 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-212 Chemical Engineering – II (*for BT Students only*)**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

Steady state conduction : Fourier's law concept of resistance to heat transfer, critical insulation thickness, conduction with heat generation.
Convection : film theory and concept of heat transfer coefficient. Heat transfer by forced convection and natural connection in Laminar and turbulent flows by dimensional analysis.

Heat Exchanger : Sizing of shell & tube heat exchangers.
Boiling & Condensation heat transfer to boiling liquids and from condensing vapours.

Fundamentals of mass transfer : molecular diffusion in fluids, concept of mass transfer coefficient. Equilibrium stage, multistage and continuous contractors with applications to gas absorption, calculation of NTU, HTU and number of stages.

Mixing : types of agitators, flow patterns and power consumption

**Course Objectives:**

- To familiarize with unit operations utilized in down stream processes of bio-technology.
- To introduce basic principles of heat transport.
- To expose the students to heat transfer operations.
- To introduce basic principles of man transport.

**Books & Reference:**

1. Heat Transfer, Holman J.P. McGraw Hill, New York, 8th Ed 1997
2. Unit Operations of Chemical Engineering, McCabe W.L. Smith J.C. and Harriott P. Mac graw Hill International edition, Singapore, 5th Ed., 1993
3. Chemical Engineering Vol.1 and II, Coulson J.M. and Richardson J.F. Butterworth Heinemann, Oxford, 6th Ed., 1999.
4. Transport Processes and Unit Operations, Geankoplis C.J., Prentice Hall of India, 3rd, 1999
5. Mass Transfer Operations, Treybal, R.E, Mc Graw Hill

**CT-252 Fluid Mechanics Laboratory**

| L | T | P | Credit |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

1. Calibration of orifice meter.
2. Performance of venturi meter.
3. Pump characteristics
4. Power consumption in agitated vessel.
5. Pressure drop in pipe.
6. Bernoulli's experiment.
7. Verification of Stokes' Law
8. Flow through packed bed.
9. Flow through fluidized bed.

**CT-254 Unit Operation Lab-II**

| L | T | P | Credit |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

1. Fractional distillation
2. Studies on drying characteristics
3. Experiments on humidification and dehumidification in a packed column.
4. Studies on batch distillation.
5. Determination of diffusion co-efficient of carbon tetrachloride in air.
6. Determination of diffusion co-efficient of naphthalene in air.