

Fifth Semester
Chemical Engineering

Branch: Chemical Year: Third Semester: Fifth

Sl. No.	Course No.	Subject	Periods			Evaluation Scheme					
			L	T	P	Sessional Exam			ESE	Subject Total	Credit
						TA	CT	Total			
Theory											
1	HU 501	Econ & Prinpl of Mngmnt	3	1		30	20	50	100	150	4
2	CH 582	Chemical Reaction Engineering-I	3	1		30	20	50	100	150	4
3	CH 583	Mechanical Operations	3	1		30	20	50	100	150	4
4	CH 584	Chemical Engineering Thermodynamics	3	1		30	20	50	100	150	4
5	CH 585	Process Utilities	3	1		30	20	50	100	150	4
6	CH 586	Process instrumentation	3	1		30	20	50	100	150	4
Practicals											
7	CH 582L	Chemical Reaction Engg Lab			3	30	20	50		50	2
8	CH 583L	Mechanical Operations Lab			3	30	20	50		50	2
9	CH 584L	Chemical Engineering Thermodynamics Lab			3	30	20	50		50	2
10	CH 586L	Process instrumentation Lab			3	30	20	50		50	2
11	CH 587	General Proficiency							50	50	2
Total			18	6	12						

Total Marks: 1150

Total Periods: 36

Total Credits: 34

TA: teachers assessment

CT: Class Test

ESE: End Sem Exam

HU 501 Economics and Principles of Management. (3-1-0)
PART A: Economics Theory 50; Sessional : 25

1. Economics: Meaning, nature and scope
2. Consumer behavior and demand analysis: Alternate theories on consumer behavior; Derivation of the demand function. Demand and revenue analysis. Demand forecasting.
3. Producer behavior. Production function. Production analysis and input demand. Cost Analysis. Estimation of cost functions. Managerial uses of cost functions.
4. Price and output determination; Price concepts; pricing under different objectives; Profit and break even analysis. Differential pricing; Alternative market models; Market structure and Government intervention.
5. Investment analysis: time value of money. Cash flows and measures of investment worth; Investment analysis.
6. Money. Why money matters. Value of money- Quantity theory of Money; Index numbers. Interest rate determination.
7. The financial system- The Central Bank, Stock Exchange and the market for securities, Money market instruments.
8. International trade- Theories of international trade. The World Trading Environment Multilateralism and Bilateralism.
9. Emerging Economic and business environment.

References:

- i. Samuelson and Nordlhaus: Economics. Irwin McGraw Hill
- ii. Gupta, G.S, Managerial Economics.
- iii. H. Davis Managerial Economics.
- iv. Sengupta A.K. and Agarwal M.K. Money Market Operations in India; Skylark Publications, New Delhi.

Part B. Principles of Management. Theory: 50. Sessional: 25.

1. Management —concepts, status and functions. Role of management. Management skills. Effective versus successful managerial activities. Motivation - Early and contemporary theories on motivation- implication for managers and applications.
2. Group behaviour and Group dynamics: Foundations of group behaviour. Defining and classifying groups; stages of Group development; group interaction; External conditions; Group member resources; Group structure; Group processes; tasks and decision making.
3. Leadership- Leadership theories. Recent approach to leadership and contemporary issues in leadership.
4. Organisational Dynamics- Organisational change and stress management. Human factors in industry- fatigue and symptoms. Fatigue control.
5. Human Resource policies and Practices- Selection practices, Training and Development programmes; Performance Evaluation; Union — Management interface; Managing diversity in organisations.
6. Investment analysis: Time value of money. Cash flows and measures of investment worth; Investment analysis.
7. Projects and Project evaluation. Economic and financial evaluation of projects. Economic and social cost benefit analysis.

Recommended Books.:

1. Essentials of management- J.L. Marcis.
2. Organisational Behaviour. Concepts, Controversies and Applications - Stephen P. Robbins.
3. Gupta, G.S, Managerial Economics

CH 582 CHEMICAL REACTION ENGINEERING-I

L-P-T

3-2-1

Theory : 100 marks

Sessional : 50 marks

Practicals: 50 marks

Time : 3 hrs

1. Rate of reactions, differential & integral rate laws, order and molecularity of reactions, Activation energy.

2. Interpretation of batch reactor data :

Integral and differential methods of analysis of data for constant volume variable volume cases, zero order, first order, second order auto catalytic reactions, reversible and irreversible reactions, half-life period, series and parallel reactions.

3. Introduction to reactor design :

Mass and energy balance around a volume element, single ideal reactors under steady state conditions, development of design expression for batch, tubular and stirred-tank Reactor.

4. Reactor design or single reactions (with reference to 1st. and 2nd. order reactions), comparison of single reactions, general graphical representation.

Multi reactor systems – plug flow reactors in series, mixed flow reactors in series, combination reactors, recycle reactors and autocatalytic reactors.

Practicals (Sessional) :

1. Differential and integral method of analysis of Reaction, etherification of Butanol with acetic acid.

2. Determination of rate constant for saponification of ethyl acetate with NaOH in batch reactor.

Books

1. Chemical Reaction Engineering by Levenspiel, Wiley Eastern.

2. Elements of Chemical Reaction engineering, Fogler, 3rd Ed., Prentice hall

3. Chemical Engineering Kinetics by D.M. Smith, McGraw Hill Publication.

4. Reaction Kinetics for Chemical Engineers by Wales, McGraw Hill Publication.

CH584 Chemical Engineering Thermodynamics

L – T -P

3- 1- 2

Time : 3 hrs

Theory :100 Marks

Sessional : 50 Marks

Practicals: 50 Marks

Introduction :- Conservation of energy and first law of thermodynamics, application to steady state flow process, enthalpy, internal energy, equilibrium state, Phase rule, reversible vs irreversible process, heat capacity and specific heat.

Heat Effects: - Heat capacities of gases as a function of temperature, heat capacities of solids and liquids, concept of $C_{p,m}$, heat effects accompanying phase changes of pure substances, standard heats of reactions, formation, combustion, effects of temperature on the standard heat of reaction, heat effects of Industrial reactions.

Second law of thermodynamics:- Second law of thermodynamics, thermodynamic temperature scale, ideal gas temperature scale, concept of entropy, entropy change and irreversibility, single and multistage compressor: various types and applications.

Thermodynamics Properties of fluids:-Relationships among thermodynamics properties – work function and free energy, thermodynamics properties of single phase and two-phase systems, effects of temperature and pressure on various properties and their evaluation, types of thermodynamics diagrams, generalized correlations of thermodynamic properties of ideal gas mixtures.

Phase_Equilibria :-Criteria of equilibrium, the Fugacity, Duhem's theorem, vapor – liquid equilibrium idealization, phase diagram for miscible systems, immiscible systems, partially miscible systems, testing of vapor –liquid equilibrium data, Gibbs –Duhem equation

Chemical_Equilibria :-Criteria of chemical equilibrium, equilibrium conversion X_e equilibrium constant, effect of temperature and pressure on K. evaluation of K by conditions, construction of equilibrium conversion charts. Calculation of X_e for exothermic, endothermic, reversible, irreversible reactions.

BOOKS:

1. Smith , J.M. and Van Ness, H.C. , Introduction to Chemical Engg. Thermodynamics, McGraw-Hill
2. K V Narayanan, a Text book of Chemical Engg Thermodynamics, Prentice Hall India.
3. Dodge, Chemical Engg. Thermodynamics, McGraw-Hill.
4. Wilson and Ric, Principles of Chemical Engg. Thermodynamics, McGraw-Hill.

Practicals:

1. Experiment on chemical Equation
2. Experiments on 1st and 2nd law of thermodynamics
3. Determination of heat of reaction.

CH 583: MECHANICAL OPERATIONS

L – T – P

3 – 1 – 2

Time :3 hrs.

Theory : 100 marks

Sessional : 50 marks

Practicals: 50 Marks

1. **PARTICULATE SOLIDS** : Particle characterization – particle size distribution and mean particle size; Particulate solid in bulk-agglomeration, angle of repose and friction, flow of solids in hoppers, flow of solids through orifices, conveying of solids, measurement of solid flow rate; Classification of solid particles – gravity settling, centrifugal separators, sieves, magnetic separators, electrostatic separators, floatation.

2. **SIZE REDUCTION OF SOLIDS**: Mechanism of size reduction, Energy for size reduction – energy utilization, Methods of operating crushers, Nature of materials to be crushed, Types of crushing equipments-Coarse crushers, Intermediate crushers, Fine crushers, Vibration mills, Colloid mills, Fluid energy mills.

3. **MOTION OF PARTICLES IN A FLUID**: The drag force on a spherical particle – total force on the particle – effect of motion of the fluid – terminal falling velocities, Non-spherical particles – effect of shape & orientation on drag – terminal falling velocities, Motions of bubble and drops, Acceleration motion of a particle in the gravitational field, Motion of particles in a centrifugal field.

4. **SEDIMENTATION**: Gravitational sedimentation – Fine suspensions – Coarse suspensions – Solids flux in batch sedimentation – The Kynch theory of sedimentation – thickener, Centrifugal separation – behavior of liquids in centrifuge basket – fluid pressure – sedimentation in a centrifugal field – separation of two immiscible liquids – centrifugal equipment.

5. **FLUIDISATION**: Characteristics of fluidized systems – properties of gas – solids and liquid – solids systems – effect of fluid velocity on pressure gradient – minimum fluidizing velocity, Liquid-solid system-bed expansion-liquid and solid mixing, Gas-solid systems-bed characteristics-properties of bubbles in the bed-gas and solid mixing, Mass and heat transfer between fluid and particles, Application of the fluidized solids techniques-fluidized bed catalytic cracking-application in chemical industries-fluidised bed combustion.

6. **PNEUMATIC AND HYDRAULIC CONVEYING**: Pneumatic conveying-vertical and horizontal, Hydraulic conveying-homogenous flow-horizontal transport of settling suspensions-vertical transport-industrial applications.

7. **GAS CLEANING**:.Gravity separators, centrifugal separators, inertia or momentum separators, fabric filters, electrostatic precipitators, liquid washing, Agglomeration and coalescence.

8. **FILTRATION**:The theory of filtration – relation between thickness of cake and volume of filtrate-flow of liquid through the cloth-flow of filtrate through the cloth and cake combined, compressible filter cakes, Filtration practice-The filter medium-blocking filtration, effect of particle sedimentation on filtration-delayed cake filtration-preliminary treatment of slurries before filtration-washing of filter cake,Filtration equipment,Filtration in a centrifuge, Filtration calculations.

9. **MIXING AND AGITATION**: Agitation of liquids – Purpose of agitation-agitation equipment-Impellers-Flow patterns in agitation vessels-circulation rate- velocity gradients in agitated vessels-power correlations for specific impellers-effect of system geometry-calculation of power consumption.

Practicals:

1. Study of crushers and grinders
2. Verification of Rittinger's law
3. Experiment on batch sedimentation
4. Differential and cumulative screen analysis
5. Determination of screen effectiveness.
6. Experiment on plate and frame filter Press
7. Determination of minimum fluidization velocity

BOOKS :

1. Introduction to Chemical Engineering by Badger & Banchemo.
2. Unit Operation in Chem. Engg. By McCabe & Smith.
3. Chemical Engineering Vol I & II by Coulson & Richardson.
4. G G Brown: Unit Operations, CBS Publishers and Distributors

CH 586 PROCESS_ INSTRUMENTAION

L – T -P
3- 1- 2

Time : 3 hrs
Theory :100 Marks
Sessional : 50 Mark
Practicals: 50 Marks

1. Fundamental : Elements of instruments, static characteristics, Dynamic characteristics, Application of Laplace transform in instrumentation . Response of 1st order and 2nd order instruments.
2. Temperature measuring instruments:-Like bimetallic , Vapour pressure , thermocouples, automatic potential recorders, resistance thermometers, radiation pyrometers, optical pyrometers, photoelectric pyrometers, thermistors, response of these instruments.
3. Composition measuring instruments:-Spectroscopic methods , thermal conductivity cells, co-analysis, Fuel gas analysis , humidity measurement, moisture in paper, pH meter, oxygen analysis , polarography, colorimetry, combustible gas analysis.
4. Measurement of pressure and vacuum :-Manometers, pressure Spring , McLeod gauge, Pirani Gauge, Ionization gauge, Thermocouple gauge, Liquid seals, responses of these instruments.
5. Viscosity & Sp. Gravity measurement:-Level measuring devices . Flow measuring devices , measurement of displacement, measurement of density.

Practicals:

1. Determination of time constant of a first order system
2. Calibration of flow measuring devices.
3. Composition analysis using spectrophotometer.
4. Study of conductivity meter and pH meter.
5. Experiment on humidity measurement.

BOOKS :

1. Donld P. Eckman – Industrial Instrumentaion.
2. A. Suryanarayana, Instrumentation & Process Control , Khanna Publishers, New Delhi.
3. R. K. Jain , Mechanical and Industrial Measurements, Khanna Publishers, New Delhi.

CH 585 PROCESS UTILITIES

L – T -P

3- 1- 0

Time : 3 hrs

Theory :100 Marks

Sessional : 50 Mark

1. Importance of process utilities in chemical industries and plants. Introduction to the use of various utilities.
2. Water as a utility in process industries, conservation and recycle of water, cooling tower, spray pond.
3. Compressed air systems. Vacuum systems, boosters, air receivers, piping network, air leaks, and lubrication and oil removal.
4. Refrigeration systems and their characteristics, use of cryogenic temperatures.
5. Air condition and ventilation systems and their characteristics, air water systems, introduction to humidification and dehumidification equipments, air blending and exhaust.
6. Generation distribution and utilization of steam, steam economy and handling steam engines, boiler and performance characteristics.
7. Internal combustion engine cycles – otto, Diesel, sual , Rankine cycles and their characteristics and performances.
8. Fire and safety in chemical industry :
 - (a) Chemical hazards, classification and threshold limits
 - (b) Chemical as a cause of poisoning and occupational disease.
 - © Engineering control of chemical plant hazards , ventilation and lighting , maintenance of pressure vessels, storage , handling and transportation of chemicals , electrical systems, instrumentation , fire prevention , personnel protection devices , maintenance procedure , laboratory safety, effluent disposal and checking of spillage.
 - (d) Properties of important flammable liquids and gases and their classification , threshold limits and maximum permissible concentration of these chemicals. Concept of spontaneous combustion with remedial measures.
 - e) Rules and Acts governing explosive and flammable materials . Colour codes for safety color codes for pipe lines and gas cylinders. An exposure to Indian standards.

BOOKS :

1. Heat Engines – Pandya and Shaha
2. Heat Engines – Patel and Karamchandani (Vol II, III)
3. Air conditioning & Refrigeration – Stephen & Elonka
4. Efficient use of Steam – HMSO, London.

Branch: Chemical Year: Third Semester: Fifth

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						TA	CT	Total			
Theory											
1	HU 501	Econ & Prinpl of Mngmnt	3	1		30	20	50	100	150	4
2	CH 582	Chemical Reaction Engineering-I	3	1		30	20	50	100	150	4
3	CH 583	Mechanical Operations	3	1		30	20	50	100	150	4
4	CH 584	Chemical Engineering Thermodynamics	3	1		30	20	50	100	150	4
5	CH 585	Process Utilities	3	1		30	20	50	100	150	4
6	CH 586	Process instrumentation	3	1		30	20	50	100	150	4
Practicals											
7	CH 582L	Chemical Reaction Engg Lab			3	30	20	50		50	2
8	CH 583L	Mechanical Operations Lab			3	30	20	50		50	2
9	CH 584L	Chemical Engineering Thermodynamics Lab			3	30	20	50		50	2
10	CH 586L	Process instrumentation Lab			3	30	20	50		50	2
11	CH 587	General Proficiency							50	50	2
Total			18	6	12						

Total Marks: 1150

Total Periods: 36

Total Credits: 34

TA: teachers assessment

CT: Class Test

ESE: End Sem Exam

COMMON TO ALL BRANCHES:

HU 501 Economics and Principles of Management. (3-1-0)

PART A: Economics Theory 50; Sessional : 25

- 1.Economics: Meaning, nature and scope
- 2.Consumer behavior and demand analysis: Alternate theories on consumer behavior; Derivation of the demand function. Demand and revenue analysis. Demand forecasting.
- 3.Producer behavior. Production function. Production analysis and input demand. Cost Analysis. Estimation of cost functions. Managerial uses of cost functions.
4. Price and output determination; Price concepts; pricing under different objectives; Profit and break even analysis. Differential pricing; Alternative market models; Market structure and Government intervention.
5. Investment analysis: time value of money. Cash flows and measures of investment worth; Investment analysis.
6. Money. Why money matters. Value of money- Quantity theory of Money; Index numbers. Interest rate determination.
- 7.The financial system- The Central Bank, Stock Exchange and the market for securities, Money market instruments.
8. International trade- Theories of international trade. The World Trading Environment Multilateralism and Bilateralism.
9. Emerging Economic and business environment.

References:

- i.samuelson and Nordlhaus: Economics. Irwin McGraw Hill
- ii.Gupta, G.S, Managerial Economics.

iii.H.Davis Managerial Economics.

iv.Sengupta A.K. and Agarwal M.K. Money Market Operations in India; Skylark Publications, New Delhi.

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- 1.Management —concepts, status and functions. Role of management. Management skills. Effective versus successful managerial activities. Motivation - Early and contemporary theories on motivation- implication for managers and applications.
- 2.Group behaviour and Group dynamics: Foundations of group behaviour. Defining and classifying groups; stages of Group development; group interaction; External conditions; Group member resources; Group structure; Group processes; tasks and decision making.
- 3.Leadership- Leadership theories. Recent approach to leadership and contemporary issues in leadership.
- 4.Organisational Dynamics- Organisational change and stress management. Human factors in industry- fatigue and symptoms. Fatigue control.
- 5.Human Resource policies and Practices- Selection practices, Training and Development programmes; Performance Evaluation; Union — Management interface; Managing diversity in organisations.
- 6.Investment analysis: Time value of money. Cash flows and measures of investment worth; Investment analysis.
- 7.Projects and Project evaluation. Economic and financial evaluation of projects. Economic and social cost benefit analysis.

Recommended Books.:

- 1.Essentials of management- J.L. Marcis.
- 2.Organisational Behaviour. Concepts, Controversies and Applications - Stephen P. Robbins.
- 3.Gupta, G.S, Managerial Economics

CHEMICAL ENGINEERING:

CH 582 CHEMICAL REACTION ENGINEERING-I

L-P-T

3-2-1

Theory : 100 marks

Sessional : 50 marks

Practicals: 50 marks

Time : 3 hrs

1. Rate of reactions, differential & integral rate laws, order and molecularity of reactions, Activation energy.
2. Interpretation of batch reactor data :

Integral and differential methods of analysis of data for constant volume variable volume cases, zero order, first order, second order auto catalytic reactions, reversible and irreversible reactions, half-life period, series and parallel reactions.

3. Introduction to reactor design :

Mass and energy balance around a volume element, single ideal reactors under steady state conditions, development of design expression for batch, tubular and stirred-tank Reactor.

4. Reactor design for single reactions (with reference to 1st. and 2nd. order reactions), comparison of single reactions, general graphical representation.

Multi reactor systems – plug flow reactors in series, mixed flow reactors in series, combination reactors, recycle reactors and autocatalytic reactors.

Practicals (Sessional) :

1. Differential and integral method of analysis of Reaction, etherification of Butanol with acetic acid.
2. Determination of rate constant for saponification of ethyl acetate with NaOH in batch reactor.

Books

1. Chemical Reaction Engineering by Levenspiel, Wiley Eastern.
2. Elements of Chemical Reaction engineering, Fogler, 3rd Ed., Prentice hall
3. Chemical Engineering Kinetics by D.M. Smith, McGraw Hill Publication.
4. Reaction Kinetics for Chemical Engineers by Wales, McGraw Hill Publication.

CH 583: **MECHANICAL OPERATIONS**

L – T – P

3 – 1 – 2

Time :3 hrs.

Theory : 100 marks

Sessional : 50 marks

Practicals: 50 Marks

1. **PARTICULATE SOLIDS** : Particle characterization – particle size distribution and mean particle size; Particulate solid in bulk-agglomeration, angle of repose and friction, flow of solids in hoppers, flow of solids through orifices, conveying of solids, measurement of solid flow rate; Classification of solid particles – gravity settling, centrifugal separators, sieves, magnetic separators, electrostatic separators, floatation.

2. **SIZE REDUCTION OF SOLIDS**: Mechanism of size reduction, Energy for size reduction – energy utilization, Methods of operating crushers, Nature of materials to be crushed, Types of crushing equipments-Coarse crushers, Intermediate crushers, Fine crushers, Vibration mills, Colloid mills, Fluid energy mills.

3. **MOTION OF PARTICLES IN A FLUID**: The drag force on a spherical particle – total force on the particle – effect of motion of the fluid – terminal falling velocities, Non-spherical particles – effect of shape & orientation on drag – terminal falling velocities, Motions of bubble and drops, Acceleration motion of a particle in the gravitational field, Motion of particles in a centrifugal field.

4. **SEDIMENTATION**: Gravitational sedimentation – Fine suspensions – Coarse suspensions – Solids flux in batch sedimentation – The Kynch theory of sedimentation – thickner, Centrifugal separation

– behavior of liquids in centrifuge basket – fluid pressure – sedimentation in a centrifugal field – separation of two immiscible liquids – centrifugal equipment.

5. **FLUIDISATION:** Characteristics of fluidized systems – properties of gas – solids and liquid – solids systems – effect of fluid velocity on pressure gradient – minimum fluidizing velocity, Liquid-solid system-bed expansion-liquid and solid mixing, Gas-solid systems-bed characteristics-properties of bubbles in the bed-gas and solid mixing, Mass and heat transfer between fluid and particles, Application of the fluidized solids techniques-fluidized bed catalytic cracking-application in chemical industries-fluidised bed combustion.

6. **PNEUMATIC AND HYDRAULIC CONVEYING:** Pneumatic conveying-vertical and horizontal, Hydraulic conveying-homogenous flow-horizontal transport of settling suspensions-vertical transport-industrial applications.

7. **GAS CLEANING:** Gravity separators, centrifugal separators, inertia or momentum separators, fabric filters, electrostatic precipitators, liquid washing, Agglomeration and coalescence.

8. **FILTRATION:** The theory of filtration – relation between thickness of cake and volume of filtrate-flow of liquid through the cloth-flow of filtrate through the cloth and cake combined, compressible filter cakes, Filtration practice-The filter medium-blocking filtration, effect of particle sedimentation on filtration-delayed cake filtration-preliminary treatment of slurries before filtration-washing of filter cake, Filtration equipment, Filtration in a centrifuge, Filtration calculations.

9. **MIXING AND AGITATION:** Agitation of liquids – Purpose of agitation-agitation equipment-Impellers-Flow patterns in agitation vessels-circulation rate- velocity gradients in agitated vessels-power correlations for specific impellers-effect of system geometry-calculation of power consumption.

Practicals:

8. Study of crushers and grinders
9. Verification of Rittinger's law
10. Experiment on batch sedimentation
11. Differential and cumulative screen analysis
12. Determination of screen effectiveness.
13. Experiment on plate and frame filter Press
14. Determination of minimum fluidization velocity

BOOKS :

5. Introduction to Chemical Engineering by Badger & Banchero.
6. Unit Operation in Chem. Engg. By McCabe & Smith.
7. Chemical Engineering Vol I & II by Coulson & Richardson.
8. G G Brown: Unit Operations, CBS Publishers and Distributors

CH584 Chemical Engineering Thermodynamics

L – T -P

4- 1- 2

Time : 3 hrs

Theory :100 Marks

Sessional : 50 Marks

Practicals: 50 Marks

Introduction :- Conservation of energy and first law of thermodynamics, application to steady state flow process, enthalpy, internal energy, equilibrium state, Phase rule, reversible vs irreversible process, heat capacity and specific heat.

Heat Effects: - Heat capacities of gases as a function of temperature, heat capacities of solids and liquids, concept of $C_{p,m}$, heat effects accompanying phase changes of pure substances, standard heats of reactions, formation, combustion, effects of temperature on the standard heat of reaction, heat effects of Industrial reactions.

Second law of thermodynamics:- Second law of thermodynamics, thermodynamic temperature scale, ideal gas temperature scale, concept of entropy, entropy change and irreversibility, single and multistage compressor: various types and applications.

Thermodynamics Properties of fluids:- Relationships among thermodynamics properties – work function and free energy, thermodynamics properties of single phase and two-

phase systems, effects of temperature and pressure on various properties and their evaluation, types of thermodynamics diagrams, generalized correlations of thermodynamic properties of ideal gas mixtures.

Phase_Equilibria :-Criteria of equilibrium, the Fugacity, Duhem's theorem, vapor – liquid equilibrium idealization, phase diagram for miscible systems, immiscible systems, partially miscible systems, testing of vapor –liquid equilibrium data, Gibbs –Duhem equation

Chemical_Equilibria :-Criteria of chemical equilibrium, equilibrium conversion X_e equilibrium constant, effect of temperature and pressure on K . evaluation of K by conditions, construction of equilibrium conversion charts. Calculation of X_e for exothermic, endothermic, reversible, irreversible reactions.

BOOKS:

5. Smith, J.M. and Van Ness, H.C., Introduction to Chemical Engg. Thermodynamics, McGraw-Hill
6. K V Narayanan, a Text book of Chemical Engg Thermodynamics, Prentice Hall India.
7. Dodge, Chemical Engg. Thermodynamics, McGraw-Hill.
8. Wilson and Ric, Principles of Chemical Engg. Thermodynamics, McGraw-Hill.

Practicals:

4. Experiment on chemical Equation
5. Experiments on 1st and 2nd law of thermodynamics
6. Determination of heat of reaction.

CH 585 PROCESS_UTILITIES

L – T -P

3- 1- 0

Time : 3 hrs

Theory :100 Marks

Sessional : 50 Mark

1. Importance of process utilities in chemical industries and plants. Introduction to the use of various utilities.
2. Water as a utility in process industries, conservation and recycle of water, cooling tower, spray pond.
3. Compressed air systems. Vacuum systems, boosters, air receivers, piping network, air leaks, and lubrication and oil removal.
4. Refrigeration systems and their characteristics, use of cryogenic temperatures.
5. Air condition and ventilation systems and their characteristics, air water systems, introduction to humidification and dehumidification equipments, air blending and exhaust.
6. Generation distribution and utilization of steam, steam economy and handling steam engines, boiler and performance characteristics.
7. Internal combustion engine cycles – otto, Diesel, dual, Rankine cycles and their characteristics and performances.
8. Fire and safety in chemical industry :

- (a) Chemical hazards, classification and threshold limits
- (b) Chemical as a cause of poisoning and occupational disease.
- © Engineering control of chemical plant hazards , ventilation and lighting , maintenance of pressure vessels, storage , handling and transportation of chemicals , electrical systems, instrumentation , fire prevention , personnel protection devices , maintenance procedure , laboratory safety, effluent disposal and checking of spillage.
- (d) Properties of important flammable liquids and gases and their classification , threshold limits and maximum permissible concentration of these chemicals. Concept of spontaneous combustion with remedial measures.
- e) Rules and Acts governing explosive and flammable materials . Colour codes for safety color codes for pipe lines and gas cylinders. An exposure to Indian standards.

BOOKS :

- 5. Heat Engines – Pandya and Shaha
- 6. Heat Engines – Patel and Karamchandani (Vol II, III)
- 7. Air conditioning & Refrigeration – Stephen & Elonka
- 8. Efficient use of Steam – HMSO, London.

CH 586 PROCESS_ INSTRUMENTATION

L – T -P
3- 1- 2

Time : 3 hrs
Theory : 100 Marks
Sessional : 50 Mark
Practicals: 50 Marks

- 6. Fundamental : Elements of instruments, static characteristics, Dynamic characteristics, Application of Laplace transform in instrumentation . Response of 1st order and 2nd order instruments.
- 7. Temperature measuring instruments:-Like bimetallic , Vapour pressure , thermocouples, automatic potential recorders, resistance thermometers, radiation pyrometers, optical pyrometers, photoelectric pyrometers, thermistors, response of these instruments.
- 8. Composition measuring instruments:-Spectroscopic methods , thermal conductivity cells, co-analysis, Fuel gas analysis , humidity measurement, moisture in paper, pH meter, oxygen analysis , polarography, colorimetry, combustible gas analysis.
- 9. Measurement of pressure and vacuum :-Manometers, pressure Spring , McLeod gauge, Pirani Gauge, Ionization gauge, Thermocouple gauge, Liquid seals, responses of these instruments.
- 10. Viscosity & Sp. Gravity measurement:-Level measuring devices . Flow measuring devices , measurement of displacement, measurement of density.

Practicals:

6. Determination of time constant of a first order system
7. Calibration of flow measuring devices.
8. Composition analysis using spectrophotometer.
9. Study of conductivity meter and pH meter.
10. Experiment on humidity measurement.

BOOKS :

4. Donald P. Eckman – Industrial Instrumentation.
5. A. Suryanarayana, Instrumentation & Process Control , Khanna Publishers, New Delhi.
6. R. K. Jain , Mechanical and Industrial Measurements, Khanna Publishers, New Delhi.