KURUKSHETRA UNIVERSITY KURUKSHETRA

SCHEME OF STUDIES/ EXAMINATIONS

BACHELOR OF TECHNOLOGY (CHEMICAL ENGINEERING)

Semester-V (w.e.f. 2017-18)

SN	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Dur. of Exam (Hrs.)
			L	T	P	Hr/ Wk	Theory	Sessional	Practical	Total	
1	CHE-301 N	Mass Transfer-I	4	1	0	5	75	25	0	100	3
2	CHE-303 N	Chemical Reaction Engineering-I	4	1	0	5	75	25	0	100	3
3	CHE-305 N	Polymer Science Engineering	4	0	0	4	75	25	0	100	3
4	CHE-307 N	Chemical Engineering Thermodynamics-II	4	1	0	5	75	25	0	100	3
5	CHE-309 N	Chemical Technology-II	4	1	0	5	75	25	0	100	3
6	CHE-311 N	Chemical Reaction Engineering-I (P)	0	0	2	2	0	40	60	100	3
7	CHE-313 N	Chemical Engineering Thermodynamics-II (P)	0	0	2	2	0	40	60	100	3
8	CHE-315 N	Mass Transfer-I(P)	0	0	3	3	0	40	60	100	3
9	CHE-317 N	Chemical Technology-II (P)	0	0	3	3	0	40	60	100	3
10	CHE-319 N	Industrial Training-I	0	0	1	1	0	100	0	100	
		Total	**20**	**4**	**11**	**35**	**375**	**385**	**240**	**1000**	

Note: Industrial Training which was undergone by the students after IV sem is to be evaluated during V sem as (CHE-319 N) through submission of certified seminarized report to the Head of the Department followed by viva-voce, seminar/presentation.

CHE-301 N	Mass Transfer-I					
Lecture	Tutorial	Practical	Theory	Sessional	Total	Time
4	1	-	75	25	100	3 (Hrs.)
Purpose	To familiarize the students with the concepts of Diffusion in fluids, Theories of mass transfer, coefficients, Humidification and Dehumidification, Drying Crystallization					
Course Outcomes						
CO1	To familiarize with types of diffusion and theories of mass transfer coefficient, , concept of equilibrium curve, operating line					
CO2	To familiarize with humidifiers and dehumidifiers. Design of cooling towers					
CO3	To familiarize with drying mechanism and types of driers					
CO4	To familiarize with Crystallization mechanism and types of crystallizers					

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

Diffusion in fluids: Molecular and eddy diffusion, Diffusivity; Diffusion through liquids and gases. Interphasemass Transfer: Theories of mass transfer, coefficients, concept of overall mass transfer coefficient, correlation for mass transfer coefficient ideal stage concept of single and multiple stage operation in co and counter current modes, concept of equilibrium curve, operating line.

UNIT – II

Humidification and Dehumidification: Adiabatic saturation temperature, wet bulb temperature, saturation temperature. Psychometric chart, dehumidification, humidifiers and dehumidifiers. Simultaneous heat and mass transfer. Design of cooling towers, determination of NTU, HTU.

UNIT – III

Drying: Principle of drying, mechanism and rate of drying, types of driers, calculations for batch and continuous dryers. Vacuum dryers.

UNIT – IV

Crystallization: Crystallization mechanism, growth of crystals, classification of crystallizers, material and energy balance, enthalpy concentration diagram super saturation. Batch crystallizers, continuous. Crystallizer, fractional crystallization.

TEXT BOOKS:

1. Mass Transfer Operations: R.E. Treybal- McGraw-Hill Book Company, New Delhi.
2. Sherwood. T.K. Pigford. R.L. and' Wilke, C.P. Mass Transfer, McGraw Hill (1e75).
3. Transport processes and separation process princilples. by C J Geankoplis,PHI,4th ed.

REFERENCE BOOKS:

1. Unit operations of Chemical Engineering : W.L. Mccabe & J.C. smith -McGraw Hill, New Delhi.
2. Chemical Engineering: J.M. Coulson and J.F. Richardson vol-l pergamon, New York.

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CHE-303 N	Chemical Reaction Engineering-I					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
4	1	-	75	25	100	3 (Hrs.)
Purpose	To familiarize with the Kinetics of Homogenous reactions, Design of single ideal reactors, Design of multiple reactions, Temperature and pressure effects on rate of reaction					
Course Outcomes						
CO1	To understand the Kinetics of Homogenous reactions					
CO2	To understand Design of single ideal reactors					
CO3	To understand Design of multiple reactions					
CO4	To understand the Temperature and pressure effects on rate of reaction					

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

Kinetics of Homogenous reactions: Concept of reaction rate, rate equation, order and molecularity, Collision and activated complex theories. Interpretation of batch reactor data: constant volume and variable volume batch reactors, integral and differential methods of analysis, continuous reactors, effects of concentration and temperature (Arrhenius equation).

UNIT- II

Design of Single Ideal Reactors: Design equation for single ideal reactor for single reactions for batch reactor, plug flow reactor and CSTR, Thermal stability of reactors, optimum temperature progression for first order reversible reactions.

UNIT- III

Multi reactions: Parallel and series reactions, mixed reactions, autocatalytic reactions, choice of reactors for simple and complex reactions, multiple reaction system.

UNIT- IV

Temperature and Pressure Effects: Calculations of heats of reaction and equilibrium constants. General graphical design procedure, Optimum temperature progression, and Energy balance equations in adiabatic and non-adiabatic case, Performance of mixed, plug flow reactors

TEXT BOOKS:

1. Chemical Reaction Engineering: Octave Levenspiel - W Eastern Limited, New Delhi.
2. Elements of Chemical Reaction Engineering: H. Scott Fogler - Prentice-Hall of India Pvt. Ltd. New Delhi.

REFERENCE BOOKS:

1. Kinetics and Mechanisms of Chemical Transformation J. Rajaram and J.C.Kuriacose-Macmillan India Ltd. New Delhi.
2. Chemical Engineering Kinetics: J.M. Smith- McGraw -Hill Book.

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CHE-305 N	Polymer Science Engineering					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
4	0	-	75	25	100	3 (Hrs.)
Purpose	To familiarize with the different types of polymer, molecular weight distribution, polymer processing and rhelogy					
Course Outcomes						
CO1	To understand different types of polymer, polymerization techniques and their kinetics.					
CO2	To understand molecular weight distribution and polymerization processes					
CO3	To understand polymerization processing techniques					
CO4	To understand rhelogy of fluids and models					

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

Definition, types of polymers, functionality, polymerization reactions, polycondensation. Addition-free radical and chain polymerization. Co-polymerization ,kinetics of radical chain and tonic polymerization. Gelation phenomena.

UNIT-II

Molecular Weight Estimation: Average molecular weight, number average and weight average molecular weight. polydispersity, degree of polymerization. Methods of determination of molecular weight.

Polymerization Processes: Bulk, solution, suspension and emulsion polymerization. Thermoplastic composites, fiber reinforcement fillers.

UNIT-III

Polymer processing: Thermoforming, injection molding, extrusion molding, calendaring rotational casting, film casting, blow molding, foaming' Fiber spinning wet dry and melt.

UNIT-IV

Rhelogy : Simple rheological response, simple linear viscoelastic : Maxwell and Voigt model ,material response time, temperature dependence of viscosity. Elasticity of polymers.

TEXT BOOKS :

1. Polymer science by Gowarikar, Wiley eastern

2, Polymer science of plastics and rubberc by P gosh, McGrraw Hill.

3. Textbook of polymer science by Billmayer, John Wiley.

CHE-307 N	Chemical Engineering Thermodynamics-II					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
4	1	-	75	25	100	3 (Hrs.)
Purpose	To understand the concept of residual properties, vapor liquid equilibrium, chemical equilibrium					
Course Outcomes						
CO1	To familiarize with laws of thermodynamics, Thermodynamic properties of pure fluids, residual properties					
CO2	To understand the Thermodynamic properties of homogeneous mixtures, Partial molar properties, excess Properties					
CO3	To understand the vapour-liquid equilibria (vLE), miscible azeotropes, Analysis of multi-component multiphase system					
CO4	To understand Chemical Equilibria, , effect of temperature and pressure on equilibrium constant, Duhem's theorem for reacting system.					

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

Review of laws of thermodynamics, their application to real processes, PVT behavior of pure fluids, virial equations, and generalized correlations, Relationships among thermodynamic properties , Thermodynamic properties of pure fluids: concept of residual properties, Thermodynamics properties of single and two-phase systems, generalized correlations for thermodynamic properties of gases.

UNIT-II

Thermodynamic properties of homogeneous mixtures: Property relationship for systems of variable composition: Partial molar properties: fugacity and fugacity coefficients, fugacity in ideal solutions property changes of mixing - activity, heat effects in mixing processes, excess Properties activity coefficients, gaseous mixtures

UNIT-III

Phase Equilibria: importance of phase equilibria in process industries, vapour-liquid equilibria (vLE), miscible azeotropes, VLE calculations at low and high pressures' Analysis of multicomponent multiphase system. Activity coefficients from experimental data in all Margules, Van-Laar, Wilson equations

UNIT-IV

Chemical Equilibria: Reaction coordinates application of equilibrium criteria to chemical Reactions standard Gibbs free energy change and the equilibrium constant effect of temperature on equilibrium constant, effect of temperature on equilibrium constantevaluation of equilibrium constants and composition, calculation of equilibrium compositions for single reactions, phase rule and Duhem's theorem for reacting system.

TEXTBOOKS:

1. Introduction to Chemical Engineering Thermodynamics : J.M. Smith and H.C.Van Nes s McGraw Hill Book Company, New Delhi
2. Chemical Engineering Thermodynamics: Y.V. .C.Rao, Universities Press (India) Ltd., Hyderabad, India'

REFERENCE BOOKS:

1. Chemical Engineering Thermodynamics T.E. Daubert - McGraw Hill, New Delhi.
2. Chemical Process Principles Vol- II, O.A. Hougen, K.M. Wastonand R. A.Regatz- Wiley

CHE-315 N	Mass Transfer-I (P)					
Lecture	**Tutorial**	**Practical**	**Practical**	**Sessional**	**Total**	**Time**
-	-	3	60	40	100	3 (Hrs.)
Purpose	To make student able to understand concept of mass transfer coefficient and NTU in cooling tower, moisture content of material					
Course Outcomes						
CO1	Students will be able to determine mass transfer coefficient of liquid.					
CO2	Students will be able to determine Number of Transfer Unit (NTU in cooling tower.					
CO3	Students will be able to determine moisture content of material.					
CO4	Students will be able to determine the gas film coefficient of fluid mixture					

List of experiments

1. Determination of Gas Film Coefficient in a Wetted Wall Column Using Air-Water System
2. To Find Out The Critical Moisture Content of a Given Material And to Find out the Constant Rate and Falling Rate Periods
3. Determine the Diffusion Coefficient of Vaporizing of a Liquid in Air at Different Temperatures
4. (a)To Study Absorption of CO_2 in Aqueous NaOH Solution in a Sieve Plate Column.
   (b) To Determine the Gas Phase Mass Transfer Coefficient K_{ga} .
5. To Determine Number of Transfer Unit (NTU), Height of Transfer Unit (HTU) and K_{ya} for a Given Cooling Tower.
6. Study of Psychometric Properties.

CHE-317 N	Chemical Technology –II (P)					
Lecture	**Tutorial**	**Practical**	**Practical**	**Sessional**	**Total**	**Time**
-	-	3	60	40	100	3 (Hrs.)
Purpose	To provide practical knowledge for the preparation of caustic soda, extraction of oil form groundnut seed ,Saponification value and preparation of detergent					
Course Outcomes						
CO1	Students will be able to determine acid value and Saponification value of oil					
CO2	Students will be able to extract oil from groundnut seeds					
CO3	Students will be able to prepare caustic soda and detergent					
CO4	Students will be able to do analysis of water by chemical methods					

List of experiments

1. To Prepare caustic soda by chemical method
2. To determine acid value of given sample of oil
3. To Prepare hydrated lime from given calcium carbonate powder
4. To extract the oil from groundnut seed and determine its extraction coefficient
5. To determine Saponification value of given sample of oil
6. To carry out analysis of water by chemical methods
7. To prepare detergent in the lab and to carry out its cost analysis.