M. Chem. Engg. Syllabus Details: Prerequisites and Expected Learning

No.	Subject	Credit	Hr/Week			Marks			
			L	T	P	Continuous Assessment	Mid-semester Examination	Final Examination	Total
SEMESTER I									
CET 2151	Advanced Momentum Transfer	3	2	1	0	15	15	20	50
CET 2152	Advanced Heat Transfer	3	2	1	0	15	15	20	50
CET 2153	Advanced Mass Transfer Operations	3	2	1	0	15	15	20	50
CET 2351	Thermodynamics of Phase Equilibria	3	2	1	0	15	15	20	50
CET 2251	Advanced Reaction Engineering	3	2	1	0	15	15	20	50
CET 2751	Project I (critical review of one research publication)	3	---	---	3			30 (Report) 20 (Presentation)	50
CET 2752	Project II (Seminar)	3	---	---	3			30 (Report) 20 (Presentation)	50
	TOTAL:	21	10	5	6				350
SEMESTER II									
CET 2753	Process Modelling and Simulation	3	2	1	0	15	15	20	50
CET 2451	Advanced Separation Processes	3	2	1	0	15	15	20	50
CET 2252	Multiphase Reactor Engineering	3	2	1	0	15	15	20	50
	Elective I	3	2	1	0	15	15	20	50
	Elective II	3	2	1	0	15	15	20	50
	Elective III	3	2	1	0	15	15	20	50
CET 2754	Project III (critical literature review of Research Project)	3	---	---	3			30 (Report) 20 (Presentation)	50
	TOTAL:	21	12	6	3				350
SEMESTERS III and IV									
Project evaluation of 200 marks in Semester III and 500 Marks in Semester IV									

Sem I	Subject code **CE 151**	**Advanced Momentum Transfer**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		• Turbulent flow: basics, Reynolds average Navier-Stokes equations, closure problem, Boussinesques hypothesis, Prandtl mixing length theory, turbulence models, energy spectrum, Turbulent boundary layer, universal velocity profile • Bernoulli's equation and its applications • Gas-liquid and solid-liquid fluidised beds: Characteristics of particles, Principle of fluidization and mapping of various regimes, Two phase theory of fluidisation, Bubbles in fluidised bed, Entrainment and Elutriation, Fast fluidised bed, Mixing, segregation and gas dispersion, Heat andmass transfer in fluidised bed, Solid-liquid fluidised bed and three phase fluidised bed, Design of fluidised bed reactors.	15 10 20
	Pre-requisite courses	Mathematics course involving partial and ordinary different equations Physics course involving fluids, Basic concepts of viscosity, stress and strain in fluids. Basic fluid flow course involving equation of continuity, motion and related laminar flow problems.	
	Expected Learning	Students should be able to describe origin and importance of Reynolds stresses and estimate values based on simple concepts. Concept of eddy motion scales of turbulence. Student should be able to write Bernovllis equation and solve simple problems related to flow in pipes, orifice venturi meters, weir, pitot tubes, etc. Students should be able to calculate head requirements and pump sizing. Students should be able to calculate minmum fluidization velocity, terminal setting velocity, velocity voidage relationships for fluidized beds. Settling velocities under hindered setting conditions.	
	Reference Books	Transport Phenomena, R.B. Bird, W.E. Stewart, E.N. Lightfoot Transport Phenomena, R.S. Brodkey Momentum, Heat and Mass Transfer, Bennet and Myers Fluid Mechanics, Pijush K. Kundu Fluid Mechanics, K. Subramanya Fluid Dynamics, G.K. Batchelor	
	Departments	Chemical Engineering Department	

Sem	Subject		No of

I	code **CE 152**	**Advanced Heat Transfer**	hours
	Credits=		
	Lecture /Practical Hours=		
	Tutorials Hours=		
		• Forced and natural convective heat transfer, analogies of momentum and heat transfer • Design aspects of shell-and-tube heat exchangers; NTU-epsilon method; Bell-Delaware method;Flow-stream analysis • Design of compact heat exchangers • Design aspects of condensers, reboilers, and evaporators • Radiation heat transfer concepts, Angle factor calculations, Radiation calculation through gases and vapours, design methods for furnaces	8 10 10 10 7
	Pre-requisite courses	Basic course in Physics with concepts in heat conducting, radiation. Basic course in Mathematics involving solution of partial and ordinary different equations. Basic course in Fluid flow and hear transfer	
	Expected Learning	Students should be able to explain the basis of heat transfer coefficient based on analogies of momentum and heat transfer. Students should be able to calculate design details of a Shell and tube, compact heat exchangers to meet the required heat duty. Students should be able to calculate the performance of a given shell and tube, compact heat exchangers. Students should be able to calculate the size requirements of reboilers conduces, evaporators. Students should be able to calculate size requirement of a furnace.	
	Reference Books	Transport Phenomena, R.B. Bird, W.E. Stewart, E.N. Lightfoot Transport Phenomena, R.S. Brodkey Momentum, Heat and Mass Transfer, Bennet and Myers	
	Departments	Chemical Engineering Department	

Sem I	Subject code **CE 153**	**Advanced Mass Transfer Operations**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		• Interphase mass transfer for multicomponent fluids in laminar and turbulent flows, Interfacialturbulence and Marangoni effects • Stefan-Maxwell approach for milticomponent mass transfer, Multicomponent distillation;Determination of key components at minimum reflux ratio by the method of Shiras, et al.Rigorous methods of Lewis-Matheson, Thiele-Geddes, bubble point, sum rates method, Naphthali-Sandholm method, residue maps • Azeotropic and extractive distillation; stage wise calculations for multicomponent with multiplefeed streams • Liquid-liquid extraction; stage wise calculations for multicomponent with multiple feed streamsusing reflux and mixed solvents. Liquid-liquid extraction with chemical reaction • Multicomponent gas absorption: Horton-Franklin method, Edmister method. Mass transfer in gasabsorption with and without chemical reaction, model solutions by Dankwerts; Brian; Perry and Pigford.	10 8 8 10 9
	Pre-requisite courses	Basic course in fluid flow physics and matematics, basic course in mass transfer . Diffusion, Film and penetration theories.	
	Expected Learning	Students should be able to estimate mass transfer coefficients in various geometries. Students should be able to calculate the operating regime (R1, R2, R3 or R4) given the intrinsic kinetics and mass transfer coefficients. Student should be able to do sizing of equipment for azeotropic, extractive distillation, liquid-liquid extraction, gas absorption.	
	Reference Books	**Reference books:** Principles of Mass Transfer and Separation Processes, B.K. Dutta Mass Transfer Operations, R.E. Treybal Chemical Engineering, Volume 2, J.M. Coulson, J.F. Richardson Transport Processes and Unit Operations, C.J. Geankoplis Transport Processes and Separation Process Principles, C.J. Geankoplis Separation Processes, C.J. King Separation Process Principles, J.D. Seader, E.J. Henley Equilibrium Stage Separation Operations in Chemical Engineering, E.J. Henley, J.D. Seader Diffusion: Mass Transfer in Fluid Systems, E.L. Cussler	
	Departments	Chemical Engineering Department	

Sem I	Subject code **CE 351**	**Thermodynamics of Phase Equilibria**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		• Introduction to molecular thermodynamics of fluid phase equilibrium • Fundamental concepts of statistical thermodynamics • Classical thermodynamics of phase equilibrium - open and closed systems, Gibbs - Duhemequation, chemical potential, fugacity and activity • Thermodynamic properties from volumetric data / fugacities at moderate pressure, fugacity of a pure liquid or solid • Fugacities in gas mixtures - Virial equation of state, fugacities from Virial equation, third Virialcoefficient, chemical interpretations of deviation from gas phase ideality, fugacities at high pressure, Redlich - Kwong equation of state, solubility of solids and liquids in compressed gases • Fugacities in liquid mixtures: excess functions, activity and activity coefficient, testing ofequilibrium data, Wohl's expansion for excess Gibbs energy, equations of van der Waal, Wilson and Renon equations for activity coefficient. Thermodynamic criteria of miscibility • Intermolecular Forces and the theory of corresponding states - potential energy functions fordifferent molecular systems; Polar and non-polar molecules • Liquid phase models: van Laar, Scatchard-Hildebrand theory, Lattice theory, two liquid theories, Flory - Huggins theory.	5 5 5 5 5 5 5 10
	Pre-requisite courses	Basic course in mathematics, thermodynamics, physical Chemistry. Kinetic theory of gases, ideal gas law, vapor pressure, Raoults law	
	Expected Learning	Students should be able to apply various equations of state for estimation of vapor and liquid volumes and calculate various thermodynamic properties. Students should be able to calculate equilibrium compositions in vapor-liquid, and liquid-liquid using various equations and theories (for application in gas- absorption, distillation extraction etc.).	
	Reference Books	Chemical Engineering Thermodynamics, Smith, Van Ness Chemical Engineering Thermodynamics, T.E. Daubert Chemical Engineering Thermodynamics, R.E. Balzhiser Chemical Engineering Thermodynamics, S.I. Sandler Molecular Thermodynamics of Fluid Phase Equilibria, J.M. Prausnitz Properties of Gases and Liquids, R.C. Reid and T.K. Sherwood	
	Departments	Chemical Engineering Department	

Sem I	Subject code **CE 251**	**Advanced Reaction Engineering**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		• Theory of mass transfer with chemical reaction (regimes and examples), model contactors • Kinetics of solid-catalysed gas phase reactions: Diffusion with reaction in porous catalyst,Mechanism of catalytic reactions. Development of rate equations for solid catalysed fluid phasereactions; Estimation of kinetic parameters External/internal mass and heat transfer resistances in catalyst particles. • Design of fixed bed catalytic reactor - isothermal, adiabatic, non-isothermal programmed reactors: • Non-ideal flow in reactors; RTD, Estimation of dispersion/backmixing, dispersed plug flow andtanks in series model, design aspects of reactors with non ideal flow, micro and meso mixing inreactors • Reactor stability	10 10 10 10 5
	Pre-requisite courses	Basic course in reaction engineering, concepts of plug flow and CSTR, Basic course in physical Chemistry, Kinetics, Mathematics involving solutions of ordinary and partial differential equations.	
	Expected Learning	Students should be able to list various courses of non ideality of flow in reactors and draw the corresponding E curve. Students should be able to calculate the dispersion coefficient from given E- curve. Students should be able to fit a flow model for a reactor for given E curve. Students should be able to propose a rate expression for catalytic reaction based on a given set of experimental data of concentrations and rates. Students should be able to determine the importance of pore diffusion and external mass transfer for a given experimental rate concentration data. Students should be able to calculate the size required for conducting a given catalytic reaction, considering heat effects.	
	Reference Books	Chemical Reaction Engineering, O. Levenspiel Chemical Engineering Kinetics, J.M. Smith Elements of Chemical Reaction Engineering, H. Scott Foggler Chemical Reactor Analysis and Design, G.F. Froment, K.B. Bischoff Chemical Reaction Analysis, E.E. Petersen Heterogeneous Reactions vol. I and II, L.K. Doraiswamy, M.M. Sharma Gas Liquid Reactions, P.V. Danckwerts Mass Transfer with Chemical Reaction, G. Astarita	
	Departments	Chemical Engineering Department	

Sem I	Subject code **CE 751**	**Project I (critical review of one research publication)**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	3	
	Tutorials Hours=		
		INSTRUCTIONS FOR CANDIDATES In this project, the candidate is expected to review single research publication either published or manuscript in preparation as decided by the faculty advisor. In general a written report on similar guidelines as given for project II later needs to be submitted but the distribution of the content shouldbe as follows: **(a)** 5% weightage (1 page) should be given to important features of the paper in own words of the candidate. **(b)** 45% weightage should be given to literature survey including significance of the area ofre search discussed in the paper. **(c)** Remaining part should focus on the detailed analysis of the paper. Some general guidelines for the critical analysis of a research publication include: **ORIGINALITY (5 marks):** Are the facts and ideas new, or have they been covered before by this author or other authors? Is there enough useful information to warrant this paper and whether the length of the paper is justified? If you feel the material is not new, please cite references in which it has already been reported. **TECHNICALLY CORRECT (20 marks):** Is the paper technically correct; are assumptions reasonable; is the reasoning logical? If you think it is not, specify what you think is incorrect and suggest the correct approach. Are the methods used in the work appropriate? Are there any internal contradictions or computational errors and are there any loopholes in the observations? If so, please explain. **CLARITY (5 marks):** Is the paper reasonably easy to follow and understand, complete but not verbose, and does it stick to the subject? If not, please comment. **BIBLIOGRAPHY (5 marks):** Does the author cite all the references in the text and vice versa? Are the references complete and as per guidelines? Does the manuscript accurately represent statements in cited references and do not reproduce? **TITLE/ABSTRACT (5 marks):** Is the title suitable and adequate? Does the Abstract (normally 50-150 words) bring out the main points of the paper? **ILLUSTRATIONS AND TABLES (5 marks):** Is there material that could be better covered in a table? Is there needless duplication between text illustrations and tables? Are there too many 9 of 20 illustrations or tables? Are the illustrations clear and legible? Are the experiments/results	

		&discussion/illustrations/tables same/similar to other papers in similar area? **ALTERNATIVE INTERPRETATIONS (5 marks):** Are there other valid interpretations of theobservations? If so, please elaborate.	
	Pre-requisite courses	All Chemical Engineering courses	
	Expected Learning	Students should be able to do critical analysis of one review paper based on the guidelines mentioned above.	
	Reference Books		
	Departments	Chemical Engineering Department	

Sem I	Subject code **CE 752**	**Project II (Seminar)**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	3	
	Tutorials Hours=		
		The Seminar work is concerned with a detailed and critical review of an area of interest to Chemica lEngineering. Typically, the report should contain and will be evaluated based on the following points: **(a)** Introduction: 2 pages maximum, **(b)** Exhaustive review of literature (including figures): 10 – 12 pages: 50% Weightage **(c)** Critical analysis of the literature and comments on the analysis Critical analysis should alsocontain quantitative comparison of observations, results, and conclusion amongst the various papers. **2.** Two typed copies of the report on thesis size bond paper (297 mm x 210 mm) are to be submittedto Coordinator on **time to be decided by the coordinator.** The detailed timetable for the presentation would be communicated. **3.** The report should be prepared using the Times Roman font (size 12) using 1 1/2 spacing leaving1-inch margin on all sides producing approximately 29 lines per page. The report should be typed on one side of the paper and need not be bound in a hard cover binding. Figures and tables should be shown as a part of the running text. Each figure should be drawn inside a rectangular box of 12 cm width and 10 cm height. The figures must be sufficiently clear and hand drawn figures will be acceptable. Particular care must be taken if a figure is photocopied from source. Each figure must have a sequence number and caption below. Each table must have a sequence number and title at the top. **4.** Name of the student, title of the problem and year of examination must be indicated on the topcover. THE NAME OF THE SUPERVISOR (ONLY INITIALS) MUST APPEAR ON THEBOTTOM RIGHT CORNER OF THE TOP COVER. **5.** The report must be precise. All important aspects of the topic should be considered and reported.**The total number of pages, including tables, figures, and references should not exceed 30.**Chapters or subsections need not be started on new pages, while getting the report typed. **6.** Typographical errors in the report must be corrected by the student. The student will be discredited for any omission in the report. All the symbols used in the text should be arranged in an alphabetical order and given separately after conclusions. **7.** The list of references should be arranged in alphabetical order of the names of authors. In the text, the reference should be cited	

		with author's name and year. (author - date style) For example: (i) The flow pattern in gas-liquid-solid fluidized bed has been reported in the published literature(Murooka et al., 1982). **OR** (ii) Murooka et al. (1982) have measured flow patterns in gas-liquid-solid fluidized beds. The title of the article should also be included. The references must be given in the following standard format. **(a)** Format for listing references of articles from periodicals: Murooka S., Uchida K. and Kato Y., Recirculation Turbulent Flow of Liquid in Gas-Liquid-Solid Fluidised Bed", J. Chem. Engg. Japan, 15, 29-34 (1982). **(b)** Format for listing references of Books: Constant R.F.,"Crystallization, Academic Press, New York, pp. 89-90, 1968. **(c)** Format for listing Thesis: Niranjan K., "Hydrodynamic and Mass Transfer Characteristics of Packed Columns", Ph.D.(Tech.) Thesis, University of Mumbai, 1983. **(d)** Format for listing references of Patents in Chemical Abstracts: Cananaush R.M., U.S.Patent 2,647,141, Cf. C.A. 48, 82636 (1954). **(e)** Format for listing Handbooks, Tables, Symposia etc.: Kumar R and Kuloor N.R., "Formation of Drops and Bubbles", in Advances in ChemicalEngineering, Vol.8, T.B. Drew et.al. (Eds.) New York, Academic Press, pp.256-364 (1970). **(f)** Format for listing Private Communications and other categories: Sharma, M.M., Private Communication (1984). **8.** Consistency of units should be maintained in the written report. SI systems should be used. [ForSI system - Ref: Ind. Chem. Engr., 24, 32, 3 (1983)]. Units used in the literature (if not SI) should be correctly converted. **9.** The time allotted for the oral presentation of seminar is 20 minutes: additional 10 minutes areprovided for questions and answers. 10 of 20 **10.** INCOMPLETE AND CARELESSLY WRITTEN REPORT IS LIABLE TO BE REJECTED. **11.** The last date for submission will NOT be extended on any grounds whatsoever. **12.** There must not be any acknowledgment about the guidance by the faculty in the Seminar. **13.** The Seminar will be evaluated on the basis of (i) rational approach to the problem, ii) correctness and completeness of the written text and iii) performance in the oral presentation. **14.** Word-to-word copying from the published article is not permitted. Flowery language is not to be used.	
	Pre-requisite courses	All Chemical Engineering subjects	
	Expected	Students should be able to collect, analyze and present a literature	

	Learning	review on a given topic.	
	Reference Books		
	Departments	Chemical Engineering Department	

Sem II	Subject code **CE 753**	**Process Modelling and Simulation**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		• Introduction and fundamentals of process modelling and simulation; industrial usage of process modelling and simulation; Macroscopic mass, energy and momentum balances • Incorporation of fluid thermodynamics, chemical equilibrium, reaction kinetics and feed/ product property estimation in mathematical models • Simulation of steady state lumped systems including simultaneous solution, modular solution, nested inside-out algorithms • Partitioning and tearing with reference to chemical process equipments like reactors; distillation, absorption, extraction columns; evaporators; furnaces; heat exchangers; flash vessels etc. • Unsteady state lumped systems and dynamic simulation • Commercial steady state and dynamic simulators; Computer algorithms for numerical solution of steady state and unsteady state models; Microscopic balances for steady state and dynamic simulation • Process modelling of distributed systems; axial mixing; micro-mixing; diffusion etc. • Computer algorithms for microscopic models; Simulation of process flow sheets and Boolean digraph algorithms; Modelling and simulation of complex industrial systems in petroleum, petrochemicals, polymer, basic chemical industries.	4 4 4 4 8 8 6 7
	Pre-requisite courses	Mathematics course involving numerical methods for solution of linear algebraic equations differential equations. All courses in Semester I, All Chemical Engineering Subjects.	
	Expected Learning	Students should be able to formulate equations for modeling a process. Students should be able to numerically solve the set of equations derived above. Students should be able to familiar with us of software like ASPEN	
	Reference Books	Process Modelling, Simulation, and Control for Chemical Engineers, Luyben	
	Departments	Chemical Engineering Department	

Sem II	Subject code **CE 451**	**Advanced Separation Processes**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		• Membrane Processes: Principles of various membrane processes like Reverse Osmosis, pervaporation, gas separation and electro-dialysis. Design equations and module design. Concentration polarisation. • Adsorption and Ion Exchange Processes: Adsorption and ion exchange equilibrium. Various isotherms. Contact filtration, design of fixed bed adsorbed including breakthrough curve. • Chromatographic Separations: Principles of chromatographic separation, criteria for effective separation, supports, and methodology and process design. • Separation of Racemic Mixtures: Principles of racemic modification and their application inseparation of racemic mixtures with specific examples. • Dissociation Extraction, Reactive Extraction. • Reactive distillation.	
	Pre-requisite courses	Thermodynamics of phase Equilibria, Advance Mass Transfer Operations Advanced Reaction Engineering	
	Expected Learning	Students should be able to calculate the equipment size and operating conditions required for a given membrane separation process, adsorptive separation, extraction and distillation.	
	Reference Books	Transport Processes and Separation Process Principles, C.J. Geankoplis Separation Processes, C.J. King Separation Process Principles, Authors: J.D. Seader, E.J. Henley Principles of Mass Transfer and Separation Processes, B.K. Dutta Mass Transfer Operations, R.E. Treybal Green Separation Processes, C.A.M. Afonso, J.F. Crespo Equilibrium Stage Separation Operations in Chemical Engineering, E.J. Henley, J.D. Seader Diffusion: Mass Transfer in Fluid Systems, E.L. Cussler Chemical Engineering, Volume 2, J.M. Coulson, J.F. Richardson	
	Departments	Chemical Engineering Department	

Sem II	Subject code **CE 252**	**Multiphase Reactor Engineering**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		• Types, classification, application of industrial importance • Hydrodynamic characteristics of different reactors; mechanically agitated contactors, bubble columns, slurry reactors, spray columns, loop reactors and modified versions • Design aspects of multiphase reactors: pressure drop, fractional phase hold-up, mass and heat transfer coefficient, extent of mixing, etc.	5 15 25
	Pre-requisite courses	Advanced Reaction Engineering, Advanced momentum transfer, Advanced Mass transfer operations.	
	Expected Learning	Students should be able to calculate size and operating conditions required for a given multiphase reactor.	
	Reference Books	Heterogeneous Reactions vol. I and II, L.K. Doraiswamy, M.M. Sharma Fluid Mixing and Gas Dispersion in Stirred Reactors, G.B. Tatterson Bubble Columnn Reactors, W.D. Deckwer Fluidisation, D. Kunni and O. Levenspiel Fluidisation, Davidson J.F., Harrison D. Random Packings and Packed Tower Design, Strigel R.F	
	Departments	Chemical Engineering Department	

Sem II	Subject code **CE 754**	**Project III**	No of hours
	Credits=	3	
	Lecture /Practical Hours=	2 0	
	Tutorials Hours=	1	
		This would be concerned with a detailed and critical review of the area of the proposed research project to be undertaken in the second year and will be under the guidance of the research supervisor. **1.** The Seminar work is concerned with a detailed and critical review of an area of interest toChemical Engineering. Typically, the report should contain and will be evaluated based on thefollowing points: **(a)** Introduction: 2 pages maximum, **(d)** Exhaustive review of literature (including figures): 10 – 12 pages: 50% Weightage **(e)** Critical analysis of the literature and comments on the analysis Critical analysis should also contain quantitative comparison of observations, results, and conclusion amongst the various papers. **2.** Two typed copies of the report on thesis size bond paper (297 mm x 210 mm) are to be submitted to Coordinator on **time to be decided by the coordinator.** The detailed timetable for the presentation would be communicated. **3.** The report should be prepared using the Times Roman font (size 12) using 1 1/2 spacing leaving1-inch margin on all sides producing approximately 29 lines per page. The report should be typed on one side of the paper and need not be bound in a hard cover binding. Figures and tables should be shown as a part of the running text. Each figure should be drawn inside a rectangular box of 12 cm width and 10 cm height. The figures must be sufficiently clear and hand drawn figures will be acceptable. Particular care must be taken if a figure is photocopied from source .Each figure must have a sequence number and caption below. Each table must have a sequence number and title at the top. **4.** Name of the student, title of the problem and year of examination must be indicated on the top cover. THE NAME OF THE SUPERVISOR (ONLY INITIALS) MUST APPEAR ON THEBOTTOM RIGHT CORNER OF THE TOP COVER. **5.** The report must be precise. All important aspects of the topic should be considered and reported. **The total number of pages, including tables, figures, and references should not exceed 30.** Chapters or subsections need not be started on new pages, while getting the report typed. **6.** Typographical errors in the report must be corrected by the	

		student. The student will be discredited for any omission in the report. All the symbols used in the text should be arranged in an alphabetical order and given separately after conclusions. **7.** The list of references should be arranged in alphabetical order of the names of authors. In the text, the reference should be cited with author's name and year. (author - date style) Forexample: (i) The flow pattern in gas-liquid-solid fluidized bed has been reported in the published literature(Murooka et.al., 1982). **OR** (ii) Murooka et al. (1982) have measured flow patterns in gas-liquid-solid fluidized beds. The titleof the article should also be included. The references must be given in the following standardformat.12 of 20 **(a)** Format for listing references of articles from periodicals: Murooka S., Uchida K. and Kato Y.,Recirculation Turbulent Flow of Liquid in Gas- Liquid-Solid Fluidised Bed", J. Chem. Engg. Japan, 15, 29-34 (1982). **(b)** Format for listing references of Books: Constant R.F.,"Crystallization, Academic Press, New York, pp. 89-90, 1968. **(c)** Format for listing Thesis: Niranjan K., "Hydrodynamic and Mass Transfer Characteristics of Packed Columns", Ph.D.(Tech.) Thesis, University of Mumbai, 1983. **(d)** Format for listing references of Patents in Chemical Abstracts: Cananaush R.M., U.S.Patent 2,647,141, Cf. C.A. 48, 82636 (1954). **(e)** Format for listing Handbooks, Tables, Symposia etc.: Kumar R and Kuloor N.R., "Formation of Drops and Bubbles", in Advances in Chemical Engineering, Vol.8, T.B. Drew et.al. (Eds.) New York, Academic Press, pp.256-364 (1970). **(f)** Format for listing Private Communications and other categories: Sharma, M.M., Private Communication (1984). **(8)** Consistency of units should be maintained in the written report. SI systems should be used. [For SI system - Ref: Ind. Chem. Engr., 24, 32, 3 (1983)]. Units used in the literature (if not SI) should be correctly converted. **(9)** The time allotted for the oral presentation of seminar is 20 minutes: additional 10 minutes areprovided for questions and answers. **(10)** INCOMPLETE AND CARELESSLY WRITTEN REPORT IS LIABLE TO BE REJECTED. **(11)** The last date for submission will NOT be extended on any grounds whatsoever. **(12)** There must not be any acknowledgment about the guidance by the faculty in the Seminar. **(13)** The Seminar will be evaluated on the basis of (i) rational approach to the problem, ii) correctness and completeness of the written text and iii) performance in the oral presentation. **(14)** Word-to-word copying from the published article is not	

		permitted. Flowery language is not to be used.	
	Pre-requisite courses	All Chemical Engineering Courses.	
	Expected Learning	Students should be able to formulate research project to be done in semester III and IV in terms of objectives, methodology, equipment required deliverables etc.	
	Reference Books		
	Departments	Chemical Engineering Department	