ACADEMIC CURRICULA

Professional Core Courses

CHEMICAL ENGINEERING

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CHC203T	Course Name	CHEMICAL PROCESS CALCULATIONS	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Explain the system of units, predict the PVT properties of Ideal gases, understand the composition of various mixtures	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-2 :	Formulate and solve material balance for non-reactive chemical process systems																		
CLR-3 :	Formulate and solve material balance for reactive chemical process systems																		
CLR-4 :	Formulate and solve energy balance for chemical process systems																		
CLR-5 :	Formulate and solve material balance for simple process flow sheets.																		
CLR-6 :	Explain mass and energy balance for reactive and non-reactive systems																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Do unit conversions, Predict PVT properties of gases using ideal gas equation, calculate the composition of mixtures	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Solve the material balance for non-reactive Chemical process systems	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	H	-
CLO-3 :	Solve the material balance for the reactive chemical process systems	2	80	75	H	H	M	-	-	-	-	-	-	-	-	-	H	H	-
CLO-4 :	Solve the energy balance for chemical process systems	2	80	75	H	H	M	-	-	-	-	-	-	-	-	-	H	M	M
CLO-5 :	Solve the material balances including recycle, purge streams for simple process flow sheets.	2	80	75	H	H	M	-	-	-	-	-	-	-	-	-	H	L	M
CLO-6 :	Perform mass and energy balances for varied chemical systems	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Concept of various systems of Units and dimensions.	Law of conservation of mass	Chemical reactions and stoichiometric equations	Thermo physics: Heat capacity, Kopp's rule	Introduction to material balance for sequential processes.
	SLO-2	Unit conversions	Formulation of overall and individual component balance equations	Limiting reactant, excess reactant,	Sensible heat, latent heat and enthalpy	Introduction to material balance for sequential processes.
S-2	SLO-1	Various Temperature scales	Material balance for non-reactive chemical process systems: mixing	Conversion, Degree of completion, selectivity and yield.	Energy balance for non-reactive systems	Basic concepts of recycle and purge streams
	SLO-2	Types of Pressure	Material balance for non-reactive chemical process systems: mixing	Conversion, Degree of completion, selectivity and yield.	Energy balance for non-reactive systems	Basic concepts of recycle and purge streams
S-3	SLO-1	Temperature and Pressure unit conversions	Problems in mixing	Problem solving in Conversion	Problem solving on sensible heat	Basic concepts of bypass stream
	SLO-2	Concept of mole	Problems in mixing	Problem solving in Degree of completion, selectivity and yield.	Problem solving on sensible heat	Basic concepts of bypass stream
S-4	SLO-1	Predicting PVT properties of gases using ideal gas law	Material balance problems on crystallization process	Material balances for processes with reactions.	Thermo chemistry	Material balances for systems with recycle stream.
	SLO-2	Predicting PVT properties of gases using ideal gas law	Material balance problems on crystallization process	Material balances for processes with reactions.	Standard Heat of formation, standard heat of combustion	Material balances for systems with recycle stream.
S-5	SLO-1	Problems using Ideal gas law	Material balance problems on drying Process	Tutorial in Material balances for processes with reactions.	Hess law	Tutorial on Recycle Stream
	SLO-2	Problems using Ideal gas law	Material balance problems on drying	Tutorial in Material balances for processes	Tutorial on Thermochemistry	Tutorial on Recycle Stream

			Process	*with reactions.*		
S-6	SLO-1	*Basis of calculations*	*Material balance problems on membrane separation process*	*Combustion as a special case of material balance with reactions.*	*Heat of reaction from heat of formation or combustion*	*Material balances for non-reactive systems with bypass and purge stream*
	SLO-2	*Basis of calculations*	*Material balance problems on membrane separation process*	*Combustion as a special case of material balance with reactions.*	*Tutorial on Thermochemistry*	*Material balances for non-reactive systems with bypass and purge stream*
S-7	SLO-1	*Composition of mixtures – Solids*	*Material balance problems on distillation process*	*Fuels, types of fuel, flue gas*	*Tutorial on Thermochemistry*	*Tutorial on Multiple processes*
	SLO-2	*Composition of gas mixtures - mole, mass, volume and partial pressure.*	*Material balance problems on distillation process*	*Orsat analysis, theoretical air, excess air*	*Tutorial on Thermochemistry*	*Tutorial on Multiple processes*
S-8	SLO-1	*Density of gas mixtures*	*Tutorial on distillation*	*Problems on Combustion*	*Enthalpy changes in reactions with different temperatures*	*Material and energy balance analysis for multi-unit processes*
	SLO-2	*Density of gas mixtures*	*Tutorial on distillation*	*Problems on Combustion*	*Problem solving on Enthalpy for reactive systems*	*Case studies with simple process flow sheets*
S-9	SLO-1	*Problems on composition*	*Material balance problems on extraction process*	*Problems on Combustion*	*Problem solving on Enthalpy for reactive systems*	*Case study 1*
	SLO-2	*Problems on composition*	*Material balance problems on extraction process*	*Problems on Combustion*	*Problem solving on Enthalpy for reactive systems*	*Case study 1*
S-10	SLO-1	*Problems on composition*	*Partial saturation and humidity, types of humidity*	*Analysis of products of combustion*	*Problem solving on Enthalpy for reactive systems*	*Case study 2*
	SLO-2	*Problems on composition*	*Relative humidity and percentage humidity*	*calculation of excess air*	*Theoretical flame temperature.*	*Case study 2*
S-11	SLO-1	*Solutions and their concentrations*	*Material balances involved in two-phase gas-liquid systems as in humidification and dehumidification.*	*Tutorial on excess air*	*Theoretical flame temperature.*	*Case study 3*
	SLO-2	*Solutions and their concentrations*	*Tutorial on Humidification*	*Tutorial on excess air*	*Tutorial on Energy Balance*	*Case study 3*
S-12	SLO-1	*Tutorial on concentrations*	*Tutorial on Humidification*	*Tutorial on Reactive systems*	*Tutorial on Energy Balance*	*Tutorial on Mass balance for process flowsheets*
	SLO-2	*Tutorial on concentrations*	*Tutorial on Humidification*	*Tutorial on Reactive systems*	*Tutorial on Energy Balance*	*Tutorial on Mass balance for process flowsheets*

Learning Resources	1. *David M. Himmelblau, James B. Riggs, Basic Principles and Calculations in Chemical Engineering, 8th ed., Pearson - Prentice Hall International* 2. *B. I. Bhatt, S. B Thakore., Stoichiometry, 5th ed., Tata McGraw-Hill Publishing Company, New Delhi*	3. *B. Lakshmikutty, K. V. Narayanan, Stoichiometry and Process Calculations, PHI Publishers, Delhi* 4. *Richard M. Felder, Ronald W. Rousseau, Elementary Principles of Chemical Processes, 3rd ed., John Wiley & Sons, Inc.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.,	*1. Dr. Lima Rose Miranda, Anna University, limamiranda2007@gmail.com*	*1. Mr. V. Ganesh, SRMIST*
2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College, sundararaman.tr@rajalakshmi.edu.in*	*2. Ms. E. Kavitha, SRMIST*

Course Code	18CHC205T	Course Name	CHEMICAL ENGINEERING FLUID MECHANICS	Course Category	C	Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Describe the behavior of fluids, mechanics of fluids (fluid statics and fluid dynamics) and fluid flow phenomena	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Demonstrate the Kinematics of flow			
CLR-3 :	Analyze the flow past immersed bodies			
CLR-4 :	Elucidate the transportation of fluids			
CLR-5 :	Compare the metering of fluids			
CLR-6 :	Describe fluid flow and the its transportation.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Describe fundamental knowledge in fluids properties, classification, flow in boundary layers, and pressure measurements	1	80	70	H	H	L	-	-	-	-	-	-	-	-	-	H	H	-
CLO-2 :	Interpret Bernoulli equation, Friction factor and pressure measurements	2	85	75	H	H	M	M	M	-	-	-	-	-	-	-	H	H	-
CLO-3 :	Interpret the Ergun equation, Navier–Stokes, settling velocity and fluidization	2	80	75	H	M	M	-	M	-	-	-	-	-	-	-	H	H	-
CLO-4 :	Differentiate types of seals, valves and pumps	2	85	75	M	L	M	M	M	-	-	-	-	-	-	-	L	H	-
CLO-5 :	Differentiate flow meters and flow rate calculations	2	85	75	H	H	H	-	M	-	-	-	-	-	-	-	L	H	-
CLO-6 :	Understand the flow behavior of fluids and their handling.																		

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to fluids	Streamlines and stream tubes	Drag, drag coefficients	Introduction to: pipe and tubing	Introduction to: Metering of fluids
	SLO-2	Continuum hypothesis, Forces on fluids	Eulerian and Lagrangian descriptions Continuity equation	Drag coefficients of typical shapes	Transportation of fluids	Types of metering of fluids
S-2	SLO-1	Tutorial on forces	Bernoulli equation	Ergun equation	Joints and fittings, Flanges	Constructional features of venturi meter
	SLO-2	Newtonian and Non-Newtonian fluids	Pump work in Bernoulli equation	Navier–Stokes equation	Stuffing boxes, Mechanical seals	working principles of venturi meter
S-3	SLO-1	Hydrostatic equilibrium	Tutorial on Bernoulli equation	Settling velocity	Gate valves and globe valves	Derivation for flow measurement by using Bernoulli equation
	SLO-2	Fluid statics - pressure distribution	Tutorial on Bernoulli equation	Free and hindered settlings	Plug cocks, ball valves, check valves	Tutorial on venturi meter
S-4	SLO-1	Tutorial on pressure	Friction factor	Terminal settling velocity	Classification and selection and design of pumps	Constructional features of orificemeter
	SLO-2	Eddy viscosity	relationships between skin-friction parameters	Tutorial on Settling velocity	Design of blowers and compressors	working principles of orificemeter
S-5	SLO-1	Reynolds number	Flow of incompressible fluids	Tutorial on Settling velocity	Compressible flow	Derivation for flow measurement by using Bernoulli equation
	SLO-2	laminar and turbulent nature	Flow of incompressible fluids in conduits and thin layers	Tutorial on Free and hindered settlings	Pumps: developed head, suction lift, power requirement	Tutorial on orificemeter
S-6	SLO-1	laminar and turbulent flow in boundary	Friction factor, Moody diagram	Stokes' law	Constructional features of single suction	Constructional features and working

		layers, boundary layerformation in tubes			*volute centrifugal pump*	*principles of Pitot tube*
	SLO-2	*Unsteady flows*	*Relationships between average velocity and maximum velocity*	*Newton's law for settling*	*Working principle of single suction volute centrifugal pump*	*Derivation for flow measurement by using Bernoulli equation*
S-7	SLO-1	*Dimensional analysis*	*roughness parameter, Vorticity and Circulation*	*criterion for settling regime*	*Characteristic curves of centrifugal pump, comparison of devices for moving fluids*	*Constructional features and working principles of Rotameters*
	SLO-2	*Dimensional analysis derivation for pressure drop*	*Equivalent diameter, form friction losses in Bernoulli equation, couette flow.*	*Tutorial on Newton's law for settling*	*Tutorial on pumps*	*Derivation for flow measurement*
S-8	SLO-1	*Boundarylayer*	*Hagen-Poiseuille equation*	*Fluidization*	*Constructional features of reciprocating pump*	*Tutorial on flow measurement*
	SLO-2	*Boundary layer formation in flat plate*	*Hydraulically smooth pipe, von Karman equation*	*Types of fluidization*	*working principle of reciprocating pump*	*Tutorial on flow measurement*
S-9	SLO-1	*Manometer, types of manometers*	*Tutorial on Hagen-Poiseuille equation*	*Conditions for fluidization,*	*Tutorial on pumps*	*Target meter, turbine meter*
	SLO-2	*Tutorial on Manometer*	*Tutorial on Hagen-Poiseuille equation*	*Minimum fluidization velocity*	*Constructional features and working principle of jet ejectors*	*Vortex shedding meter, Magnetic flow meter*

Learning Resources	*1. McCabe, W.L., Smith, J.C., Harriot, P., Unit Operations in Chemical Engineering, 7th ed., McGraw-Hill, 2005* *2. Noel de Nevers, Fluid Mechanical for chemical Engineers, 2nd ed., McGraw Hill International Editions, 1991*	*3. Badger W.L. and Banchero J.T., Introduction to Chemical Engineering, Tata McGraw Hill, 1997* *4. Coulson. J.M, Richardson. J.F, Backhurst.. J.R. Harker. J.M, Coulson & Richardson's Chemical Engineering, Vol. II, 5th ed., Butter worth Heinemann, Oxford, 2002*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.,	*1. Dr. Lima Rose Miranda, Anna University, limamiranda2007@gmail.com*	*1. Dr. K. Anbalagan SRMIST*
2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College, sundararaman.tr@rajalakshmi.edu.in*	*2. Dr. S. Vishali, SRMIST*

Course Code	18CHC206T	Course Name	MECHANICAL OPERATIONS	Course Category	C	Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Illustrate the process of Characterizing, handling and storage of solids, and Screening concepts			
CLR-2 :	Explain the principle of size reduction and size enlargement of solid particles			
CLR-3 :	Describe the methods of separations of particles through fluids			
CLR-4 :	Elucidate the principles of filtration and working of various industrial filtration equipment			
CLR-5 :	Explain the concept of agitation and mixing, and various types of impellers, design of turbines			
CLR-6 :	Describe the concepts of size reduction and particle handling			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Characterize the particles size analysis	2	85	70	-	H	-	H	L	-	-	-	-	-	-	M	H	-	-
CLO-2 :	Describe the size reduction machineries	1	90	80	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-3 :	Demonstrate the fluid-solid separation techniques	3	85	75	H	H	M	H	-	-	M	-	-	-	-	-	H	-	-
CLO-4 :	Formulate the filtration concepts and design the equipment	2	85	75	H	H	H	H	-	-	M	-	-	-	-	-	H	-	-
CLO-5 :	Apply the concepts of agitation and mixing in processes	3	80	70	H	H	M	H	-	-	-	-	-	-	-	-	H	-	-
CLO-6 :	Understand particle separation based on size and their handling	3	80	70	H	H	M	H	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Characterization of solids: Particle shape and size	Purposes of size reduction	Motion of particles in fluid	Principles of Filtration	Introduction and purposes of mixing and agitation
	SLO-2	Mixed Particle size measurement techniques	Principles of Comminution	Free settling and Hindered settling	Mechanism of filtration	Agitation equipment
S-2	SLO-1	Specific surface area of mixture, Average particle size	Power and Energy requirements in size reduction	Gravity settling processes, Classifier and Clarifier	Filter Medium and Filter aids	Impellers : Turbines
	SLO-2	Tutorial on particle size	Crushing efficiency	Drag forces and Lift forces, Drag coefficient Terminal settling velocity	Cake and Filter medium Resistances	Propellers and Paddles
S-3	SLO-1	Tutorial on particle size	Empirical relationships-Rittinger's law, Kick's law, Bond's law	Settling under Stoke's law regime	Principles of cake filtration - Pressure drop through filter cake	Standard turbine design
	SLO-2	Tutorial on particle size	Tutorial on power required for size reduction	Newton's law regime	Compressible and incompressiblefilter cakes	Flow patterns inside the agitation vessel
S-4	SLO-1	Screen analysis: Differential and cumulative method	Tutorial on power required for size reduction	Tutorial on Stoke's law	Constant pressure Filtration	Prevention of swirling and vortex formation
	SLO-2	Standard screen series	Tutorial on power required for size reduction	Tutorial on Stoke's law	Constant rate filtration	Draft tubes
S-5	SLO-1	Screening equipment - Stationary screens and Grizzlies	Classification of size reduction equipments Crushers: Jaw crushers-Blake jaw	Sorting Classifiers: Sink and Float method	Tutorial on filtration	Flow number

	SLO-2	*Gyrating screens, Vibrating screens*	*Gyratory crushers*	*Differential settling method and Equal settling*	*Tutorial on filtration*	*Calculation of power consumption in Newtonian liquids*
S-6	SLO-1	*Ideal and actual screens*	*Grinders: hammer mills, Impactors*	*Batch Sedimentation*	*Tutorial on filtration*	*Dimensional analysis*
	SLO-2	*Capacity and Screen effectiveness*	*Tumbling mills : Ball mill*	*Equipment for Sedimentation: thickeners*	*Tutorial on filtration*	*Power number correlation through Buckingham's π theorem*
S-7	SLO-1	*Tutorial on Screen effectiveness*	*Critical speed of Ball mill*	*Kynch theory of sedimentation*	*Filtration equipments*	*Power correlation*
	SLO-2	*Tutorial on Screen effectiveness*	*Tutorial on Ball mill*	*Design of thickener*	*Pressure Filters-Batch Process-Plate and Frame Filter press*	*Significance of dimensionless groups*
S-8	SLO-1	*Tutorial on Screen effectiveness*	*Ultrafine grinders - Fluid energy mills*	*Tutorial on sedimentation*	*Vacuum Filters*	*Tutorial on Power correlation*
	SLO-2	*Tutorial on Screen effectiveness*	*Cutting machines: Knife cutters*	*Tutorial on sedimentation*	*Continuous filters- Rotary Drum Vacuum filter*	*Tutorial on Power correlation*
S-9	SLO-1	*Storage and transportation of solids*	*Size enlargement*	*Flocculation and Froth floatation*	*Centrifugal filters–Types of centrifuges*	*Blending of miscible liquids*
	SLO-2	*Silos, Bins, Hoppers and conveyors*	*Open and Closed circuit operation*	*Cyclone Separators, Centrifugal decanters*	*Working mechanism of Suspended batch centrifuge*	*Type of Mixers and its application*

Learning Resources	1. *McCabe, W.L., Smith, J.C., Harriot, P., Unit Operations in Chemical Engineering, 7th ed., McGraw-Hill, 2005* 2. *Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., Anderson, L.B., Principles of Unit Operations, 2nd ed., John Wiley & Sons, 2008*	3. *Badger W.L., Banchero J.T., Introduction to Chemical Engineering, Tata McGraw Hill, 1997* 4. *Coulson. J.M, Richardson. J.F, Backhurst.. J.R., Harker. J.M, Coulson & Richardson's Chemical Engineering, Vol. II, 5th ed., Butter worth Heinemann, Oxford, 2002* 5. *Swain. A, Patra H, Roy. G K, Mechanical Operations, Tata McGraw Hill, 2010*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Dr. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.,	*1. Dr. Lima Rose Miranda, Anna University, limamiranda2007@gmail.com*	*1. Dr. K. Deepa, SRMIST*	
2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College, sundararaman.tr@rajalakshmi.edu.in*	*2. Mr. K. Selvam, SRMIST*	*3. Mrs. D. Nanditha, SRMIST*

Course Code	18CHC207T	Course Name	HEAT TRANSFER	Course Category	C	Professional Core	L	T	P	C
							4	0	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Utilize heat transfer modes, evaluate rate of heat transfer, analyze steady, unsteady state conduction, evaluate heat transfer coefficient	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-2 :	Explain and analyze the basic concepts of natural and forced convection as applied to various flows and geometry.																		
CLR-3 :	Demonstrate the application of heat transfer principles in heat exchanger design																		
CLR-4 :	Explain the principles of radiation heat transfer																		
CLR-5 :	Describe the principles of evaporation and evaporator design																		
CLR-6 :	Describe the different modes of heat transfer, concepts and applications.																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Evaluate rate of heat transfer, analyze steady state and unsteady state conduction and evaluate heat transfer coefficient	2	80	75	H	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CLO-2 :	Evaluate heat transfer coefficient of natural, forced convection as applied to various flows and geometry	2	80	75	H	M	L	-	-	-	-	-	-	-	-	-	M	M	-
CLO-3 :	Design the heat exchangers	2	80	75	H	H	H	L	-	-	-	-	-	-	-	-	M	M	L
CLO-4 :	Analyze the principles of radiation heat transfer	2	80	75	H	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CLO-5 :	Design the evaporators	2	80	75	H	H	M	L	-	-	-	-	-	-	-	-	M	M	L
CLO-6 :	Understand the concepts of heat transfer and the equipments	2	80	75	H	M	L	-	-	-	-	-	-	-	-	-	M	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to various modes of heat transfer	Concept of heat transfer by convection. Natural and forced convection	Types of heat exchange equipments	Basic concepts of radiation	Introduction to Evaporation and its applications
	SLO-2	Concept of resistance to heat transfer.	Forced convection in systems of simple geometries- Flow over a flat plate	Co-current and counter -current flow in heat exchangers - Temperature distribution	Emissive power, Black body	Single effect and multiple effect evaporation
S-2	SLO-1	Fourier's law of heat conduction	Thermal boundary layer, flow across a cylinder	Double pipe heat exchanger	Gray body, emissivity, radiation intensity	Types of evaporators
	SLO-2	Effect of temperature on thermal conductivity	Mean temperature difference, LMTD	Shell and tube heat exchanger-single pass and multipass	Laws of radiation: Stefan-Boltzmann law, Planck's law, Wien's displacement law	Working principle of Long tube vertical evaporators: Falling film evaporators
S-3	SLO-1	Steady state conduction of heat through a plane wall	Application of dimensional analysis for convection	Baffles and tube arrangements	Kirchhoff's law	Climbing film evaporators
	SLO-2	Steady state conduction of heat through a hollow cylinder	Heat transfer correlations for natural Convection- Free convection from a flat surface, cylinder	multi -pass shell and tube heat exchanger, LMTD correction factor	View factor	Agitated film evaporators
S-4	SLO-1	Tutorial on conduction	Tutorial on LMTD	Fouling of a heat exchanger	Tutorial on Stefan-Boltzmann law	Evaporator capacity and economy
	SLO-2	Tutorial on conduction	Tutorial on LMTD	Tutorial on heat exchangers	Tutorial on Stefan-Boltzmann law	Boiling point elevation, Duhring's rule
S-5	SLO-1	Steady state conduction of heat through a composite plane wall	Heat transfer correlations for forced Convection	Process design considerations	Energy exchange between black bodies	Enthalpy balance equation for single effect evaporator
	SLO-2	Steady state conduction of heat through	Forced convection in laminar and turbulent	Enthalpy balance and heat duty calculation	Gray surfaces: Energy exchange between	Tutorial on Enthalpy balance

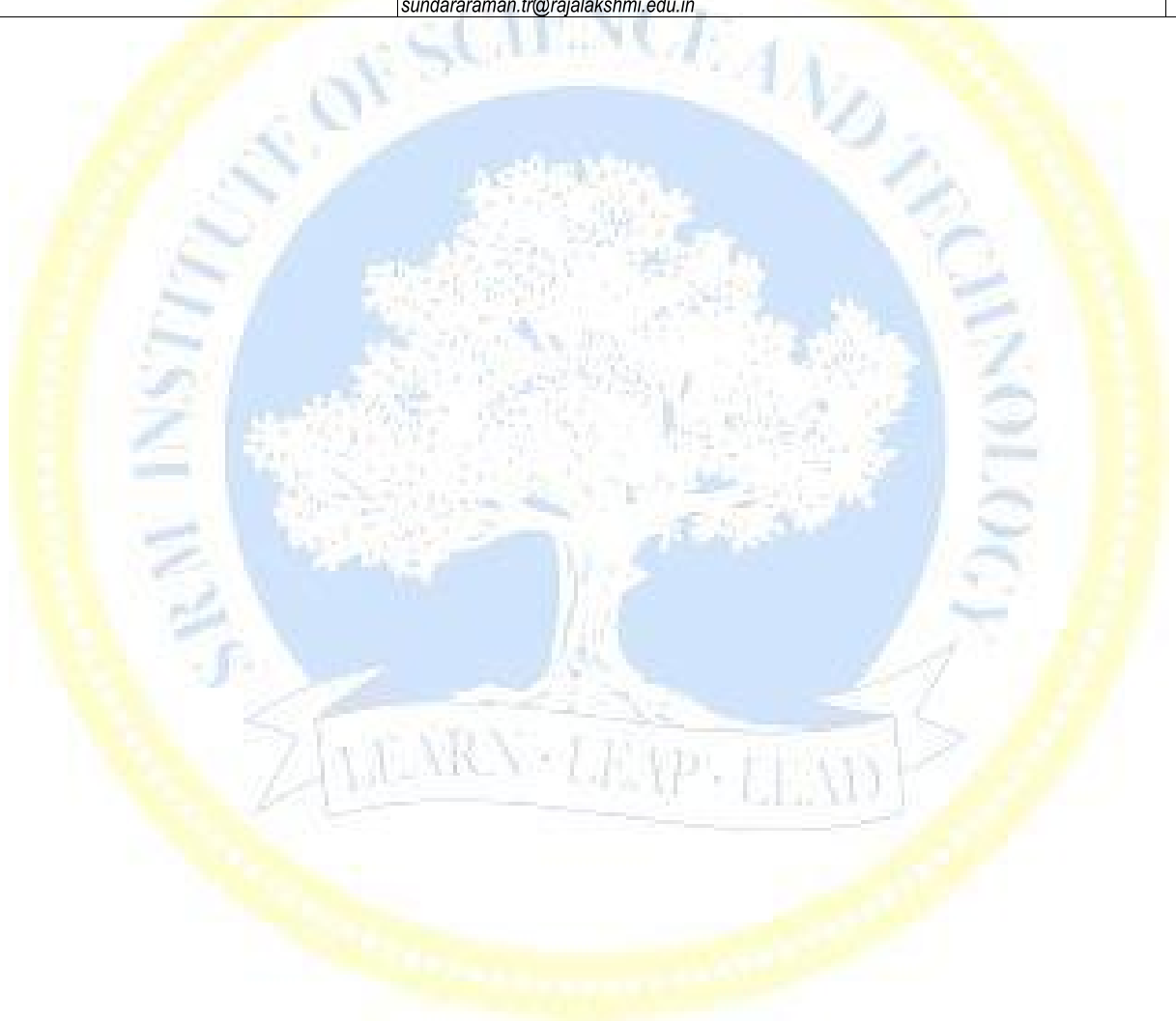
		coaxial cylinders	*flow in circular pipes*	*in double pipe heat exchanger*	*two large parallel planes*	
S-6	SLO-1	*Problem solving on composite layers*	*Overall heat transfer coefficient.*	*Tutorial on heat exchangers*	*Energy exchange between two large parallel planes of different emissivity*	*Tutorial on Enthalpy balance*
	SLO-2	*Problem solving on composite layers*	*Relationship between individual and overall heat transfer coefficients*	*Tutorial on heat exchangers*	*Energy exchange between a small object placed in a large enclosure*	*Tutorial on evaporators*
S-7	SLO-1	*Problem solving on composite layers*	*Problem solving on Overall heat transfer coefficient.*	*Enthalpy balance and heat duty calculation in shell and tube heat exchanger*	*Problem solving on energy exchange*	*Tutorial on evaporators*
	SLO-2	*Steady state conduction in bodies with heat sources - The plane wall*	*Problem solving on Overall heat transfer coefficient.*	*Tutorial on heat exchangers design*	*Problem solving on energy exchange*	*Multiple effect evaporators: Methods of feeding*
S-8	SLO-1	*Steady state conduction in bodies with heat sources - The cylinder*	*Momentum and heat transfer analogies*	*Tutorial on heat exchangers design*	*Problem solving on energy exchange*	*Comparison between the methods of feeding*
	SLO-2	*Combined conductive and convective heat transfer and the concept of Heat Transfer Coefficient*	*Heat transfer to fluids with phase change- The Condensation Phenomenon*	*Tutorial on heat exchangers design*	*Problem solving on energy exchange*	*Effect of boiling point elevation in a multiple effect evaporator*
S-9	SLO-1	*Heat transfer between fluids separated by a plane wall*	*Film wise and drop wise condensation*	*The effectiveness- NTU method of heat exchanger analysis*	*Radiation shield*	*capacity and economy of multiple effect evaporators*
	SLO-2	*Heat transfer between fluids separated by a cylindrical wall*	*Heat transfer coefficientfor film wise condensation -condensation on vertical and horizontal cylinders*	*Expression for Effectiveness of parallel flow double pipe heat exchanger*	*Radiation intercepted by a shield placed between two large parallel planes*	*Enthalpy balance equation for multiple effect evaporator*
S-10	SLO-1	*Tutorial on Combined conductive and convective heat transfer*	*Tutorial on condensation*	*Expression for Effectiveness of counter current flow double pipe heat exchanger*	*Radiation intercepted by a shield in a cylindrical enclosure*	*Problem solving on evaporators effect*
	SLO-2	*Tutorial on Combined conductive and convective heat transfer*	*Tutorial on condensation*	*Tutorial on heat exchangers design*	*Radiation intercepted by a shield in a spherical enclosure*	*Tutorial on multiple effect evaporators*
S-11	SLO-1	*Critical insulation thickness, applications*	*Effect of non-condensable gases*	*Tutorial on heat exchangers design*	*Tutorial on Radiation shield*	*Tutorial on multiple effect evaporators*
	SLO-2	*Heat transfer from Extended surfaces – The Fins*	*The boiling phenomenon*	*Tutorial on heat exchangers design*	*Tutorial on Radiation shield*	*Tutorial on multiple effect evaporators*
S-12	SLO-1	*Unsteady state heat conduction - Introduction*	*The regimes of boiling in pool boiling*	*Tutorial on heat exchangers effectiveness*	*Tutorial on Radiation shield*	*Tutorial on multiple effect evaporators*
	SLO-2	*Unsteady state heat conduction –Cartesian coordinates*	*Correlations for pool boiling heat transfer*	*Tutorial on heat exchangers effectiveness*	*Tutorial on Radiation shield*	*Evaporator selection*

Learning Resources	1. *Holman J.P, Heat Transfer, 10th ed. Tata McGraw Hill, 2010* 2. *Binay K Dutta, Heat Transfer: Principles and Applications, PHI Learning Private Limited, 2010*	3. *Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, 7th ed., McGraw Hill Education, 2014*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.,	*1. Dr. Lima Rose Miranda, Anna University, limamiranda2007@gmail.com*	*1. Mr. V. Ganesh, SRMIST*
2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College, sundararaman.tr@rajalakshmi.edu.in*	*2. Ms. E. Kavitha, SRMIST*



Course Code	18CHC208T	Course Name	PRINCIPLES OF MASS TRANSFER	Course Category	C	Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18CHC303T
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Explain the basic principles of mass transfer, Diffusion phenomena and rate of mass transfer			
CLR-2 :	Illustrate various theories of mass transfer, dimensionless numbers and rate of mass transfer across fluid interfaces			
CLR-3 :	Apply the principles of gas absorption and design an ideal tray/packed absorption tower			
CLR-4 :	Demonstrate humidification and dehumidification operations and design the cooling tower			
CLR-5 :	Explain the principles of drying, different types of driers and drying time for different drying periods			
CLR-6 :	Describe the basics of mass transfer and their concepts			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Gain basic knowledge of mass transfer principles, and solve diffusion problems for fluids	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-2 :	Determine mass transfer coefficients and identify rate controlling mechanism	2	80	75	H	H	M	L	-	-	-	-	-	-	-	-	M	M	-
CLO-3 :	Design the absorption column and analyze the performance of packed and plate columns	3	80	75	H	H	M	M	-	-	-	-	-	-	-	-	M	M	-
CLO-4 :	Solve humidification and dehumidification problems and design cooling towers	3	80	75	H	H	M	L	-	-	-	-	-	-	-	-	M	M	-
CLO-5 :	Gain knowledge on the basic principles of drying, selection of driers and calculate drying time	2	80	75	H	H	M	M	-	-	-	-	-	-	-	-	M	M	-
CLO-6 :	Understand the fundamentals of mass transfer and the equipments																		

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Mass Transfer operations	Introduction to Mass transfer coefficients	Introduction to Gas absorption	Introduction to humidification	Introduction, Importance of drying in processes
	SLO-2	Diffusion and its types, Fick's I law of Diffusion	Types of mass transfer coefficients	Packing Characteristics	Humidity, dry bulb temperature, saturated gas, saturation humidity	principles of drying, wet Basis and dry basis calculations
S-2	SLO-1	Steady state molecular diffusion in fluids at rest and in laminar flow	Relationship between mass transfer coefficients	Types of tower packings	Relative humidity, percentage humidity, humid volume	Free moisture, equilibrium moisture, bound and unbound moisture
	SLO-2	Molecular diffusion in gases: steady state diffusion of A through non diffusing B	Dimensionless groups in mass transfer	Characteristics of solvent	Humid heat, total enthalpy, dew point	Mechanism of drying
S-3	SLO-1	Tutorial on diffusion	Simultaneous momentum, heat and mass transfer	Contact between liquid and gas	Concept of adiabatic saturation	Constant and falling rate period
	SLO-2	Gas phase equimolal counter diffusion. Diffusion in Multicomponent gas mixtures	Theories of mass transfer: film theory	pressure drop and limiting flow rates	Adiabatic saturation temperature	Rate of drying curve, critical moisture content
S-4	SLO-1	Tutorial on diffusion	Penetration theory	Material balances	Wet-bulb temperature, theory of wet-bulb temperature	Calculate drying time under constant drying conditions: constant rate period
	SLO-2	Tutorial on diffusion	surface-renewal Theory	limiting gas-liquid ratio	psychrometric line and Lewis relation	Calculate drying time: falling rate period Total drying time
S-5	SLO-1	Molecular diffusion in liquids: steady state diffusion of A through non diffusing B	Interphase Mass Transfer	Rate of absorption	Humidity chart, use of humidity chart	Tutorial on constant and falling rate period

	SLO-2	*Tutorial on diffusion*	*Equilibrium between phases*	*calculation of tower height*	*Tutorial on humidification*	*Tutorial on drying*
S-6	SLO-1	*Tutorial on diffusion*	*Concentration profile in Interphase mass transfer*	*number of transfer units, height of transfer unit*	*Tutorial on humidification*	*Tutorial on drying*
	SLO-2	*Liquid phase equimolal counter diffusion*	*Two film theory*	*alternate forms of transfer coefficients*	*Tutorial on humidification*	*Classification of dryers, solids handling in dryers*
S-7	SLO-1	*Tutorial on counter diffusion*	*Mass transfer using Film Mass transfer Coefficients and Interphase concentrations*	*Tutorial on absorption*	*Types of Cooling towers*	*equipment's for batch and continuous drying processes*
	SLO-2	*Tutorial on counter diffusion*	*Overall Mass transfer Coefficients and Driving Forces*	*Tutorial on absorption*	*Working principle of cooling towers*	*Working principle of tray drier*
S-8	SLO-1	*Pseudo – steady state Diffusion.*	*Relation between individual and overall mass transfer coefficient*	*Absorption in plate columns: Determination of number of plates, Tray efficiencies*	*Design of a cooling tower*	*Working principle of rotary drier*
	SLO-2	*Tutorial on counter diffusion*	*Tutorial on mass transfer coefficient*	*Height equivalent to a theoretical plate (HETP)*	*NTU, HTU concept*	*Working principle of spray drier*
S-9	SLO-1	*Effect of temperature and pressure on diffusivity*	*Experimental determination of mass transfer coefficients*	*Tutorial on HETP*	*Tutorial on design of a cooling tower*	*Working principle of fluidized bed drier*
	SLO-2	*Tutorial on diffusivity*	*Tutorial on mass transfer coefficient*	*Introduction to absorption with chemical reaction*	*Tutorial on design of a cooling tower*	*Concept of freeze drying*

Learning Resources	1. *Robert E. Treybal, Mass-Transfer Operations, 3rd ed., McGraw Hill Education, 2012* 2. *Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, 7th ed., McGraw Hill Education, 2014*	3. *Christie John Geankoplis, Transport Processes and Separation Process Principles (Includes Unit Operations), 4th ed., Pearson India Education Services Pvt. Ltd., 2015* 4. *Binay K. Dutta, Principles of Mass transfer and Separation Processes, Prentice- Hall of India, New Delhi, 2007*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

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1. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.,	*1. Dr. Lima Rose Miranda, Anna University, limamiranda2007@gmail.com*	*1. Mrs. E. Poonguzhali, SRMIST*
2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College, sundararaman.tr@rajalakshmi.edu.in*	*2. Ms. E. Kavitha, SRMIST*

Course Code	18CHC209L	Course Name	CHEMICAL ENGINEERING LABORATORY - I	Course Category	C	Professional Core	L	T	P	C
							0	0	4	2

Pre-requisite Courses	18CH206T, 18CHC205T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize solid handling techniques as size reduction & particle separation techniques using Crushing, grinding and screening equipments	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Demonstrate the of Filtration techniques and design of filters			
CLR-3 :	Analyze the fluid - Solid separation techniques and to design of thickener			
CLR-4 :	Analyze the metering of fluids and Frictional loss calculation			
CLR-5 :	Compare the transportation devices and design the pumps			
CLR-6 :	Demonstrate the concepts of mechanical operation and the fluid mechanics.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Handle the size reduction machineries	1	80	75	M	L							H						
CLO-2 :	Learn the fundamentals and understand the design of filters	2	80	75	H	M	M	M					L						
CLO-3 :	Differentiate the fluid–Solid separation techniques and can implement the knowledge in design the equipments	3	90	80	H	M	M	M					L			H			
CLO-4 :	Interpret the knowledge in design of piping system	2	80	75	M	M	L	M					L			H			
CLO-5 :	Operate and execute the knowledge to design of pumps	2	80	75	L	L	L						L			H			
CLO-6 :	Analyze the various size reduction techniques and fluid flow.	1	80	75	M	L							H						

Duration (hour)		12	12	12	12	12
S 1-4	SLO-1	Determine Average Particle Size using Sieve Analysis method	Calculate efficiency of given cut diameter opening of Sieve using Screen Effectiveness method	Find size reduction ratio of the given Solid material Using Jaw crusher	Calculate size reduction ratio of the given substance using Ball Mill and to find the critical speed of mill	Analyze settling of particle under gravity using batch sedimentation set up and design of thickener
	SLO-2					
S 5-8	SLO-1	Find the particle size and collection efficiency using Cyclone separator	Calculate Cake and medium resistance using plate and frame filter press	Determine Conveyance efficiency of Screw Conveyor	Calculate Cake and Medium resistance using Vacuum leaf filter	Find the size reduction ratio of the given material using Drop Weight Crusher
	SLO-2					
S 9-12	SLO-1	Find the Orifice Coefficient using Orifice Meter and Venturi meter	Determine discharge coefficient on V-Notch in open flow channel	Verify relationship between Reynolds number and friction factor using pipe friction test Rig.	Verify performance Characteristics of pumps	Calculate Pressure drop of flow through packed bed
	SLO-2	Find the discharge coefficient using Rota Meter	Calculate pressure loss coefficient of contraction, Expansion and fittings on pipe			Calculate minimum fluidization velocity of flow through Fluidized bed

Learning Resources	1. McCabe, W.L., Smith, J.C., and Harriot, P., Unit Operations in Chemical Engineering, 7th ed., McGraw-Hill, 2005.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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