MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute affiliated to RGPV, Bhopal)

B.Tech. I Semester (Chemical Engineering) *For batches admitted in academic session 2022-23*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	Mode of Exam	Duration of Exam
				Theory Slot				Practical Slot										
				End Sem.		Mid Sem. Exam.	Quiz/ Assignment	End Sem	Lab Work & Sessional	Skill Based Mini Project		L	T	P				
				End Term Evaluation	$Proficiency in subject /course													
1.	170121	DC	Fuel Technology	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP	2Hrs
2.	100020	ESC	Basic Civil Engineering & Mechanics	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP	2Hrs
3.	100021	ESC	Basic Mechanical Engineering	50	10	20	20	-	-	-	100	2	1	-	3	Blended	MCQ	1.5 Hrs
4.	100022	ESC	Basic Electrical & Electronics Engineering	50	10	20	20	60	20	20	200	2	1	2	4	Blended	MCQ	1.5 Hrs
5.	170122	DC	Computer Programming	50	10	20	20	60	20	20	200	2	1	2	4	Blended	AO	2Hrs
6.	100024	ESC	Manufacturing Practices	-	-	-	-	60	20	20	100	-	-	2	1	Offline	SO	-
Total				**250**	**50**	**100**	**100**	**240**	**80**	**80**	900	**10**	**5**	**8**	**19**	-	-	-
7.	3000004	**Natural Sciences & Skills**	**Language**	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ	1.5 Hrs

Induction program of first three weeks (MC):Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visit / Virtual Visit to local Areas, Familiarization to Dept./Branch & Innovations

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$Proficiency in course/subject – includes the weightage towards ability/ skill/ competency /knowledge level /expertise attained etc. in that particular course/subject

Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language (Credits of Natural Sciences & Skills will be added in the VI Semester)

MCQ: Multiple Choice Question AO: Assignment + Oral OB: Open Book PP: Pen Paper SO: Submission + Oral

Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
-	-	15	4	06	03	06	04	19
-	-	78.94%	21.05%	31.57%	15.78%	31.57%	21.05%	Credits %

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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B.Tech. (Chemical Engineering) II Semester *For batches admitted in academic session 2022-23*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	Mode of Exam	Duration of Exam
				Theory Slot				Practical Slot										
				End Sem.														
				End Term Evaluation	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Lab Work & Sessional	Skill Based Mini Project		L	T	P				
1.	100011	BSC	Engineering Mathematics – I	50	10	20	20	-	-	-	100	3	1	-	4	Offline	PP	2 Hrs
2.	170221	DC	Chemical Process Calculations	50	10	20	20	-	-	-	200	2	1	-	3	Blended	PP	2 Hrs
3.	100014	ESC	Engineering Graphics	50	10	20	20	-	-	-	100	3	-	-	3	Offline	AO	2 Hrs
4.	170222	DC	Python Programming	50	10	20	20	60	20	20	100	2	1	2	4	Blended	MCQ	1.5 Hrs
5.	170223	DC	Fluid Particle Mechanics	50	10	20	20	60	20	20	100	2	1	2	4	Blended	PP	2 Hrs
6.	100018	ESC	Eg. Graphics Lab	-	-	-	-	60	20	20	100	-	-	2	1	Offline	SO	-
Total				**250**	**50**	**100**	**100**	**180**	**60**	**60**	**800**	**12**	**4**	**6**	**19**	-	-	-
7.	**3000003**	**Natural Sciences & Skills**	**Environmental Engineering**	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ	1.5 Hrs
Summer Internship Project – I (Institute Level) (Qualifier): Minimum two-week duration: Evaluation in III Semester.																		

$Proficiency in course/subject – includes the weightage towards ability/ skill/ competency /knowledge level /expertise attained etc. in that particular course/subject

Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language (Credits of Natural Sciences & Skills will be added in the VI Semester)

MCQ: Multiple Choice Question AO: Assignment + Oral OB: Open Book PP: Pen Paper SO: Submission + Oral

Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
07	-	09	03	10	03	03	03	19
36.84%	-	47.36%	15.78%	52.63	15.78%	15.78%	15.78%	Credits %

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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Department of Chemical Engineering

Scheme of Evaluation

B. Tech. III Semester *For batches admitted in academic session 2022-23*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching (Online, Offline, Blended)	$$Mode of Exam.
				Theory Slot				Practical Slot				L	T	P			
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation								
				End Sem. Exam	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.		**BSC**	Engineering Mathematics-II	50	10	20	20	-	-	-	100	3	1	-	**4**	Offline	PP
2.	2170311	**DC**	Fluid Mechanics	50	10	20	20	60	20	20	200	2	1	2	**4**	Blended	PP
3.	2170312	**DC**	Organic Process Technology	50	10	20	20	-	-	-	100	3	-	-	**3**	Blended	PP
4.	2170313	**DC**	Chemical Engineering Thermodynamics	50	10	20	20	-	-	-	100	3	-	-	**3**	Blended	PP
5.	2170314	**DC**	Heat Transfer	50	10	20	20	60	20	20	200	3	-	2	**4**	Blended	PP
6.	2170315	**DLC**	Chemical Synthesis Lab	-	-	-	-	60	20	20	100	-	-	2	**1**	Offline	SO
7.	2170316	**DLC**	Self-learning/Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	40	-	40	-	-	2	**1**	Online + Mentoring	SO
8.	200XXX	**CLC**	**Novel Engaging Course (Informal Learning)**	-	-	-	-	50	-	-	50	-	-	2	**1**	Interactive	SO
9.	2170317	**DLC**	Summer Internship Project–I (Institute Level) (Evaluation)	-	-	-	-	60	-	-	60	-	-	4	**2**	Offline	SO
Total				**250**	**50**	**100**	**100**	**290**	**100**	**60**	**950**	**14**	**2**	**14**	**23**	-	-
10.	3000002	**Natural Sciences & Skills**	Engineering Chemistry	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ
11.	1000001	**MAC**	Indian Constitution & Traditional Knowledge	50	10	20	20	-	-	-	100	2	-	-	GRADE	Online	MCQ

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Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language (Credits of Natural Sciences & Skills will be added in the VI Semester)

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Department of Chemical Engineering
Scheme of Evaluation
B. Tech. IV Semester *For batches admitted in academic session 2022-23*

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching (Online, Offline, Blended)	$$Mode of Exam.
				Theory Slot				Practical Slot				L	T	P			
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation								
				End Sem. Exam.	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.		BSC	Engineering Mathematics-III	50	10	20	20	60	20	20	200	2	1	2	4		
2.	2170411	DC	Instrumentation & Process Control	50	10	20	20	-	-	-	100	3	-	-	3		
3.	2170411	DC	Mass Transfer –I	50	10	20	20	60	20	20	200	3	-	2	4		
4.	2170411	DC	Mechanical Design of Process Equipments	50	10	20	20	-	-	-	100	3	-	-	3		
5.	2170411	DC	**Inorganic Process Technology**	50	10	20	20	-	-	-	100	3	-	-	3		
		MC	Cyber Security	50	10	20	20	-	-	-	100	2	-	-	2		
6.	2170411	DLC	Process Control Lab	-	-	-	-	60	20	20	100	-	-	2	1		
7.	200XXX	CLC	**Novel Engaging Course (Informal Learning)**	-	-	-	-	50	-	-	50	-	-	2	1		
Total				**250**	**50**	**100**	**100**	**230**	**60**	**60**	**850**	**16**	**01**	**8**	**21**	-	-
8.	3000001	Natural Sciences & Skills	Engineering Physics	50	10	20	20	-	-	-	100	2	-	-	GRADE	Online	MCQ
Summer Internship Project-II (Soft skills Based) for two weeks duration: Evaluation in V Semester																	

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Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language (Credits of Natural Sciences & Skills will be added in the VI Semester)

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Subject Code: Fuel Technology

Category	Title	Code	Credit	Theory Paper
	Fuel Technology			

Course Objectives: To introduce the basic knowledge about solid, liquid and gaseous fuels. To provide knowledge about origin, classification and quality control of Fuels. To introduce various renewable energy resources used as an alternative to these fuels.

Syllabus

UNIT-I Solid Fuel: Origin and Classification of coal, analysis and properties of coal, oxidation of coal, hydrogenation of coal, Coal Liquefaction, agro fuels, solid fuel handling.

UNIT-II Coal Carbonization: Mechanism of low and high temperature carbonization, By product recovery from coke oven, Grinding, Pulverization and briquetting of solid fuel.

UNIT-III Liquid Fuel: Classification of petroleum products, Handling and storage of petroleum products, Refining and other conversion processes including cracking, reforming, hydro-treating. Quality control of Petroleum Products.

UNIT-IV Gaseous Fuel: Types of gaseous fuels, natural gases, methane from coal mines, manufactured gases, producer gas, water gas, blast furnace gas, refinery gas, LPG, cleaning and purification of gaseous fuels.

UNIT-V Renewable energy Sources: Introduction to Wind Energy, Solar Thermal Energy, Geothermal Energy and Wave Energy. Status of Renewable Energy Projects in India.

Course outcomes: After the successful completion of this course, students will be able to:

CO1: Differentiate between various Fuels

CO2: Know about Quality Control Parameters for different types of fuels

CO3: Develop process flow for petroleum fuel.

CO4: Analyze the major engineering problems involved in the process.

CO5: Make interpretation about the renewable energy sources.

CO6: explain the current status of fuel consumption and requirement in India.

Text Books:

1. O.P. Gupta (1st Edition 2018, Khanna Publishers) E-lements of Fuel and Combustion Technology
2. R. Prasad (1st Edition 1995, Khanna Publishers)- Petroleum Refining Technology
3. S.C. Bhatia, R. K. Gupta -Textbook of Renewable Energy (Woodhead Publishing India in Energy) 2019)

References:

1. G.D Hobson (9th Edition 198, john Willey & Sons)- Modern Petroleum Technology Part-I & II
2. Mehmet Kanoğlu,Yunus A. Çengel, John M. Cimbala (1st Edition, 2020 McGraw-Hill Education)- Fundamentals and Application of Renewable Energy

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170221: Chemical Process Calculations

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Chemical Process Calculation	170211	L	T	P	Max.Marks-60 Min.Marks-19
			2	1	2	Duration-2hrs.

Course Objective:

To understand and apply the basics of calculations related to material and energy flow in the processes.

Syllabus:

Unit-I: Mathematical and Engineering Calculations:- Units and dimensions, conversion units, expression and equations, Dimensional groups and constants, stochiometric and composition relationships, conversion of mass, mass and volumetric reactions, basis of compositions, Excess reactants , degree of completion.

Unit-II: Ideal Gases & vapor Pressure: Behavior of ideal gases, Gaseous mixtures, vapor pressure , Clausius Clapeyron equation, Cox chart, Duhring's plot, Raoult's law, Humidity and saturation, relative humidity, humid volume, dew point, humidity chart and its use.

Unit-III: Material Balance: Crystallization, dissolution, solving material balance problems with and without simultaneous equations, Recycle, bypass and purge calculations

Unit-IV: Energy Balance: Heat capacity, calculation of enthalpy changes, Energy balance with chemical reactions,

Unit-V: Heat of vaporization, Heat of formation, Laws of thermo chemistry, Heat of combustion of fuels, Heat and Theoretical flame temperature, Case study of selected problems.

Course Outcomes: After the completion of this course, Students will be able to

CO1 **Recall** different unit system, basic mass volume relationship, conversion of units

CO2 **Classify** ideal and non –ideal gases.

CO3 **Solve** energy balance problems.

CO4 **Analyze** the recycle, bypass, and purge calculation.

CO5 **Estimate** the raw material requirement for synthesis of a chemical product based on stoichiometry.

CO6 **Estimate** the performance of chemical equipment using material and energy balance

Text Books

1.O.A. Hougen, K.M. Watson, R.A. Ragatz (CBS publications New Delhi 1995 edition)- Chemical Process Principles**,** part-I

Reference Books

1.David M. Himmelbau(prentice Hall ,sixth edition Feb. 1999)- BASIC PRINCIPLES AND CALCULATIONS IN CHEMICAL ENGINEERING.

2. B.L.Bhatt, S.M. Vora(Tata Mc-Graw –Hill, 1996) STOCHIOMETRY.

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170223: FLUID PARTICLE MECHANICS

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Fluid Particle Mechanics	170223	L	T	P	Max.Marks-50 Duration-2hrs.
			3	-	2	

Course Objective:

To understand basic principles of various mechanical operations & construction and working of the equipments.

Syllabus:

Unit-I: Particulate Solids: Properties of particulate solids, Evaluation of size and shape, surface and population of particles, standard screens and screen analysis of solids. **Size Reduction:** Principles of comminution, size reduction, crushing, grinding, pulverizing and ultra fine size reduction equipment, power requirement in comminution.

Unit-I: Mixing: Mixing of solids, mixing equipment's design and power requirement of mixers, Mixer Effectiveness and Mixing Index.

Unit-III: Separation: Principles of Separation techniques for system involving solids, liquids and gases, Classification, Sedimentation, filtration, separation equipments.

Unit-IV: Transportation and Handling of Solids: Selection and conveying devices for solids: Belt, Chain, Screw- conveyors, elevators and pneumatic conveying devices, Elementary design aspects of the devices

Unit –V: Fluidization & Application: Particulate & aggregative fluidization, Characteristics of fluidized bed due to particle size, size distribution, shape and density, Pressure drop through a fluidized bed, Character of dense phase fluidization as revealed by pressure drop fluctuations, Up flow and down flow fluidization, Fluid Catalytic process, bed drying, Mass transfer in fluidized beds.

Course Outcomes: After the completion of this course, Students will be able to

CO1 **Recognize** the application of Screen Analysis in Industry.

CO2 **Describe** the various methods of size reduction using the various principles.

CO3 **Explain** the separation techniques and equipments.

CO4 **Illustrate** the various process like sedimentation, filtration etc.

CO5 **Classify** the various conveying devices.

CO6 **Illustrate** the fluidization and fluid catalytic process.

Text Books

1. Badger & Bencharo- INTRODUCTION TO CHEMICAL ENGG- Tata Mc Grawhill 1998.
2. McCabe Smith- UNIT OPEARATION OF CHEMICAL ENGG, Mc Graw Hill 2001.

Reference Books

1. Coulson & Richordson Vol. 2-CHEMICAL ENGG. New Delhi Asian Book Pvt. Ltd.
2. G.G. Brown- UNIT OPERATIONS-CBS Publications New Delhi 1995.

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2170311: FLUID MECHANICS

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Fluid Mechanics	2170311	L	T	P	Max.Marks-50 Duration-2hrs.
			2	1	2	

Course Objective:

To understand the basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery like pumps and various flow meters.

Syllabus:

Unit –I: Introduction: Properties of fluid, forces on fluid, stresses, the concept of constitution relations, fluid statics, Normal forces in fluid, pressure measurement, forces on submerged bodies, buoyancy, Stability.

Unit-II: Classification of Fluids: Newtonian and Non – Newtonian fluid, Viscosity measurement, Equations of changes: Equation of Continuity & Equation of Motion, Navier stokes equation, concept of Reynolds number and friction factor: friction for rough and smooth pipes, loss of head due to friction in pipes and fittings.

Unit-III: Boundary layer theory, Bernoulli's equation, fluid machinery, pumps, fans, blowers, compressors and vacuum pumps, Power and head requirement for pumps.

Unit-IV: Flow of incompressible fluid in conduits and thin layers, flow past immersed bodies, Dimensional analysis, Buckingham π- Theorem, dimensionless numbers and their significance, similitude criteria.

Unit-V: Measurement of Flow: Fluid flow Measurement pitot tube, orifice meter, venture meter, rotameter, weirs and notches.

Course Outcomes: After the completion of this course, Students will be able to

CO1 **Explain** the fundamentals of fluid statics & fluid flow.

CO2 **Estimate** pressure drops, forces acting on bodies & power and head requirements of pumps.

CO3 **Apply** equations of change to various fluid flow systems.

CO4 **Formulate** the interdependence of various parameters using dimensional analysis.

CO5 **Determine** the flow rate through different flow measuring devices.

CO6 **Examine** the losses due to friction in pipes and other fluid machinery.

Text Books

1.W.L. McCabe & J.C. Smith- UNIT OPERATIONS IN CHEMICAL ENGG- 7rd edition McGraw Hill.

Reference Books

1. J.M. Coulson & J.F. Richardson- Chemical Engineering- Vol I & II.
2. B.S. Maney, Zel(SI) Van Nostand & Reinhold- Mechanics of Fluid-ELBS, 1970.
3. I. Grannet- Fluid Mechanics for Engineering and Technology.
4. S.K. Gupta- Momentum Transfer- New Age Publication

List of Experiments:

1. To determine the local point pressure with the help of a pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. To determine the viscosity of a spherical body in water.
4. To find the pressure drop in a packed bed,
5. To study the flow behavior of a Non-Newtonian fluid and to determine the flow constants.
6. To determine the power number- Reynolds Number curve.
7. To differentiate between laminar and turbulent flow using Reynolds experiments.
8. To study the characteristics of an air compressor.
9. To study the characteristics of a centrifugal pump.
10. To study the flow of a fluid in a pipeline and to prepare the friction factor-N_{Re} plot.
11. To determine the friction losses, expansion losses and reduction losses in bends and pipes and verify the Bernoulli equation.
12. To prepare the calibration curve for an orifice meter and Rotameter.
13. To prepare the calibration curve for a Venturimeter.

Note: Every student should perform at least eight experiments out of the above list.

Lab Course Outcomes

After the completion of this lab course, Students will be able to

CO1 Analyze the effects of flow measurement by flow measuring devices.
CO2 Calculate the degree of error in discharge rate of rotameter.
CO3 Calculate the coefficient of discharge for venturimeter and orifice meter.
CO4 Calculate the coefficient of discharge for notches & weirs.
CO5 Analyze the losses in pipe fittings & pressure drop in packed bed
CO6 Analyze transportation of fluids via pumps & other devices.

2170312: ORGANIC PROCESS TECHNOLOGY

Category	Title	Code	Credits-3			Theory Paper
Departmental Core-DC	Organic Process Technology	2170312	L	T	P	Max.Marks-50 Duration-2hrs.
			3	0	0	

Course Objective:
The purpose of the organic process technology course is to improve knowledge of the chemical processes along with emphasis on recent technological development.

Syllabus:

Unit-I: Pulp and paper industry-Raw Materials, types of pulp and its preparation, Manufacturing of paper, Agro based industries, Fermentation industry, Alcohol by fermentation, Citric acid and Antibiotics like Penicillin.

Unit-II: Intermediates for petrochemicals from petroleum based stocks, phenol, methanol, ethylene propylene, aromatic, toluene and xylene, polymer industries.

Unit-III: Preparation, manufacturing and properties of Fats and oil, man made fiber; rayon, polyester polyamides and acrylics, cellulose and acetate, Rubber industries, Soap and detergent. Insecticides and pesticides, Dyes and dyes intermediate.

Unit-IV: Carbon Technology: Introduction, Classification of activated carbons, raw materials and manufacture of activated carbons, classification of carbon fibers, precursors for carbon fibers, manufacture of carbon fibers from polyacrylonitrile, manufacture of carbon black by furnace black process, applications.

Unit-V: Nanotechnology: Introduction, properties of Nanoparticles like optical properties, reactivity, synthesis, Introduction, Structure and properties of carbon Nanotubes and fabrication of carbon nanotubes & applications.

Course Outcomes: After the completion of this course, Students will be able to

CO1: **Explain** the processing of natural products.
CO2: **Describe** microbial processes and edible oil refining process.
CO3: **Elaborate** the processes for producing petrochemicals.
CO4: **Characterize** polymers and elaborate its production processes.
CO5: **Describe** the production processes of fibers.
CO6: Evaluate the different processes from economical aspects.

Text Books

1. Austin, G.T. Shreve's Chemical Process Industries -5th edition McGraw Hill New York 1984.
2. Dryden C.E., Outlines of chemical technology-3rd edition affiliated East – West Press, New Delhi, 1997.

Reference Books

1.V. B. Gupta & V.K. Kothari- Manufacturing Fiber Technology- Chapman Hall, New York I edition 1997.
2. V.K. Kothari-Process in Textile, science Technology, Vol –I & II –IAFL publication, S-351 Greater Kailash part-I New Delhi.-48 Ed.

2170313: Chemical Engineering Thermodynamics

Category	Title	Code	Credit-3			Theory Paper
Departmental Core-DC	Chemical Engineering Thermodynamics	2170313	L	T	P	Max.Marks-50 Duration-2hrs.
			3	0	0	

Course Objective:
To understand the basic concepts and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase and chemical equilibria.

Syllabus

Unit- I The First law of Thermodynamics and Equations of State: Steady and unsteady closed and flow process, Critical properties corresponding state, Compressibility, P-V-T behavior of pure fluids, Virial-equations, Generalized correlations and eccentric factor.

Unit-II The Second and Third Law of Thermodynamics: Entropy of various systems, Thermodynamics equations, Effect of pressure on specific heat, Joule-Thompson effect, Third law of thermodynamics, Compression of ideal gas, Refrigeration capacity, Carnot cycle, Vapor compression cycle, Air refrigeration cycle.

Unit-III Thermodynamic Properties of Fluids: Thermodynamic properties of homogeneous mixtures, Property relations for systems of variable compositions, Partial properties, Fugacity and Fugacity coefficient in ideal solutions, Properties change of mixing, Activity, Heat effects of mixing process, Excess properties, Activity coefficient of gaseous mixtures.

Unit-IV Phase Equilibria: Criteria of phase equilibrium and stability, Phase equilibrium in single component system, Phase rule, Gibbs-Duhem's equation, Vapor-liquid equilibria.

Unit- V Chemical Reaction Equilibria: Chemical potential, Effect of pressure and temperature on heat of reaction and on free energy, Van't Hoff's equation, Clausius-Clapeyron equation, Chemical Reaction Equilibria and its applications

Course Outcomes: After the successful completion of this course, students will be able to

CO1: infer the fundamental concepts of thermodynamics to chemical engineering applications.
CO2: explain the first and second laws of thermodynamics with their practical implications.
CO3: analyze the processes involving refrigeration and compression.
CO4: classify the thermodynamic properties of solutions with their relationships.
CO5: infer the detail of vapor liquid equilibria and its use in practical situations.
CO6: analyze the chemical equilibrium with thermodynamics for predicting behavior of reacting systems.

Text Books

1. Smith J.M. & Van Ness., "Introduction to Chemical Engineering Thermodynamics", McGraw Hill
2. Sandler, S.I., "Chemical Engineering Thermodynamics", John Wiley & Sons
3. Dodge B.F., "Chemical Engineering Thermodynamics", McGraw Hill
4. Narayanan K.V., "Chemical Engineering Thermodynamics", Prentice Hall India Learning Private Limited

Reference Books

1. Balzhiser, Samuels and Eliassen, "Chemical Engineering Thermodynamics", Prentice Hall.
2. Rao Y.V.C, "Chemical Engineering Thermodynamics", University Press (I) Ltd., Hyderabad
3. Kyle B.G., "Chemical Process Thermodynamics", Prentice Hall of India Pvt. Ltd., New Delhi

2170314: HEAT TRANSFER

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Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Heat Transfer	2170314	L	T	P	Max.Marks-50 Duration-2hrs.
			2	1	2	

Course Objective:

To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

Syllabus:

Unit – I: Modes of heat transfer one-dimensional and two dimensional, heat rate equations, theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylindrical and sphere.

Unit-II: Consecutive heat transfer, heat transfer in boundary layer and in film, natural and forced convection, co/ counter /cross current contacting for heat transfer, individual and overall heat transfer coefficient, fouling factor.

Unit- III: Radiative heat transfer, Black body radiation, concept of shape factor, method of determination of shape factor, radiation exchange in enclosure with black surfaces.

Unit-IV: Heat transfer under phase change conditions, boiling and condensation of pure components, heat flux temperature diagram for boiling and condensation under vertical and horizontal surfaces, nucleate and pool boiling, effect of surface condition of condensation, correlation for heat transfer under condensation. Evaporation: Types of evaporators and their applications, single and multiple effect evaporators, Design and operation of forward, backward and mixed feed operations, effect of boiling point elevation and hydrostatic heat vapor recompression.

Unit- V: Heat exchange equipment- General design of shell and tube exchangers, condensers, extended surface equipment, heat exchanger equation – coli to fluid, jacket to fluid, double pipe, shell and finned tube heat exchanger.

Course Outcomes: After the completion of this course, Students will be able to

CO1: Explain the mechanism of heat transfer by conduction, convection and radiation.
CO2: **List** dimensionless Numbers applicable in heat transfer and their physical significance.
CO3: **Illustrate** individual and overall heat transfer coefficient.
CO4: **Explain** all parts of the Heat Exchangers and Evaporators.
CO5: **Analyze** the design of various types of Heat exchangers.
CO6: Analyze the design of various types of Evaporators.

Text Books

1. J. P. Holman – Heat Transfer – P.H.I.

Reference Books

1. Donald Q. Kern- Process Heat Transfer– Tata Mc Graw Hill.
2. Alan J. Chapman- Heat Transfer IV ED. – Collier Mc. Millan.

List of Experiments:

1. To determine the thermal conductivity of metal rod.
2. To determine the equivalent thermal conductivity of composite wall.
3. To determine heat transfer coefficient in forced convection.
4. To determine heat transfer coefficient in natural convection.
5. To determine heat transfer coefficient with the help of Stefan Boltzmann Apparatus.
6. To calculate emissivity of the test plate by emissivity measurement apparatus.
7. To determine heat transfer coefficient in double pipe heat exchangers.
8. To study the heat transfer characteristics of a shell and tube heat exchanger (Heating / cooling) of water.
9. To determine heat transfer coefficient in counter and parallel flow heat exchanger.
10. To measure the rate of evaporation using an open pan evaporator.
11. To measure the rate of condensation of pure water vapor and to determine the heat transfer coefficient.
12. Demonstrate the film wise, drop wise condensation and determination of heat transfer coefficient.
13. To study the single effect evaporator and find out the heat transfer coefficient.

Note: Each student should perform at least eight experiments out of the above list.

Lab Course Outcomes

After the completion of this lab course, Students will be able to

CO1: Able to understand the modes of heat transfer conduction, convection and radiation

CO2: Analyze the application of various experimental heat transfer correlations in engineering applications

CO3: Evaluate the thermal analysis and sizing of heat exchangers.

CO4: Evaluate the emissivity of materials

CO5: Study the thermal conduction in metal rod

CO6: Able to know the application of heat exchanging equipment in chemical process industries.

2170315: CHEMICAL SYNTHESIS LAB

Category	Title	Code	Credits-1			Practical Paper
Departmental Lab-DLC	Chemical Synthesis Lab	2170315	L	T	P	Max.Marks-30 Min.Marks-10.
			-	-	2	

Course Objective

The aim of this course is to give you exposure to advanced synthetic techniques, introduce you to chemical literature searches, give you experience following and expanding on literature preparations, and provide you with an opportunity to improve your technical writing.

List of Experiments:

1. To determine BOD & COD for a given wastewater sample.
2. Preparation of acetic acid from ethyl alcohol.
3. To find out the sucrose content in aqueous solution by polarimeter.
4. To evaluate the viscosity of molasses.
5. To determine the percentage of formaldehyde in formalin.
6. To determine iodine value of the given oil sample.
7. To determine the acetic acid, ethanol concentration in aqueous solutions.
8. To prepare azo dye and find the yield.
9. Prepare a standard phenol solution and estimate the percentage of phenol in the given unknown sample of phenol.
10. To prepare urea formaldehyde resin and report percentage conversion.
11. To determine total dissolved and suspended solids in water and wastewater
12. To determine turbidity in water and waste water
13. To determine hardness of water

Note: Each student should perform at least eight experiments out of the above list.

Course Outcomes: After the completion of this course, Students will be able to

CO1. Research a specific compound, or a family of compounds, to propose a synthetic route for isolation of this compound.

CO2. Perform advanced manipulations of apparatus relevant to a synthetic chemistry laboratory; use a Schlenk line to synthesize oxygen- and moisture-sensitive products.

CO3. Characterize chemical compounds using modern spectroscopic techniques.

CO4. Maintain a laboratory notebook following scientific best practices.

CO5. Communicate findings in a format consistent with the scholarly standards of the chemical sciences.

CO6. Articulate and follow ethical principles in a scientific context, including professional standards of laboratory practice, the communication of literature research without plagiarism, and the crediting of collaborators.