PONDICHERRY ENGINEERING COLLEGE, PUDUCHERRY – 605 014

CURRICULUM AND SYLLABI FOR AUTONOMOUS STREAM

B.TECH. (CHEMICAL ENGINEERING) COURSES

(FOR STUDENTS ADMITTED FROM ACADEMIC YEAR 2014-15 ONWARDS)

CURRICULUM[a]

I SEMESTER

Subject Code	Subject	Category*	Periods			Marks#			Credits
			L	T	P	CA	SE	TM	
MA101	Mathematics I	TB	3	1	-	40	60	100	4
PH101	Engineering Physics	TA	4	-	-	40	60	100	4
CY101	Engineering Chemistry	TA	4	-	-	40	60	100	4
BE101	Basic Civil and Mechanical Engineering	TC	4	-	-	40	60	100	4
CE101	Engineering Mechanics	TB	3	1	-	40	60	100	4
HS101	Communicative English	TA	4	-	-	40	60	100	4
PH103	Physics Laboratory	LB	-	-	3	60	40	100	2
CY103	Chemistry Laboratory	LB	-	-	3	60	40	100	2
ME103	Workshop Practice	LB	-	-	3	60	40	100	2
Total Credits									**30**

II SEMESTER

Subject Code	Subject	Category*	Periods			Marks#			Credits
			L	T	P	CA	SE	TM	
MA102	Mathematics II	TB	3	1	-	40	60	100	4
PH102	Material Science	TA	4	-	-	40	60	100	4
CY102	Environmental Science	TA	4	-	-	40	60	100	4
BE102	Basic Electrical and Electronics Engineering	TC	3	1	-	40	60	100	4
ME101	Engineering Thermodynamics	TA	3	1	-	40	60	100	4
CS101	Computer Programming	TA	3	1	-	40	60	100	4
ME102	Engineering Graphics	EGD	2	-	3	50	50	100	4
CS102	Computer Programming Laboratory	LB	-	-	3	60	40	100	2
BE103	Basic Electrical and Electronics Laboratory	LB	-	-	3	60	40	100	2
Total									**32**

CA – Continuous Assessment, **SE** – Semester Examination, **TM** – Total Marks

***** **TA** – Theory Category A, **TB** – Theory Category B, **TC** – Theory Category C,
LB – Laboratory**, EGD** – Engineering Graphics / Drawing
POD – Practice Oriented Design, **TCP** – Theory Combined with Practice, **PR** - Practice

[a] Approved in 3rd Academic Council Meeting

III SEMESTER

Subject Code	Subject	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
MA103	Mathematics III	TB	3	1	-	40	60	100	4
CY104	Physical Chemistry	TA	4	-	-	40	60	100	4
CE103	Mechanics of Solids-I	TB	3	1	-	40	60	100	4
EE136	Electrical and Electronics Engineering	TA	3	1	-	40	60	100	4
CH101	Process Calculations	TB	3	1	-	40	60	100	4
CH102	Momentum Transfer	TA	3	1	-	40	60	100	4
CY105	Physical Chemistry Laboratory	LB	-	-	3	60	40	100	2
EE137	Electrical and Electronics Engineering Laboratory	LB	-	-	3	60	40	100	2
Total Credit									**28**

IV SEMESTER

Subject Code	Subject	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
MA106	Partial Differential Equations and Numerical Methods	TB	3	1	-	40	60	100	4
CY106	Organic Chemistry	TA	4	-	-	40	60	100	4
CH103	Chemical Engineering Thermodynamics	TA	3	1	-	40	60	100	4
CH104	Process Heat Transfer	TA	3	1	-	40	60	100	4
CH105	Mass Transfer I	TB	3	1		40	60	100	4
-	Programme Elective I / General Elective I	TX[@]	-	-	-	-	-	100	4
CY107	Organic Chemistry Laboratory	LB	-	-	3	60	40	100	2
CH106	Momentum Transfer Laboratory	LB	-	-	3	60	40	100	2
Total Credits									**28**

TX[@] - Theory Course (Category TA/ TB/ TC/TCP)

V SEMESTER

Subject Code	Subject	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
CH107	Mass Transfer II	TB	3	1	-	40	60	100	4
CH108	Mechanical Operations	TA	4	-	-	40	60	100	4
CH109	Chemical Reaction Engineering I	TB	3	1	-	40	60	100	4
-	Programme Elective II	TX[@]	-	-	-	-	-	100	4
-	Programme Elective III / General Elective II	TX[@]	-	-	-	-	-	100	4
CH110	Heat Transfer Laboratory	LB	-	-	3	60	40	100	2
CH111	Mass Transfer Laboratory	LB	-	-	3	60	40	100	2
CH112	Mechanical Operations Laboratory	LB	-	-	3	60	40	100	2
Total Credits									**26**

VI SEMESTER

Subject Code	Subject	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
ME129	Industrial Engineering and Management	TA	4	-	-	40	60	100	4
CH113	Chemical Reaction Engineering II	TA	3	1	-	40	60	100	4
CH114	Chemical Process Industries	TA	4	-	-	40	60	100	4
-	Programme Elective IV	TX[@]	-	-	-	-	-	100	4
-	Programme Elective V/ General Elective III	TX[@]	-	-	-	-	-	100	4
CH115	Process and Mechanical Design of Chemical Equipment	POD	2	-	3	60	40	100	4
CH116	Chemical Reaction Engineering Laboratory	LB	-	-	3	60	40	100	2
CH117	Computational Laboratory	LB	-	-	3	60	40	100	2
HS102	General Proficiency	PR	-	-	3	100	-	100	1
Total Credits									**29**

TX[@] - Theory Course (Category TA/ TB/ TC/TCP)

VII SEMESTER

Subject Code	Subject	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
CH118	Transport Phenomena	TB	3	1	-	40	60	100	4
CH119	Process Dynamics and Control	TB	3	1	-	40	60	100	4
CH120	Process Engineering Economics	TA	4	-	-	40	60	100	4
-	Programme Elective VI	TX[@]	-	-	-	-	-	100	4
-	Programme Elective VII /General Elective IV	TX[@]	-	-	-	40	-	100	4
CH121	Process Control and Simulation Laboratory	LB	-	-	3	60	40	100	2
CH122	Project Work (Phase I)	PR	-	-	3	100	-	100	2
CH123	Professional Ethics and Practice	PR	-	-	3	100	-	100	1
Total Credits									**25**

VIII SEMESTER

Subject Code	Subject	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
-	Programme Elective VIII	TX[@]	4	-	-	40	60	100	4
-	Programme Elective IX	TX[@]	4	-	-	40	60	100	4
-	Programme Elective X/General Elective V	TX[@]	4	-	-	40	60	100	4
CH124	Comprehensive Test and Viva-Voce	PR	-	-	3	60	40	100	1
CH125	Project Work (Phase II)	PR	-	-	9	60	40	100	6
-	Professional Development Courses (*3 one credit courses*)	PR	-	-	-	100	-	300	3
Total Credits									**22**

TX[@] - Theory Course (Category TA/ TB/ TC/TCP)

LIST OF PROGRAMME ELECTIVES

Subject Code	Subject	Category
CHP01	Energy Technology and Management	TA
CHP02	Bioprocess Engineering	TA
CHP03	Risk and Safety Management in Process Industries	TA
CHP04	Nano Technology	TA
CHP05	Process Modeling and Simulation	TCP
CHP06	Polymer Science and Technology	TA
CHP07	New Separation Techniques	TA
CHP08	Petrochemical Technology	TA
CHP09	Nuclear Technology	TA
CHP10	Drugs and Pharmaceutical Technology	TA
CHP11	Pinch Technology	TA
CHP12	Chemical Process Synthesis	TA
CHP13	Enzyme Engineering	TA
CHP14	Chemical Engineering Practice	TA
CHP15	Pollution Control in Process Industries	TA
CHP16	Sugar Technology	TA
CHP17	Membrane Technology	TA
CHP18	Fluidization Engineering	TA
CHP19	Process Optimization	TCP
CHP20	Petroleum Refinery Engineering	TA

LIST OF GENERAL ELECTIVES

Sl. No.	Subject Code	Subject	Category
1	**CEG01**	Entrepreneurship Development	TA
2	**CEG02**	Finite Element Analysis	TB
3	**CEG03**	Fluid Mechanics and Machines	TB
4	**CEG04**	Building Maintenance	TA
5	**CEG05**	Building Physics	TA
6	**CEG06**	Non Destructive Testing Methods	TA
7	**CEG07**	Building Automation and Smart Structures	TA
8	**CEG08**	Heath Monitoring of Structures	TA
9	**CEG09**	Remote Sensing and GIS	TA
10	**CEG10**	Experimental Stress Analysis	TA
11	**CEG11**	Environment Impact Assessment	TA
12	**CEG12**	Industrial Waste Disposal and Treatment	TA
13	**CEG13**	Project Management	TA
14	**CEG14**	Fluid Mechanics and Strength of Materials	TB
15	**MEG01**	Elements of Project Management	TA
16	**MEG02**	Fluid and Thermal machines	TA
17	**MEG03**	Industrial Automation	TA
18	**MEG04**	Industrial Refrigeration and Air-Conditioning	TA
19	**MEG05**	Quantitative Techniques for Engineers	TA
20	**MEG06**	Renewable energy	TA
21	**ECG01**	Consumer Electronics	TA
22	**ECG02**	Communication Theory	TA
23	**ECG03**	CMOS VLSI Design	TA
24	**ECG04**	Communication for Engineers	TA
25	**ECG05**	Avionics	TA
26	**CSG01**	Hardware and Troubleshooting	POD
27	**CSG02**	JAVA Programming	TCP
28	**CSG03**	Fundamentals of Operating Systems	TA
29	**CSG04**	Object Oriented Programming using C++	TA
30	**CSG05**	Microprocessors and its Applications	TA
31	**EEG01**	Electrical Machines and Utilizations	TA
32	**EEG02**	Soft Computing Techniques	TA
33	**EEG03**	Power Generation Systems	TA
34	**EIG01**	System Design Using Advanced Microcontrollers	TA

35	**EIG02**	Measurement and Instrumentation	TA
36	**EIG03**	Process Instrumentation	TA
37	**EIG04**	PLC and Industrial Automation	TA
38	**EIG05**	Micro-Electro Mechanical Systems	TA
39	**EIG06**	Neural Networks and Fuzzy logic	TA
40	**CHG01**	Process Engineering Principles	TA
41	**CHG02**	Fundamentals of Momentum, Heat and Mass Transfer	TA
42	**CHG03**	Heat Transfer Analysis	TA
43	**CHG04**	Non-Conventional Energy	TA
44	**ITG01**	Bio-Informatics	TA
45	**ITG02**	Principles of Programming Languages	TA
46	**ITG03**	Introduction to Operating Systems	TA
47	**ITG04**	Introduction to Database and Oracle	TA
48	**ITG05**	Business Process	TA
49	**MAG01**	Linear Algebra	TA
50	**MAG02**	Queuing Theory and Networks	TA
51	**MAG03**	Optimization Techniques	TA
52	**PHG01**	Introduction to Nanoscience and Nanotechnology	TA
53	**PHG02**	Nanotechnology and Nanoelectronics	TA
54	**PHG03**	Non Destructive Testing	TA
55	**PHG04**	Smart Materials and Structures	TA
56	**CYG01**	Cheminformatics	TA
57	**CYG02**	Instrumental Methods of Chemical Analysis	TA
58	**HSG01**	Soft skill and Personality Development	TA
59	**HSG02**	Engineering Economics and Management	TA

CONSOLIDATED CREDIT DISTRIBUTION

Sl. No.	Course type	Credits		
		Theory	**Lab/ Practice**	**Total**
1	Basic Sciences (Mathematics, Physics, Chemistry)	32	12	44
2	Basic Engineering Courses	36	15	51
3	Programme Core Courses	47	24	71
4	Programme Electives	24	-	24
5	General Electives	08	-	08
6	Project Work and Comprehensive Viva-voce	-	09	09
7	Humanities and Social Sciences	08	-	08
8	General Skill Development Courses			
	(a) Soft Skill Development	-	01	01
	(b) Professional Development and Ethics	-	04	04
	(c) Mandatory Courses		*3 zero credits*	*3 zero credits*
	Total	**155**	**65**	**220**

SYLLABUS (Core Subjects)

Department: Mathematics					**Programme:** B.Tech.			
Semester : One					**Category :** TB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
MA101	Mathematics I	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To introduce the ideas of differential and integral calculus • To familiarize students with functions of several variables • To introduce methods for solving differential equations							
Outcome	• Understands Calculus • Functions of several variables • Able to solve differential equations							
UNIT – I					**Hours: 09**			
Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.								
UNIT – II					**Hours: 09**			
Partial derivatives, Total derivative, Differentiation of implicit functions, Change of variables, Jacobians and their properties, Partial differentiation of implicit functions, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.								
UNIT – III					**Hours: 09**			
Multiple Integrals, change of order of integration in double integrals, Applications: Plane areas (double integration), Change of variables (Cartesian to polar), volumes by solids of revolution, double and triple integrations (Cartesian and polar) – Center of mass and Gravity (constant and variable densities).								
UNIT – IV					**Hours: 09**			
Exact equations, First order linear equations, Bernoulli's equation, orthogonal trajectories, growth, decay and geometrical applications. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.								
UNIT – V					**Hours: 09**			
Linear differential equations of higher order - with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes:**			**Total Hours: 60**			
Text Books:								
1. Erwin Kreyszig, Advanced Engineering Mathematics (9th Ed), John Wiley & Sons, New Delhi, 2011. 2. Venkataraman M.K., Engineering Mathematics, Vol. I&II, National Publishing Company, Chennai, 2007. 3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.								
Reference Books:								
1. Sundaram V. et al, Engineering Mathematics, Vol. I& II, Vikas Publications, 6th Edition, 2007. 2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010. 3. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2011.								

Department : Physics		**Programme :** B.Tech.						
Semester : One		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
PH101	Engineering Physics	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To provide a bridge between basic Physics and Engineering courses. • To introduce the concepts and applications of Ultrasonics, Optics, Lasers, Optical Fibers, and wave mechanics and fundamentals of crystal structure.							
Outcome	• At the end of the course, Students would have adequate exposure to the concepts of the various topics of this Engineering Physics course and their real life applications.							
UNIT – I	**Acoustics and Ultrasonics**				**Hours: 12**			
Acoustics: Factors affecting Acoustics of Buildings and their Remedies - Sabine's formula for Reverberation Time – sound absorption coefficient & its determination; **Ultrasonics:** Ultrasonic Waves- Properties-Production by Piezoelectric & Magnetostriction methods. Detection-acoustic grating and piezoelectric transducer methods. Applications of ultrasonic waves-Industrial applications, Medical application-sonogram. Flaw detection by ultrasonic NDT -Ultrasonic Pulse Echo Method.								
UNIT – II	**Optics**				**Hours: 12**			
Interference: Air Wedge – Michelson's Interferometer – Types of fringes- Determination of Wavelength of a light source– Antireflection Coatings -Interference Filter; **Diffraction:** Concept of Resolution of Spectral lines-Rayleigh's criterion -Resolving Power of Grating, Prism & Telescope; **Polarisation :** Basic concepts of Double Refraction and Optical Rotation- Quarter and Half Wave Plates – Specific Rotatory Power – Laurent's Half Shade Polarimeter-polarizing filters								
UNIT – III	**Crystal Structure and Lattice Defects**				**Hours: 12**			
Crystal structure: Space Lattice**,** Unit Cell, Lattice Parameters, Crystal Systems, Bravais Lattices- Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC, HCP structures – Miller Indices- Powder X Ray Diffraction Method; **Lattice Defects**: Qualitative ideas of point, line, surface and volume defects and their influence on properties of solids								
UNIT – IV	**Wave Mechanics**				**Hours: 12**			
Matter Waves – de Broglie hypothesis – Uncertainty Principle – Schrodinger Wave Equations – Time Dependent – Time Independent – Application to Particle in a One Dimensional potential Box –Concept of Quantum Mechanical Tunneling (without derivation) – Applications of tunneling (qualitative) to Alpha Decay, Tunnel Diode, Scanning Tunneling Microscope.								
UNIT – V	**Lasers and Fiber Optics**				**Hours: 12**			
Lasers : Principles of Laser – Spontaneous and Stimulated Emissions - Einstein's Coefficients – population Inversion and Laser Action –optical resonators(qualitative)- Types of Lasers – Nd:YAG, CO_2 laser, GaAs Laser**-** Industrial & Medical applications of Lasers; **Fiber Optics**: Principle and Propagation of light in optical fiber– Numerical aperture and acceptance angle – Types of optical fibers-based on Material, refractive index profile, Modes of propagation(single & Multimode Fibres) -Qualitative ideas of attenuation in optical Fibers-Applications of Optical Fibers- Fibre Optic communication (Schematic), Active and passive fibre optic sensors, Endoscope								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Avadhanulu M N , Engineering Physics, S. Chand & Co, 2007.
2. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.

Reference Books:

1. Ajoy Ghatak, Optics, 5th Edition TMH, New Delhi, 2012.
2. K.R.Nambiar**,** Lasers, New Age International, New Delhi, 2008.
3. K. Thyagarajan and Ajoy Ghatak, Lasers Fundamentals and Applications, 2nd Edition, Springer 2010.
4. V Raghavan , Materials Science and Engineering- A First Course, 5th Edition, Prentice Hall of India, 2008.
5. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi 2008.
6. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co, 2006.

Department : Chemistry		**Programme :** B.Tech						
Semester : One		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CY101	Engineering Chemistry	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To know the importance of chemistry in engineering education • To understand the chemistry of industrial processes • To apply the knowledge of chemistry to solve engineering problems							
Outcome	• Students will be able to understand and appreciate usefulness of chemistry concepts in the design, fabrication and maintenance of materials for engineering applications. • Students will gain knowledge about the chemistry background of some of the important industrial processing techniques. • With the knowledge gained in conceptual chemistry, engineering students will be able to approach confidently the design and development of futuristic materials to meet the requirement of industry and society.							
UNIT – I	**Water Treatment**				**Hours: 12**			
Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water- EDTA method. Disadvantages of hard water-boiler scale and sludge, caustic embrittlement, priming and foaming and boiler corrosion. Water softening methods – internal and external conditioning – lime-soda process, zeolite process and ion exchange process. Desalination – reverse osmosis and electro dialysis. Specifications for drinking water, BIS and WHO standards.								
UNIT – II	**Industrial Polymers**				**Hours: 12**			
Classification, types of polymerization reactions - mechanism of free radical, ionic and Ziegler-Natta polymerizations. Polymer properties - chemical resistance, crystallinity and effect of temperature. Polymer molecular weight - Mn and Mw. Thermoplastics and thermosets. Rubbers – vulcanization. Synthetic rubber - Buna S, Buna N, Silicone and Butyl rubber. Conducting polymers – classification and applications. Moulding constituents of plastic. Biodegradable polymers – preparation, properties and applications of PLA, PCL and PGA. Liquid crystalline polymers.								
UNIT – III	**Electrochemical Cells**				**Hours: 12**			
Galvanic cells, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes – hydrogen, calomel, Ag/AgCl and glass electrodes. Batteries - primary and secondary batteries, Laclanche cell, lead acid storage battery, Ni-Cd battery and alkaline battery. Fuel cells - H_2-O_2 fuel cell.								
UNIT – IV	**Corrosion and Control**				**Hours: 12**			
Chemical and electrochemical corrosion – Galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion. Corrosion control methods - cathodic protection and corrosion inhibitors. Protective coatings - types of protective coatings - metallic coating - tinning and galvanizing, cladding, electroplating and anodizing.								
UNIT – V	**Engineering Materials**				**Hours: 12**			
Abrasives – Natural and artificial abrasives. Refractories – classification, properties and manufacture. Refractory bricks – silica bricks, fire clay bricks, high alumina bricks and silicon carbide bricks. Glass and ceramics – properties, manufacture and types of glass, ceramics – clays - types, fabrication of ceramic ware. Composite materials – classification. Processing of fibre-reinforced composites, applications. Glazing.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi, 2004. 2. S.S. Dara and S.S Umare, A Textbook of Engineering Chemistry, S. Chand & Co., Ltd. New Delhi, 2013.								
Reference Books:								
1. B. K. Sharma, Engineering Chemistry, Krishna Prakashan Media (P) Ltd., Meerut, 2001. 2. P.Kannan,A.Ravikrishnan, Engineering Chemistry, Sri Krishna Hi-tech. Publishing Company Pvt.Ltd, Chennai, 2009. 3. V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Polymer Science, New Age Intl (P) Ltd, Chennai, 2006.								

Department : Civil Engineering / Mechanical Engineering				**Programme :** B.Tech				
Semester : One				**Category :** TC				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
BE101	Basic Civil and Mechanical Engineering	4	-	-	4	40	60	100
Prerequisite								
Objectives	• To be able to differentiate the types of buildings according to national building code. • To understand building components and their functions as well as different types of roads, bridges and dams • To convey the basics of Mechanical Engineering • To establish the necessity of basics of Mechanical Engineering to other engineering disciplines • To explain the concepts of thermal plants used in power systems being a common issue • To narrate the methods of harnessing renewable energies and their working principles • To explain the role of basic manufacturing processes • To develop an intuitive understanding of underlying working principles of mechanical machines and systems.							
Outcome	• Parallels are drawn between the subject and the student's everyday experience so that this course may be related to what the students already know. • Students are made to understand the principles of Mechanical Engineering based on theories. • Students are encouraged to make engineering judgments, to conduct independent exploration of topic of renewable energy systems and to communicate the findings in a professional manner. • Students are made to develop natural curiosity to explore the various facets of mechanical equipment and machines. • While emphasizing basic principles, students are provided with explanations used in real time engineering systems.							
UNIT – I	**Buildings and Building Materials**				**Hours: 10**			
Buildings-Definition-NBC Classification - plinth area, floor area, carpet area, floor space index-construction materials-stone, brick, cement, cement-mortar, concrete, steel- their properties and uses. Impact of manufacture and use of building materials on the environment.								
UNIT – II	**Buildings and their Components**				**Hours: 10**			
Buildings: Types and Behaviour. Foundation: Soil classification – functions and types of foundations. Masonry: Types and uses. Floors: Types and functions. Roofs-Types and functions. Concepts of green building.								
UNIT – III	**Basic Infrastructure**				**Hours: 10**			
Surveying-Types, general principles, uses, instruments used. Roads - Components, types and their merits and demerits. Bridges-components and types of bridges. Dams-Purpose, types of dams and its components. Water supply-sources and quality requirements. Rainwater harvesting.								
UNIT – IV	**IC Engines and Steam Generators**				**Hours: 10**			
IC engines – Classification – Working principles - Diesel and petrol engines: two stroke and four stroke engines – Merits and demerits. Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits - Applications.								
UNIT – V	**Conventional and Non-conventional Power Generation**				**Hours: 10**			
Power Generation Systems – Convectional and Non-Conventional: Hydraulic – Thermal – Nuclear power plants – Schemes and layouts (Description Only) Solar – wind –Geothermal - Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).								
UNIT – VI	**Introduction to Manufacturing Technology**				**Hours: 10**			
Machines: Lathe – Drilling machine – Grinding machine (Description only) Machining Processes: Turning – Planning – Facing – Taper turning – Knurling – Chamfering – Drilling – Grinding Moulding: Pattern making – Green and dry sand moulding – casting. Metal Joining – Arc and Gas welding –								

Brazing – Soldering (process description only).			
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Natarajan, K V, Basic Civil Engineering, 11th Edition, Dhanalakshmi Publications, Chennai, 2011. (*For Units I to III*)
2. Lindberg, R.A.Process and Materials of Manufacture, PHI, 1999.
3. H.N.Gupta, R.C.Gupta and Arun Mittal, Manufacturing Processes, New Age Publications, 2001.
4. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

Reference Books:

1. Purushothama Raj.P., Basic civil engineering, 3rd Edn., Dhanam Publications, Chennai, 2001.
2. Punmia, B.C., et.al Building Construction, Laxmi Publishers, New Delhi, 2012.
3. El.Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co., 1985.
4. Hajra Choudhry, et. al., Workshop Technology Vol. I and II, Media Promoters Publishers Pvt. Ltd., Bombay, 2004.

Web sites:

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/
2. http://ocw.mit.edu/courses/mechanical-engineering/

Department : Civil Engineering				**Programme :** B.Tech.				
Semester : One				**Category :** TB				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CE101	Engineering Mechanics	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To explain the importance of mechanics in the context of engineering. • To understand the static equilibrium of particles and rigid bodies in two dimensions • To introduce the techniques for analyzing the forces in the bodies. • To study the motion of a body and to write the dynamic equilibrium equation.							
Outcome	• On successful completion of the course, a student would be able to identify and analyze the problems by applying the principles of engineering mechanics, and to proceed to advanced study on mechanical systems.							
UNIT – I	**Fundamentals of Mechanics**				**Hours: 09**			
Mechanics and its relevance, Force System, Definition- Force, Moment and Couple -Principle of Transmissibility, laws of mechanics, Resultant of force system – Concurrent and non-concurrent coplanar forces, Conditions of static equilibrium for coplanar force system, stability and equilibrium, concept of free body diagrams.								
UNIT – II	**Application of Force System**				**Hours: 09**			
Types loads and supports – simply supported beams, cantilever beams and plane trusses – reactions (Introduction only). Friction: Laws of friction, Static dry friction, simple contact friction problems, body on inclined planes, ladders, wedges, simple screw jack.								
UNIT – III	**Properties of Surfaces**				**Hours: 09**			
Properties of sections – centroids, center of gravity, area moment of inertia, product moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia. Principle of virtual work – work done – application to simple structural arrangements.								
UNIT – IV	**Kinematics and Kinetics of Particles**				**Hours: 09**			
Introduction of Dynamics – Types of Motion – D Alembert's principle – work energy method – work energy equation for translation and – Motion of connected bodies – work done by a spring – Impulse momentum equation – conservation of momentum – Impact of elastic bodies – oblique impart – Loss of kinetic energy.								
UNIT – V	**Kinematics and Kinetics of Rigid Bodies**				**Hours: 09**			
Circular Motion of Rigid bodies – Acceleration during circular motion – Rotation of rigid bodies – Angular motion – Relationship between Angular and linear motion – Kinetics of Rigid body rotation – General plane of motion – Kinematics – Instantaneous Axis of rotation – kinetics of Rolling bodies – Kinetics of General plane motion.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Bhavikatti,S.S and Rajashekarappa,K.G., Engineering Mechanics, New Age International (P) Ltd, New Delhi, 2013.								
Reference Books:								
1. Timoshenko, S., Young, D.H., Rao, J.V. and Sukumar Pati, Engineering Mechanics, Fifth edition, McGraw Hill Education (India) Pvt. Ltd., 2013. 2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol. 2 Dynamics, McGraw – Hill International Edition, 1997.								

Department : Humanities and Social Sciences		**Programme** : B.Tech.						
Semester : One		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
HS101	Communicative English	4	-	-	4	40	60	100
Prerequisite								
Objectives	• To improve the LSRW skills of I. B.Tech students • To instill confidence and enable the students to communicate with ease • To equip the students with the necessary skills and develop their language prowess							
Outcome	On successful completion of the module students should be able to: • communicate effectively in English • get rid of their inhibitions • possess effective language skills • improve their career prospects							
UNIT – I	**Basic Concepts of Communicative English**				**Hours: 12**			
Definition – Importance – Process – Channels and Types – Barriers – Strategies for Effective Communicative – Listening Skills.								
UNIT – II	**Comprehension and Analysis**				**Hours: 12**			
Comprehension of Technical and Non – Technical Passages – Skimming. Scanning, Inferring – Note-making, Predicting and responding to context –Intensive Reading and Reviewing.								
UNIT – III	**Writing**				**Hours: 12**			
Paragraph and Essay – Report – Memorandum – Instructions – Job Application Letters – Resume – E-Mail Writing.								
UNIT – IV	**Oral Communication**				**Hours: 12**			
Basics of Phonetics- Presentation Skills- Group Discussions –Extempore- Debates- Role Plays.								
UNIT – V	**Vocabulary and Language Through Literature**				**Hours: 12**			
Analysis of 1. "English in India", R.K. Narayan 2. "Toasted English", R.K. Narayan 3. "Politics and the English Language", George Orwell Contextual variations of language – interpretation of literary language – vocabulary building – nuances of language (grammar, pronunciation, spelling) – developing critical framework.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books: 1. Ashraf M. Rizvi. Effective Technical Communication. New Delhi: Tata McGraw, 2005. 2. George Orwell. Essays. Penguin Books, 2000. 3. R.K.Narayan. A storyteller's World. Penguin Books, 1989.								
Reference Books: 1. Daniel Jones. English Pronouncing Dictionary. Cambridge University Press, 2003. 2. Sanjay Kumar and Pushpalata. Communication Skills. New Delhi: OUP, 2011. 3. Nory Sankar Mukerjee. Business Communication: Connecting at Work. New Delhi: OUP, 2013.								

Department : Physics					**Programme :** B.Tech.			
Semester : One					**Category :** LB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
PH103	Physics Laboratory	-	-	3	2	60	40	100
Prerequisite								
Objectives	To provide a practical understanding of some of the concepts learnt in the theory course on Physics and Materials Science.							
Outcome	The Students would have gained practical experience about some of the Theoretical concepts learnt in the Physics and Materials Science courses.							

List of Experiments:

(Any 10 experiments including a maximum of 2 Demonstration experiments are to be performed.)

1. Radius of curvature of a Lens - Newton's rings
2. Thickness of a thin object by Air – wedge
3. Spectrometer – Resolving power of a Prism
4. Spectrometer – Resolving power of a Transmission grating
5. Determination of wavelength of a Laser source using transmission grating, reflection grating (vernier calipers) & particle size determination
6. Determination of numerical aperture & Accptance angle of an optical fiber.
7. Laurent's Half shade polarimeter – Determination of specific rotatory power*
8. Spectrometer - Hollow prism / Ordinary & Extraordinary rays by Calcite Prism*
9. Determination of optical absorption coefficient of materials using laser*
10. Coefficient of Thermal conductivity - Radial flow method
11. Coefficient of Thermal conductivity – Lee's Disc method
12. Jolly's Bulb Apparatus experiment – determination of α
13. Magnetism: I – H curve
14. Field along the axis of a coil carrying current
15. Vibration magnetometer – calculation of magnetic moment & pole strength
16. Electrical conductivity of semiconductor – two probe / four probe method*
17. Hall effect in a semiconductor*
18. Michelson's Interferometer*

*Demonstration Experiments.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Reference Book:

1. Physics Practical Observation Manual Book issued by Dept. of Physics, Pondicherry Engineering College.

Department : Chemistry		**Programme :** B.Tech.						
Semester : One		**Category :** LB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CY103	Chemistry Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved in chemical analysis. • To provide practical knowledge of handling chemicals and chemical analysis. • To understand the importance of chemical analysis in various fields.							
Outcome	• Students will be able to understand chemical analysis and its usefulness in engineering, industry and other fields. • Students will gain laboratory skills and that will give confidence in analyzing samples in engineering, industry and other fields. • Students will gain knowledge about the principles and methods of listed methods of quantitative analyses.							

List of experiments: (Any 10 experiments)

1. Determination of total, permanent and temporary hardness of water by EDTA method.
2. Determination of magnesium in water by complexometry.
3. Determination of calcium in lime stone by complexometry.
4. Determination of alkalinity of water.
5. Determination of percentage of acetic acid in vinegar.
6. Determination of ferrous ion in Mohr's salt.
7. Determination of lead dioxide by permanganometry.
8. Determination of ferrous and ferric ions in a solution by dichrometry.
9. Determination of iron by spectrophotometry.
10. Determination of dissolved oxygen in water.
11. Determination of COD of water sample.
12. Determination of available chlorine in bleaching powder.
13. Determination of chloride content in water by argentometry.
14. Determination of lead in polluted water by conductometry.
15. Preparation of potash alum from scrap aluminium.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemistry, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

1. V. Venkateswaran, R. Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, 2001.
2. J. Mendham, R.C. Denney, J.D. Barnes and M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, Pearson Education, New Delhi, 2002.

Department : Mechanical Engineering			**Programme :** B.Tech.					
Semester : One			**Category :** LB					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ME103	Workshop Practice	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To convey the basics of mechanical tools used in engineering • To establish hands on experience on the working tools • To develop basic joints and fittings using the hand tools • To establish the importance of joints and fitting in engineering applications • To explain the role of basic workshop in engineering • To develop an intuitive understanding of underlying physical mechanism used in mechanical machines.							
Outcome	• Parallels are drawn between the subject and the student's everyday experience so that this course may be related to what the students already know. • Students are introduced to basic hand tools used in various mechanical cutting operations. • Students are encouraged to make simple joints and fittings. • Students are made to develop natural curiosity to explore the various facets of basic cutting operations. • While emphasizing basic operations, students are provided with modern hand tools to use in real time engineering jobs. • Students are exposed to make objects like tray, welded joints.							
UNIT – I	**Fitting**				**Hours: 11**			
1. Study of tools and Machineries 2. Symmetric fitting 3. Acute angle fitting 4. Obtuse angle fitting								
UNIT – II	**Welding**				**Hours: 11**			
1. Study of arc and gas welding equipment and tools 2. Simple lap welding (Arc) 3. Single V butt welding (Arc) 4. Corner joint (Arc)								
UNIT – III	**Sheet Metal**				**Hours: 11**			
1. Study of tools and machineries 2. Funnel 3. Waste collection tray 4. Rectangular Box								
UNIT – IV	**Carpentry**				**Hours: 12**			
1. Study of tools and machineries 2. Half lap joint 3. Corner mortise joint 4. Dovetail joint								
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**				**Total Hours: 45**		
Text Books:								
1. Hajra Choudhry, et al., Workshop Technology Vol. I and II, Media Promoters Publ. Pvt. Ltd., Bombay, 2004. 2. H.N.Gupta, R.C.Gupta and Arun Mittal, Manufacturing Processes, New Age Publications, 2001.								
Web sites:								
1. http://en.wikipedia.org/wiki/Category:Carpentry_tools 2. http://en.wikipedia.org/wiki/Welding								

Department : Mathematics		**Programme:** B.Tech.						
Semester : Two		**Category :** TB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
MA102	Mathematics II	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To acquaint with theory of Matrices • Hyperbolic functions and theory of equations • Vector calculus and statistics							
Outcome	• Understands Matrix theory • Solving techniques of equations • Understands Vectors and statistics							
UNIT – I					**Hours: 09**			
Eigen values and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigen values. Cayley-Hamilton Theorem, Diagonalisation of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation and nature of quadratic forms.								
UNIT – II					**Hours: 09**			
Trigonometry: Hyperbolic and circular functions, logarithms of complex number, resolving real and imaginary parts of a complex quantity. Theory of equations: Relation between roots and coefficients, reciprocal equations, transformation of equations and diminishing the roots.								
UNIT – III					**Hours: 09**			
Finite differences: Definitions and relation between operators (Δ, ∇, δ, E, μ, D), Solution of difference Equations, Solving Boundary value problems for ordinary differential equations using finite difference method.								
UNIT – IV					**Hours: 09**			
Gradient, divergence and curl, their properties and relations. Stoke's theorem and Gauss divergence theorem (without proof). Simple applications involving cubes, sphere and rectangular parallelepipeds.								
UNIT – V					**Hours: 09**			
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics (9th Ed), John Wiley & Sons, New Delhi, 2011.
2. Venkataraman M.K., Engineering Mathematics, Vol II&III, National Publishing Company, Chennai, 2011.
3. Kandasamy P. et al, Numerical Methods, S. Chand & Co., New Delhi, 2012.

Reference Books:

1. Grewal B. S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41stEdition, 2011.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2011.

Department : Physics			**Programme:** B.Tech.					
Semester : Two			**Category :**TA					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
PH102	Material Science	4	-	-	4	40	60	100
Prerequisite:	-							
Objectives:	• To impart knowledge to the Engineering students about the significance of Materials Science and its contribution to Engineering and Technology • To introduce the Physical concepts and properties of Different category of materials and their modern applications in day-to-day life.							
Outcome:	• Engineering Students would have gained fundamental knowledge about the various types of materials and their applications to Engineering and Technology.							
UNIT – I	**Dielectric Materials**				**Hours: 12**			
Dielectric Polarization and its Mechanisms – Calculation of Polarizabilities (for electronic and ionic polarizations only) - Temperature dependence of polarization-Internal Field in solids - Clausius-Mossotti relation.– Elementary ideas of Piezo-, Pyro- and Ferro-electric materials and Applications. NLO materials and piezoelectric actuators (introductory concepts).								
UNIT – II	**Magnetic Materials and Superconductors**				**Hours: 12**			
Magnetic Materials: Origin of atomic magnetic moment – Bohr magneton-classification of magnetic materials (Dia, Para, Ferro, antiferro&Ferri) – Domain Theory of Hysteresis – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic Hard Disk. Ferro-fluids and applications. **Superconductors**: Basic concepts – properties of superconductors –Meissner effect – Type I and II superconductors – BCS theory (qualitative) - High Temperature Superconductors– Qualitative ideas of Josephson effect, quantum interference and SQUID – their applications.								
UNIT – III	**Semiconductors**				**Hours: 12**			
Semiconductors –Concept of Fermi Distribution Function, Fermi Energy Level- Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors - temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in Semiconductors -- Application of Hall Effect. Basic Ideas of Compound Semiconductors (II-VI & III-V). Photovoltaic Effect-Solar photovoltaic cells.								
UNIT – IV	**Nuclear Reactors & Materials**				**Hours: 12**			
Mass Defect & Binding Energy of Nucleus - Disintegration in fission –Nuclear Reactors: BWR – FBR. Materials used in Nuclear Reactors; Materials for Moderator, coolant, reactor control elements containment shell. Nuclear Fuel materials and Fuel processing - Fuel enrichment. Nuclear fusion reactions for fusion reactors-D-D and D-T reactions, Basic principles of Nuclear Fusion reactors								
UNIT – V	**Smart Materials and Nanomaterials**				**Hours: 12**			
Smart Materials: Introduction –definitions. Shape Memory alloys (SMA): One way and two way Shape memory effect, pseudoelasticity, Properties and applications of SMA- features of Ni-Ti SMA alloy. Liquid Crystals : Types – nematic, cholesteric, smectic- Application to Display Devices Metallic Glasses: preparation by melt spinning. Properties and applicationsNanomaterials : Introduction to Nano materials–Methods of synthesis (CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials.C_{60}-Buck Minister Fullerence, carbon nanotubes– synthesis (Plasma arc, Pulsed Laser evaporation methods) Properties and applications.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Avadhanulu M N, Engineering Physics, Vol.-II, S. Chand & Co, 2009. 2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi 2008. (For Unit V only)								
Reference Books:								
1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011. 2. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012. 3. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009. 4. Pillai S.O, Solid State Physics, 6th Edition – New Age International, 2005. 5. Vijayamohanan K Pillai and MeeraParthasarathy, Functional Materials, Universities Press Hyderabad,								

2012.
6. C.M. Srivastava and C. Srinivasan, Science of Engineering Materials, 2nd Edition, New Age Int. (P) Ltd, New Delhi, 1997.

Department : Chemistry				**Programme:** B.Tech.				
Semester : Two				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CY102	Environmental Science	4	-	-	4	40	60	100
Prerequisite:	-							
Objectives:	• To widen the knowledge of environmental awareness and pollution • To educate the importance of preserving the earth's resources and ecosystem • To highlight the modern techniques and regulations to monitor and control pollution							
Outcome:	• Students will be able to understand about the environment and natural resources we are blessed with. • Students will become aware of environmental issues like pollution, dwindling natural resources and degrading ecosystem. • Students will be inspired to act as environmentally friendly and work for sustainable development of the humanity.							
UNIT – I	**Ecosystem and Biodiversity**				**Hours: 12**			
Concept of an ecosystem-structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, estuarine and marine) ecosystem. Biodiversity-definition-genetic species and ecosystem diversity. Value of biodiversity–consumptive use, productive use, social, ethical, aesthetic and option values. Hotspots of biodiversity. Threats to biodiversity-habitat loss, poaching of wildlife, human-wildlife conflicts. Wildlife protection act and Forest conservation act. Endangered and endemic species. Conservation of biodiversity - in-situ and ex-situ conservation of biodiversity.								
UNIT – II	**Air Pollution**				**Hours: 12**			
Environmental segments-lithosphere, hydrosphere, biosphere and atmosphere. Atmospheric layers. Pollution-definition and classification. Pollutants-classification. Causes, sources, effects and control measures of air pollutants-oxides of nitrogen, oxides of sulphur, oxides of carbon, hydrocarbon, chloroflurocarbons and particulates. Green house effect-causes and effects on global climate and consequences. Ozone depletion-causes, mechanism and effect on the environment. Smog-sulfurous and photochemical smog-effect on the environment. Acid rain-theory of acid rain and effects. Environmental protection act-air (prevention and control of pollution) act.								
UNIT – III	**Water and Land Pollution**				**Hours: 12**			
Water resources. Water pollution-causes and effects of organic water pollutants-pesticides and detergents. Causes and effects of inorganic water pollutants-heavy metal pollution due to Hg, Pb, Cr and Cu. Thermal pollution. Analysis of DO, BOD, COD and TOC. Water (prevention and control of pollution) act. Land pollution-Solid waste management-causes, effects and control measures of urban and industrial wastes. Radioactive pollution.								
UNIT – IV	**Instrumental Pollution Monitoring**				**Hours: 12**			
Classification of instrumental techniques. Electromagnetic radiation, properties, emission and absorption of radiation. Principle and Instrumentation of atomic absorption and emission spectrometry. Beer-Lamberts law. UV–visible spectrophotometry-Principle and instrumentation. IR spectroscopy – Principle and instrumentation. Chromatography–Introduction, Principle and Instrumentation of HPLC and gas chromatography. Conductometry and potentiometry. Analysis of air pollutants-NOx, SOx and COx.								
UNIT – V	**Energy and Environment**				**Hours: 12**			
Energy resources-growing energy needs. Renewable and non-renewable energy resources and use of alternate-energy sources. Green Chemistry - Significance. Basic components of green chemistry – alternative starting materials, reagents, reaction conditions and final products. Atom economy. Industrial applications of green chemistry. From unsustainable to sustainable development. Role of an individual in prevention of pollution.								
Total contact Hours: 60	**Total Tutorials:**	**Total Practical Classes:**			**Total Hours: 60**			
Text Books:								

1. Anubha Kaushik and C.P. Kaushik, Environmental Science and Engineering, New Age International (P) Ltd, New Delhi, 2009. (Unit I)
2. S.S. Dara,AText Bookof Environmental Chemistry and Pollution Control, S. Chand and Company Ltd, New Delhi, 2008. (Unit II, III, & V)
3. C.N. Sawyer, P.L. McCarty And G.F. Parkin, Chemistry for Environmental Engineering and Science, Tata

McGraw-Hill Publishing Co Ltd, New Delhi, 2004. (Unit IV)

Reference Books:

1. K. Raghavan Nambiar, Text Book of Environmental Studies, Scitech Publications India Pvt. Ltd, Chennai, 2008.
2. A.K. De, Environmental Chemistry, New Age International (P) Ltd, New Delhi,2006.
3. B.K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut, 2001.
4. G.S. Sodhi, Fundamental Concepts of Environmental Chemistry, Narosa Publishing House, New Delhi, 2013.

Department : Electronics and Communication Engineering / Electrical and Electronics Engineering				**Programme:** B.Tech.				
Semester : Two				**Category :** TC				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
BE102	Basic Electrical and Electronics Engineering	3	1	-	4	40	60	100

Prerequisite:	-
Objectives:	• To apply Kirchhoff's law to simplify the given circuit. • To understand the concept of AC circuit and to simplify the given RL, RC, RLC series and parallel circuits. • To understand the principle of electromagnetic induction and the working principle of electrical machines. • The students understand the working principle of transistor, FET, MOSFET, CMOS and their applications. • To design adders, subtractors and to gain knowledge on sequential logic circuits. • To understand the need for communication and acquire knowledge on different communication systems. • To have an overview of different emerging technologies in day-to-day applications.
Outcome:	• The students explored the basic terminology, laws and concepts of DC and AC circuits in electrical engineering. • The students know the principle of operation of DC and AC electrical machines and different types of power plants. • Will understand the importance of FET's, MOSFET's, CMOS and their applications. • Will be able to design Combinational and Sequential circuits. • Awareness towards different Communication Systems. • Gain knowledge in the working principle of real time applications used in day today life like ATM, Microwave Oven, Bluetooth, WiFi and Computer Networks.

UNIT – I	**DC Circuits**	**Hours: 07**
Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchoff's law & its applications – Simple Problems - Division of current in Series & parallel circuits - star/delta conversion - Node and mesh methods of analysis of DC circuits.		
UNIT – II	**AC Circuits**	**Hours: 08**
Concepts of AC circuits – rms value, average value, form and peak factors – Simple RL, RC and RLC series and parallel circuits – Concept of real and reactive power – Power factor – Series and parallel resonance - Introduction to three phase system - Power measurement by two wattmeter method.		
UNIT – III	**Electrical Machines and Power Plants**	**Hours: 08**
Law of Electromagnetic induction, Fleming's Right & Left hand rule - Principle of DC rotating machine, Single phase transformer, single phase induction motor and synchronous motor (Qualitative approach only) - Layout of thermal, hydro and nuclear power generation (block diagram approach only). Components of AC transmission and distribution systems – One line diagram.		
UNIT – IV	**Electronics**	**Hours: 07**
Transistor as an Amplifier – RC Coupled Amplifier – Characteristics of JFET – MOSFET – CMOS – Block Diagram of SMPS – LED – LCD – Solar Cells. Combinational Logic – Design of Half Adder - Half Subtractor –Full Adder – Full Subtractor – Sequential Logic – Ripple Counters – Shift Registers.		
UNIT – V	**Communication**	**Hours: 08**
Need for Modulation – Block Diagram of Analog Communication System - AM, FM, PM Definitions & Waveforms – Comparison of Digital & Analog Communication System- Block Diagram of Digital Communication System – Electromagnetic Spectrum. Wired & Wireless Channel – Block Diagram of Communication Systems – Satellite Communication – Cellular Mobile Communication – Fibre Optical Communication System.		
UNIT – VI	**Overview of Emerging Technologies**	**Hours: 07**

Evolution of Mobile Communication Generations (1G, 2G, 2.5G, 3G and Beyond 3G) – Overview of Bluetooth, Wifi, WiMax, Sensor Networks and Wireless LANs –– Introduction to VLSI Technology and Embedded Systems – Internet of Things (IOT).

Microwave Ovens - RFID - Automated Teller Machines (ATM).

Total contact Hours: 45	Total Tutorials: 15	Total Practical Classes: -	Total Hours: 60

Text Books:

Electrical

1. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, Electrical and Electronics Technology, Pearson Education Limited, New Delhi, 2010.
2. Kothari D P and Nagrath I J, Basic Electrical Engineering, Tata McGraw Hill, 2009.
3. S.K. Sahdev, Fundamentals of Electrical Engineering and Electronics, DhanpatRai& Co, 2013.

Electronics and Communication

4. Jacob Millman and Christos C. Halkias, Electronic Devices and Circuits,Tata McGraw Hill, 2008
5. R.L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, PHI Learning Private Limited, Ninth Edition, 2008
6. Morris Mano, Digital design, PHI Learning, Fourth Edition, 2008.
7. Wayne Tomasi, Electronic Communication Systems- Fundamentals Theory Advanced, Fourth Edition, Pearson Education, 2001.
8. RajendraPrasad, Fundamentals of Electronic Engineering, Cengagelearning, New Delhi, First Edition, 2011.
9. William Stallings, Wireless Communication and Networks, Second Edition, Pearson Education, 2011.

Reference Books:

Electrical

1. R.Muthusubramaniam, S.Salivahanan and K.A. Muraleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004.
2. Rejendra Prasad, Fundamentals of Electrical Engineering. Prentice Hall of India, 2006.

Electronics and Communication

3. David. A. Bell, Electronic Devices and Circuits, PHI Learning Private Ltd, India, Fourth Edition, 2008.
4. Donald P Leach, Albert Paul Malvino and GoutamSaha, Digital Principles and Applications,6thedition,Tata McGraw Hill Publishing Company Ltd.,New Delhi,2008.
5. Roddy andCollen, Communication Systems, PHI learning, 2001.
6. George Kennedy and Bernard Davis, Electronics communication Systems, Tata McGraw-Hill Ltd, New Delhi, 2007.

Web sites:

1. www.electronics-tutorials.ws
2. www.en.wikipedia.org/wiki/Telecommunication
3. www.nptel.ac.in/courses/IIT-MADRAS/Basic_Electronics.../LECTURE1.pdf

Department : Mechanical Engineering				**Programme:** B.Tech.				
Semester : Two				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ME101	Engineering Thermodynamics	3	1	-	4	40	60	100

Prerequisite: -

Objectives:

- To convey the basics of the thermodynamic principles
- To establish the relationship of these principles to thermal system behaviors
- To develop methodologies for predicting the system behavior
- To establish the importance of laws of thermodynamics applied to energy systems
- To explain the role of refrigeration and heat pump as energy systems
- To develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world.

Outcome:

- Parallels are drawn between the subject and the student's everyday experience so that this course may be related to what the students already know.
- Students are made to understand the principles of thermodynamics and adjudge the viability of operation of any thermal system in real time applications
- Students are encouraged to make engineering judgments, to conduct independent exploration of topic of thermodynamics and to communicate the findings in a professional manner.
- Students are made to develop natural curiosity to explore the various facets of thermodynamic laws.
- While emphasizing basic laws, students are provided with modern tools to use in real time engineering problems.

UNIT – I **Hours: 09**

Energy conversion and efficiencies of steam and nuclear power plants, internal combustion engines, gas turbine and refrigeration systems- Thermodynamic systems, properties and state - Thermodynamic equilibrium- path and point functions - Temperature - Zeroth law of thermodynamics – Pure substance - P, V and T surface – steam formation-quality-dryness fraction-Thermodynamic property diagrams and charts in common use.

UNIT – II **Hours: 09**

The concept of energy, work and heat – reversible work- internal energy -Perfect gas – specific heats – Joules law - enthalpy- Conservation of Energy principle for closed and open systems - First law of thermodynamics – Application of first law to a process (flow and non-flow) – Steady flow energy equation and its engineering application - Calculation of work and heat for different processes.

UNIT – III **Hours: 09**

Limitations of first law – Performance of heat engines – Reversible and irreversible processes – Statements of second law of thermodynamics - Carnot principle - Clausius inequality- Entropy – temperature entropy diagram – entropy change for a closed and open systems.

UNIT –IV **Hours: 09**

Air standard cycles: The air standard Carnot cycle - Air standard Otto cycle, diesel cycle, dual cycle and their comparison – Gas turbine - Brayton cycles and their efficiencies.

UNIT – V **Hours: 09**

Reverse Carnot cycle - COP - Vapor compression refrigeration cycle and systems (only theory) - Gas refrigeration cycle - Absorption refrigeration system – Liquefaction – Solidification (only theory).

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Nag, P. K., Engineering Thermodynamics, 5th edition, McGraw - Hill Education India Pvt. Ltd., New Delhi, 2013.
2. Burghardt, M.D. and James A Harbach, Engineering Thermodynamics, 4th edition, Harper Collins college publisher, N.Y.,1993.

Reference Books:

1. Arora, C.P., Thermodynamics, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2003.
2. Wark, K., Thermodynamics, 4th edition,McGraw Hill, N.Y.,1985.
3. Huang, F.F., Engineering Thermodynamics 2nd edition, Macmillan Publishing Co. Ltd., N.Y., 1989.
4. Cengel, Y.A. and Boles, M.A., Thermodynamics - An Engineering Approach, 7th edition, Tata Mc-Graw Hill Education, 2011.

Web sites:

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/
2. http://ocw.mit.edu/courses/mechanical-engineering/

Department : Computer Science and Engineering / Information Technology			**Programme:** B.Tech.					
Semester : Two			**Category :** TA					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS101	Computer Programming	3	1	-	4	40	60	100
Prerequisite:								
Objectives:	• To introduce the basics of computers and information technology. • To educate problem solving techniques. • To impart programming skills in C language. • To practice structured programming to solve real life problems.							
Outcome:	On successful completion of the course, students will be able to: • Understand the basics of computers and its related components • Have the ability to write a computer program to solve specified problems							
UNIT – I					**Hours: 09**			
History and Classifications of Computers – Components of a Computer – Working Principle of Computer – Hardware – Software and its Types – Applications of Computers –Network and its Types – Internet and its services – Intranet– Extranet – Generations of Programming Languages – Introduction to Number System – Introduction to MS-Office Package.								
UNIT – II					**Hours: 09**			
Problem solving techniques – Program development life-cycle – Algorithm – Complexities of Algorithm – Flowchart – Pseudo code. Introduction to C –C Program Structure – C tokens: Keyword, Identifiers, Constants, Variable, Data types (simple and user-defined) – Operators and its types – Operator Precedence – Expression Evaluation – Type Conversion – Input/output operations.								
UNIT – III					**Hours: 09**			
Branching Statements – Looping Statements – Arrays – Multidimensional arrays. Functions: Function Prototype, Passing Arguments to Function – Call by Value and Call by Reference – Nested function call – Library Functions – User-defined Functions – Recursion. Strings – String I/O functions, String Library functions – Storage classes.								
UNIT – IV					**Hours: 09**			
Structures – Arrays and Structures – Nested structures – Structure as Argument to functions– Union Pointers – Declaration, Initialization and Accessing Pointer variable – Pointers and arrays – pointers as argument and return value – Pointers and strings - pointers and structures.								
UNIT – V					**Hours: 09**			
Introduction to File Concepts in C – File types – I/O operations on files – File modes – Random access to files – Command line arguments. Dynamic Memory Allocation: MALLOC, CALLOC, FREE, REALLOC Introduction to preprocessor – Macro substitution directives – File inclusion directives –Compiler Control directives – Miscellaneous directives.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. J. B. Dixit, Computer Fundamentals and Programming in C, Firewall Media, 2009. 2. Balagurusamy. E, Programming in ANSI C, Tata McGraw Hill, Sixth edition, 2012.								
Reference Books:								
1. Ashok N Kamthane, Computer Programming, Pearson education, Second Impression, 2008. 2. Venugopal.K and Kavichithra.C, Computer Programming, New Age International Publishers, First Edition, 2007.								

Department : Mechanical Engineering					**Programme:** B.Tech.			
Semester : Two					**Category :** EGD			
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ME102	Engineering Graphics	2	-	3	4	50	50	100
Prerequisite:	-							
Objectives:	• To convey the basics of engineering drawing • To explain the importance of an engineering drawing • To teach different methods of making the drawing • To establish the importance of projects and developments made in drawing that are used in real systems							
Outcome:	• From what students have already learnt and know, relation has been brought about how to bring their vision into realities. • Students are made to follow and understand the basic of mechanical drawing • Students are encouraged to make engineering drawing of physical object representing engineering systems. • Students are made to develop natural curiosity to explore the various facets of engineering drawings.							
UNIT – 0					**Not for exam**			
Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning.								
UNIT – I					**Hours: T-06; P-09**			
Projection of Points and Projection of lines								
UNIT – II					**Hours: T-06; P-09**			
Projection of Points and Projection of lines								
UNIT – III					**Hours: T-06; P-09**			
Projection of solids in complicated positions								
UNIT – IV					**Hours: T-06; P-09**			
Sections of solids - Development of Surfaces								
UNIT – V					**Hours: T-06; P-09**			
Axonometric Projections: Isometric Projections (simple solids); Perspective Projections (planes and simple solids; Orthographic Projections								
Total contact Hours: 30	**Total Tutorials: -**	**Total Practical Classes: 45**			**Total Hours: 75**			

Text Books:

1. K.R. Gopalakrishna and SudhirGopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.
2. K. Venugopal, Engineering Drawing and Graphics + Auto CAD, 4th edition, New Age International Publication Ltd., 2004.
3. BIS, Engineering Drawing practices for Schools & College, SP 46 : 2003

Reference Books:

1. N.D. Bhatt, Engineering Drawing, 49th edition, Charotar Publishing House, 2006.
2. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
3. David I cook and Robert N McDougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edn. 1985.
3. James D Bethune and et. al., Modern Drafting, Prentice Hall Int.,

Web sites:

1. http://www.3ds.com/products/catia/
2. http://en.wikipedia.org/wiki/CATIA

Department : Computer Science and Engineering / Information Technology		**Programme:** B.Tech.						
Semester : Two		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CS102	Computer Programming Laboratory	4	-	-	4	40	60	100
Prerequisite:	-							
Objectives:	• To study and understand the use of OS commands • To get familiarity on MS-Office packages like MS-Word, MS-Excel and MS-PowerPoint • To gain a hands on experience of compilation and execution of 'C' programs • To inculcate logical and practical thinking towards problem solving using C programming.							
Outcome:	On successful completion of the course, students will be able to: • Have the ability to write a computer program to solve specified problems • Problem solving ability will be gained by the students							
Cycle - I	**Fundamentals of Computing** 1. Study of OS commands 2. Use of mail merge in word processor 3. Use of spreadsheet to create Charts (XY, Bar, Pie) with necessary formulae. 4. Use of Power point to prepare a slide show.							**Hours: 09**
Cycle - II	**Programming Using C** 1. Study of Compilation and execution of simple C programs 2. Basic C Programs a. Arithmetic Operations b. Area and Circumference of a circle c. Swapping with and without Temporary Variables 3. Programs using Branching statements a. To check the number as Odd or Even b. Greatest of Three Numbers c. Counting Vowels d. Grading based on Student's Mark 4. Programs using Control Structures a. Computing Factorial of a number b. Fibonacci Series generation c. Prime Number Checking d. Computing Sum of Digit 5. Programs using String Operations a. Palindrome Checking b. Searching and Sorting Names 6. Programs using Arrays a. Sum of 'n' numbers b. Sorting an Array c. Matrix Addition, Subtraction, Multiplication and Transpose 7. Programs using Functions a. Computing nCr b. Factorial using Recursion c. Call by Value and Call by Reference 8. Programs using Structure a. Student Information System b. Employee Pay Slip Generation c. Electricity Bill Generation 9. Programs using Pointers a. Pointer and Array							**Hours: 36**

	b. Pointer to function c. Pointer to Structure 10. Programs using File Operation a. Counting No. of Lines, Characters and Black Spaces b. Content copy from one file to another c. Reading and Writing Data in File	

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. P.C.JainandMonikaJain,EngineeringChemistry,DhanpatRaiandSons,New Delhi,2004.
2. S.S.Dara and S.S Umare,ATextbookofEngineeringChemistry,S.Chand&Co.,Ltd.New Delhi, 2013.

Reference Books:

1. B.K.Sharma,EngineeringChemistry,KrishnaPrakashanMedia(P) Ltd.,Meerut,2001.
2. P. Kannan, A. Ravikrishnan, Engineering Chemistry, Sri Krishna Hi-tech. Publishing Company Pvt. Ltd, Chennai, 2009.
3. V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Polymer Science, New Age Intl (P) Ltd, Chennai, 2006.

Department : Electronics and Communication Engineering / Electrical and Electronics Engineering				**Programme:** B.Tech.				
Semester : Two				**Category :** LB				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
BE103	Basic Electrical and Electronics Engineering Laboratory	-	-	3	2	60	40	100
Prerequisite:	-							
Objectives:	• To understand the basic electrical tools and their applications. • To get trained in using different types of wiring. • To find faults in electrical lamp and ceiling fan. • To understand and apply Kirchhoff's laws to analyze electrical circuits. • To study the operation of CRO and principle of fiber optic communication. • To design adder and subtractors. • To understand the frequency response of RC coupled amplifier.							
Outcome:	• The students get exposure on the basic electrical tools, applications and precautions. • The students are trained for using different types of wiring for various purposes in domestic and industries. • The students are taught to find faults in electrical lamp and ceiling fan. • Will be able to learn and use equipments like Signal Generator, Power Supply and CRO. • To apply Kirchhoff's law for simplification of circuits. • To design combinational circuits. • To obtain the frequency response of Amplifiers.							
List of Experiments	**Electrical Lab** 1. Electrical Safety, Precautions, study of tools and accessories. 2. Practices of different joints. 3. Wiring and testing of series and parallel lamp circuits. 4. Staircase wiring. 5. Doctor's room wiring. 6. Bed room wiring. 7. Go down wiring. 8. Wiring and testing a ceiling fan and fluorescent lamp circuit. 9. Study of different types of fuses and A.C. and D.C. meters.							
List of Experiments	**Electronics and Communication Lab** 1. Study of Kirchoff's Laws. 2. Study of Fiber Optic Communication. 3. Study of Cathode Ray Oscilloscope. 4. Zener Diode as Voltage Regulator. 5. Design of Adder and Subtractor Circuits. 6. Frequency Response of RC Coupled Amplifier.							
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**			**Total Hours: 45**			

Department : Mathematics			**Programme :** B.Tech.					
Semester : Three			**Category :** TB					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
MA103	Mathematics - III	3	1	-	4	40	60	100
Prerequisite								
Objectives	• To introduce the ideas of Laplace and Fourier Transforms • To familiarize students with of Complex Analysis • To introduce Fourier series.							
Outcome	• Understands Transform Calculus • Understand Complex Analysis • Able to apply Fourier series							
UNIT – I	**Laplace Transform**							**Hours: 09**
Definition, properties. Transform of derivatives and integrals. Transform of unit step function, Transform of periodic functions. Initial and final value theorems, convolution theorem, Application to differential equations and integral equations. Evaluation of integral by Laplace transforms.								
UNIT – II	**Complex Variable- Analytic Functions**							**Hours: 09**
Analytic functions – Necessary conditions Cauchy-Riemann equations (Cartesian and polar form) and sufficient conditions (excluding proof) – Harmonic and orthogonal properties of analytic function – Construction of analytic functions. Conformal mapping – Simple and standard transformations like w = z+c, cz,, sinz 1/z Bilinear transformation. (excluding Schwarz- Christoffel transformation)								
UNIT – III	**Complex Integration**							**Hours: 09**
Complex integration, Cauchy's Integral theorem , Cauchy's integral formula and problems, Taylor's and Laurent's theorem (without proof) Classification of singularities.. Residues and evaluation of residues – Cauchy's Residue theorem – Contour integration:) Application of residue theorem to real integrals – unit circle and semicircular contour (excluding poles on boundaries								
UNIT – IV	**Fourier Series**							**Hours: 09**
Dirichlet's conditions – General Fourier series Expansion of periodic function into Fourier series – Fourier series for odd and even functions –Half-range Fourier cosine and sine series – Change of interval – Related problems. Root Mean Square Value – Parseval's theorem on Fourier Coefficients. Complex form of Fourier series – Harmonic Analysis.								
UNIT – V	**Fourier Transform**							**Hours: 09**
Fourier integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval's identity.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. M.K.Venkataraman, Engineering Mathematics, Vol. II & III, National Publishing Co., Madras, 2007. 2. Veerarajan T., Engineering Mathematics for first year, Tata-McGraw Hill,2014.								
Reference Books:								
1. Grewal B. S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011. 2. RamanaB.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010. 3. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.								

Department : Chemistry			**Programme :** B.Tech. (CH)					
Semester : Three			**Category :** TA					
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CY104	Physical Chemistry	4	-	-	4	40	60	100
Prerequisite:	-							
Objectives:	• To Provide Solid background in the fundamental concepts of physical chemistry needed for Chemical Engineers.							
Outcome:	At the end of the semester students should be able to understand • The properties of matter in its different states • The theories, which offer molecular level explanation to the properties of matter • Concepts which are relevant to industrial processes • Gives the foundation to understand advanced chemical engineering concepts							
UNIT – I	**Gaseous State**					**Hours: 12**		
Ideal gases, equation of state, Boyle's law, Charles law, Avagadro's law, Daltons law, kinetic molecular theory of gases, deduction of gas laws from kinetic gas equation. Maxwell's distribution of molecular velocities. Collision properties – mean free path. Deviation from ideal behaviour – van der Waals equation of state. Joule Thompson effect, Liquefaction of gases, critical constants.								
UNIT – II	**Conductance of Electrolytes**					**Hours: 12**		
Specific and equivalent conductance and their variation with concentration, Strong and weak electrolytes, measurement of electrolytic conduction, Arrhenius theory of ionization, Kohlrausch's law and its applications. Ionic Equilibria – Ostwald's dilution law and its limitations, Debye-Huckel-Onsagar theory, Common Ion effect, factors influencing degree of dissociation, Solubility and Solubility product, Selective precipitation.								
UNIT – III	**Solutions**					**Hours: 12**		
Solutions of liquid in liquids, ideal solutions, Raoult's law, Non- ideal solutions vapour pressure- composition and temperature- Composition diagrams. Fractional distillation. Partially miscible liquids – critical solution temperature. Immiscible liquids – steam distillation. Colligative properties – Lowering of vapour pressure, elevation of boiling point, depression of freezing point, molecular weight determination, osmotic pressure								
UNIT – IV	**Chemical kinetics**					**Hours: 12**		
Zero, First, Second, Third order reaction equations, Effect of temperature on reaction rates, Arrhenius equation, Energy of activation theories of reaction rates- Collision theory, absolute reaction rate theory and Lindemann theory of unimolecular reaction. **Catalysis**- Characteristics of catalysts, homogeneous catalysis – kinetics of acid base catalysis, and enzyme catalysis. Heterogeneous catalysis – kinetics of unimolecular and bimolecular surface reactions- Langmuir-Rideal – Hinshelwood mechanism.								
UNIT – V	**Adsorption**					**Hours: 12**		
Physical and chemical adsorption. Adsorption of gases by solids, Langmuir and BET Theories. Freundlich adsorption isotherm. **Colloids**:Types of Colloids systems, preparation, purification and properties of sols, charge on Sols, gold umber, stability of sols.								
Total contact Hours: - 60	**Total Tutorials: -**	**Total Practical Classes:**				**Total Hours: 60**		
Text Book:								
1. Arun Bahl, B.S. Bahi and G.D. Tuli "Essentials of Physical Chemistry", S. Chand & Company Ltd., New Delhi, Revised Edition, 2012.								
Reference Books:								
1. A.S. Negi and S.C.Anand, A Textbook of Physical Chemistry, New Age International (P) Ltd., 2nd edition, New Delhi, 2007. 2. B.R.Puri Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing Co., New Delhi, 2007. 3. Peter Atkins and Julio de Paula, Elements of Physical Chemistry, 4th edition, Oxford University Press, New Delhi, 2007.								

Department : Civil Engineering		**Programme :**B.Tech. (CH)						
Semester : Three		**Category :** TB						
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CE103	Mechanics of Solids-I	3	1	-	4	40	60	100
Prerequisite	Nil							
Objectives:	• To develop an understanding of the relationship between external loads applied to a deformable body and the internal stress, strain induced in the body. • To show proficiency in mathematics and basic sciences required to solve structural engineering and mechanics problem. • To develop analytical and graphical problem solving skills.							
Outcome:	On successful completion of the course, students will be able to: • Calculate and understand the concepts of stress and strain; • Calculate, describe, and estimate external loadings, including axial load, shear force, bending, and torsion, • calculate internal stresses and strains through the application of stress transformation equations and Mohr's circle; • Understand stability and buckling phenomena for a slender member under an axial load							
UNIT – I	**Stresses & Strains**							**Hours: 09**
Simple Stresses and Strains – Tension, compression and shear stresses - Hooke's law - Elastic constants, Relationship between Elastic constants- compound stresses -thermal stresses – Compound bars.								
UNIT – II	**Bending Stress**							**Hours: 09**
Shear force and bending moment diagrams for beams and frames- Theory of simple bending –Bending stress distribution at sections. Beams of uniform strength.								
UNIT – III	**Shear Stress**							**Hours: 09**
Shear stress distribution due to bending – Shear Centre. Springs – Stiffness – open & closed coil springs- problems in parallel, series springs-Complex stresses – Principal planes and stresses-Mohr's circle.								
UNIT – IV	**Torsion**							**Hours: 09**
Theory of simple Torsion – Torsional rigidity – Torsion of non-circular sections – Introduction to Membrane theory - Composite shafts in series and parallel. Thin cylinders and shells – Thick cylinders.								
UNIT – V	**Columns**							**Hours: 09**
Columns – Euler's theory – Rankine – Jordon formula – Columns with initial curvature and eccentric loads–Long columns- Laterally loaded columns, Combined direct and bending stresses. Application to masonry dams and retaining walls								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**						**Total Hours: 60**
Text Books:								
1. Bhavikatti. S.S., Strength of Materials, Vikas Publishing House (P) Ltd., New Delhi, SecondEdition, 2012. 2. Hearn, E. J., Strength of Materials, Pergamon Press, Oxford, 1997. 3. Punmia. B. C., Jain, A. K., and Jain, A. K., Strength of Materials and Theory of Structures,Vols. I & II, XI Edition, Laxmi Publications (P) Ltd, New Delhi, 2002.								
Reference Books:								
1. Shah.H.J. and Junnarkar.S.B., Mechanics of structures- Vol.I, Charotar Publishing house, Ltd,, 2012. 2. Surendra Singh, Strength of Materials, Vikas Publishing House, 2013 3. R.Subramaniam, Strength of Materials, Oxford University Press. 2012 4. Rattan, S.S., Strength of Materials, Tata McGraw-Hill, 2011. 5. Arbind Kumar Singh., Mechanics of solids, Printice Hall of India, 2007.								

Department : Electrical and Electronics Engineering				**Programme :** B.Tech. (CH)				
Semester : Three				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EE136	Electrical and Electronics Engineering	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the construction and operation of Transformers & Induction machines • To solve problems of electric circuit analysis.							
Outcome	At the end of the semester students should be able to • Understand the construction and operation of Transformers & Induction machines • Solve problems of electric circuit analysis. • Acquire knowledge about the operation and applications of operational amplifiers , 555 IC and Logic circuits							
UNIT – I						**Hours: 12**		
Transformer-construction –EMF equation –Transformer on No load –Transformer on Load –Equivalent Circuit – Efficiency –OC abd Sc Test –Regulation –All day efficiency-Auto trans former –Introduction to 3-phaes transformer.								
UNIT – II						**Hours: 12**		
Induction motor –principle of action –Construction –starting methods-starting torque-3phase IM –Introduction – efficiency-speed control methods-capacitor run Induction motor –Stepper motor –Characteristic & applications of DC series and shunt generators and motors.								
UNIT – III						**Hours: 12**		
Thevenin , Norton ,Maximum power transfer ,Super position theorems for DC circuits only- series resonance – Parallel resonance-Introduction to 3-phase system –Two watt meter method of power measurement.								
UNIT – IV						**Hours: 12**		
Analog Electronics: Operational Amplifiers-Idael Characteristics-741 IC details-Inverting and non-Inverting amplifier –scale changers-Inverter –Instrumentation amplifier-CMRR-Block diagram of 555IC								
UNIT – V						**Hours: 12**		
Introduction to Boolean Algebra-combination circuits-Simplification –Karnaugh map-NAND-NOR implementation – counters –UP/DOWN counters-Ring counters-Multiplexes –De multiplexes								
Total contact Hours: -60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. John Hiley, Keith Brown and Mckenzie Smith,Electrical and Electronics Technology, Pearson Education (Singapore)Pvt Ltd., 10th Edition, 2010. 2. B.L.Theraja, Fundamental of Electrical Engineering & Eletronics, S.Chand &company, 2010								
Reference Books:								
1. A.P.Malvino and David Bates, Electronic Principles, Tata Mc Graw-Hill, 7th Edition,2006. 2. V.K. Metha and Rohit Mehta , Principles of Eletronics, S.Chand &company, New Delhi, 2010								

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Three				**Category :** TB				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH101	Process Calculations	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Process Calculations needed for Chemical Engineers.							
Outcome	At the end of the semester students should be able to • Read any problem, understand it, analyze it, and write an algorithm to solve it. • Apply the laws of conservation of mass and energy, and chemical, and physical concepts to solve problems. • Understand the use of each of the chemical engineering unit operations.							
UNIT – I						**Hours: 09**		
Introduction to Chemical engineering calculations, units and dimensions, mole and molecular weight, properties of gases, vapors, liquids, solutions and solids, gas laws, partial pressures, vapor pressures, saturation and equilibria, Raoults law, partial saturation and humidity								
UNIT – II						**Hours: 09**		
Material balances without chemical reactions, stoichiometry and unit operations-distillation, absorption, stripping, extraction, leaching, crystallization, drying, and psychrometry. Recycle, purge and bypass calculations.								
UNIT – III						**Hours: 09**		
Material balances involving chemical reactions, simple oxidation reaction, calculations involving combustion of gaseous, liquid and solid fuels. Recycle, purge and bypass calculations. Introduction to unsteady state material balances.								
UNIT – IV						**Hours: 09**		
Energy balance - heat capacity and calculation of enthalpy changes, Enthalpy changes for phase transitions, evaporation, Clausius - Clapeyron equation.								
UNIT-V						**Hours: 09**		
Energy balances with chemical reaction - heat of reaction and adiabatic flame temperature calculations								
Total contact Hours: -45	**Total Tutorials: -15**	**Total Practical Classes: -**				**Total Hours: 60**		

Text Books:

1. B.I.Bhatt and S.M.Vora, Stoichiometry, Tata McGraw Hill, 5th Edition, 2013.
2. David.M.Himmelblau and Riggs , Basic Principles and Calculations in Chemical Engineering, Prentice Hall of India Ltd., 7th Edition, 2004.
3. G. V. Reklaitis, Introduction to Material and Energy Balances, John Wiley, 1983.

Reference Books:

1. A.Hougen, K.M. Watson and K.A.Ragatz, Chemical Process Principles, Vol 1, CBSE Publisher, 1980.
2. Richard M. Felder, Ronald W.Rousseau, Elementary Principles of Chemical Processes, Wiley Publications, 3rd Edition, 2007.
3. V.Venkataramani, N.Anantharaman and K.M.Meera Sheriffa Begum, Process Calculations,PHI Learning Private Limited, 2nd Edition, 2012.
4. D.C.Sikdar, Chemical Process Calculations, PHI Learning Private Limited, 2nd Edition, 2013.

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Three				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH102	Momentum Transfer	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Momentum Transfer needed for Chemical Engineers.							
Outcome	At the end of the semester students should be able to • Understand principles of fluid pressure, static equilibrium, buoyancy, compressible and incompressible fluids, Newtonian and non-Newtonian fluid motion, laminar and turbulent flow. • Have knowledge of various flow and pressure measuring devices, pumps used for transportation of fluids							
UNIT – I						**Hours: 09**		
Fluid Statics – Fluid density, compressible and incompressible fluids; Pressure, relationship between pressure and density for ideal gas; Hydrostatic equilibrium in gravitational and centrifugal force fields; Gravity decanters and centrifuge ; Pascal's law, hydraulic lever; Measurement of fluid pressure, manometers, Archimedes principle and buoyancy.Fluid Dynamics – ideal flow of fluids (non-viscous and incompressible fluids), Continuity equation and energy equation (Bernoulli's equation), applications.								
UNIT – II						**Hours: 09**		
Shear rate, Shear stress, Newton's law of fluid motion, Viscosity, concept of momentum transfer, Rheology of fluids - Newtonian and non-Newtonian fluids, laminar and turbulent flow, Reynolds number and transition from laminar to turbulent flow.Momentum balance equation, laminar flow of fluids through circular pipe and between parallel plates, Hagen-Poiseulle equation, flow through non circular cross section – equivalent diameter, Correction of Bernoulli's equation for velocity and friction, friction factor, friction factor Vs Reynold's number correlation for turbulent flow through pipes, Dimensional analysis, friction loss across sudden expansion, contraction, valves and fittings.								
UNIT – III						**Hours: 09**		
Transportation and metering of fluid - Orificemeter, Venturimeter, Pitot tube, Rotameter, Wiers and Notches, pumps and compressors, Performance and characteristics of centrifugal pumps, NPSH, Cavitation , Priming Flow of Compressible fluids – Thermodynamics of ideal gas, isentropic process, wave prorogation through compressible fluids, sonic velocity, Mach number, flow through variable area conduits (Nozzle), Equations for isentropic flow, Equations for isothermal frictional flow.								
UNIT – IV						**Hours: 09**		
Turbulent flow - Velocity fluctuations in turbulent flow, statistical nature of turbulence, Reynold's stresses, empirical theories, eddy viscosity, Prandtl's mixing length theory, Velocity distribution for turbulent flow – $1/7^{th}$ power law, Logarithmic velocity distribution, Universal velocity distribution; Relationship between friction factor and Reynold's number, Von karman correlation.Laminar flow of non-Newtonian (power law) fluids through circular pipe, friction factor and Reynold's number for power law fluid, Metzner Reed's approach, capillary tube experiment								
UNIT-V						**Hours: 09**		
Flow past immersed bodies - Boundary layer, drag and drag coefficient, Stokes law and terminal settling velocity. Flow of fluids through bed of solids - Darcy's law, Ergun's equation, Fluidization, minimum fluidization velocity, pneumatic transport.								
Total contact Hours: -45	**Total Tutorials: -15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Noel de Nevers, Fluid mechanics for Chemical Engineers, TATA McGraw- Hill edition,3^{rd} Edition 2011. 2. W.L.Mc.Cabe, J.C.Smith and P.Harriot, Unit Operations of Chemical Engineers, McGraw Hill International edition, 7^{th} Edition, 2009.								
Reference Books:								
1. Coulson J.M and Richerdson J.F., Chemical Engineering - Volume 1, Elsevier Press, 6^{th} Edition, 2006.								

Department : Chemistry				**Programme :** B.Tech. (CH)				
Semester : Three				**Category :** LB				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CY105	Physical Chemistry Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved in Physical chemistry. • To provide practical knowledge of handling instruments.							
Outcome	At the end of the semester the student should be able to • Understand method of determination of physical properties • Students will gain laboratory skills in analyzing samples using various instruments							

List of experiments: (Any 10 experiments)

1. Study of simple eutectic formed by naphthalene-biphenyl system.
2. Study of simple eutectic formed by naphthalene-Diphenylamine system.
3. Critical solution temperature of phenol – water system.
4. Acetic acid – chloroform – water three component system.
5. Rate constant of hydrolysis of ethyl acetate by an acid.
6. Rate constant of a second order reaction – Saponification
7. Partition coefficient of iodine between carbon tetra chloride and water.
8. Partition coefficient of benzoic acid between benzene and water.
9. Determination of molecular weight from depression of freezing point.
10. Transition Temperature of $Na_2S_2O_3.5H_2O$
11. Adsorption of acetic acid on charcoal – Freundlich adsorption isotherm.
12. Adsorption of oxalic acid on charcoal – Freundlich adsorption isotherm.
13. Conductometry titration – Strong acid Vs Strong base
14. Conductometry titration – mixture of hydrochloric acid and acetic acid vs sodium hydroxide.
15. Determination of lead by conductometry titration.
16. Potentiometry - Estimation of Iron.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemistry, Pondicherry Engineering College, Puducherry-605 014.

Reference Books:

Department : Electrical and Electronics Engineering					**Programme :** B.Tech. (CH)			
Semester : Three					**Category :** LB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EE137	Electrical and Electronics Engineering Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To introduce load test methods • To verify important principles in basic electrical and Electronics Engineering							
Outcome	At the end of the semester the student should be able to • Design and conduct experiments on Transformers , AC and DC electrical machines for their performance analysis, • Understand theorems for electric circuit analysis, logic gates to analyze and interpret results.							

List of experiments: (Any 10 experiments)

1. Performance characteristics of transformers through OC and SC test.
2. Load test on single-phase transformer.
3. Load test on DC shunt motor.
4. Load test on single phase IM.
5. OCC of DC generator.
6. Swinbarn's test.
7. Verification of logic gates.
8. Verification of Thevinin and Norton theorem.
9. Verification of superposition theorem.
10. Series and parallel resonance.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Electrical and Electronics Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department: Mathematics			**Programme :** B. Tech. (CH)					
Semester : Four			**Category :**TB					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
MA106	Partial Differential Equations and Numerical Methods	3	1	0	4	40	60	100
Prerequisite								
Objective	• To introduce the ideas of Partial Differential Equations • To familiarize students Boundary value problems related to PDE • To solve problems in ordinary and partial differential equations by some basic numerical methods							
Outcome	• Understands how to solve first order Partial Differential Equations • Gain knowledge on solving Boundary Value Problems • Will be able to solve ordinary and partial differential equations numerically							
UNIT – I	**Solution of Partial Differential Equations**				**Hours: 10**			
Formation of PDE by elimination of arbitrary constants and arbitrary functions –General, Singular, Particular and complete integrals – Lagrange's linear first orderequation – Higher order differential equations with constant coefficients.								
UNIT – II	**Solution of Boundary Value Problems I**				**Hours: 9**			
Solution of partial differential equation by the method of separation of variables –Boundary value problems – Fourier series solutions – Transverse vibration of anelastic string.								
UNIT – III	**Solution of Boundary Value Problems II**				**Hours: 9**			
Fourier series solution for one dimensional heat flow equation – Fourier series solution for two dimensional heat flow equations under steady state conditions (Cartesian and polar forms).								
UNIT – VI	**Numerical solution of Ordinary Differential Equations**				**Hours: 10**			
Single step methods: Taylor series method, Picard's method, Euler, Modified Euler and Improved Euler methods, Runge-Kutta method of fourth order only. Multistep methods: Milne and Adams - Bashforth methods.								
UNIT – V	**Numerical solution of Partial Differential Equations**				**Hours: 10**			
Laplace and Poison equations:Liebmann's iterative method. Diffusion equation: Explicit and Crank-Nicholson implicit difference schemes. Wave equation: Explicit difference method.								
Total contact Hours: 48	**Total Tutorials: 12**	**Total Practical Classes:**			**Total Hours: 60**			
Text Books:								
1. Veerarajan T., Engineering Mathematics for second year, Tata-McGraw Hill, 2014. 2. M.K.Venkataraman, Engineering Mathematics, Vol. II & III, NationalPublishing Co., Madras, 2007. 3. P. Kandasamy, K. Gunavathy and K. Thilagavathy, "Numerical Methods", S. Chand & Company Ltd, New Delhi, 2014								
Reference Books:								
1. Bali N. P and Manish Goyal, Text book of Engineering Mathematics, 3rd Edition, Laxmi Publications (p) Ltd., 2012. 2. B.S. Grewal, Numerical methods in Engineering & Science, Khanna Publishers, New Delhi, 2013 3. M.K. Venkataraman, Numerical methods in Science and Engineering, National Publishing Company, Madras, 2013								
Web sites: {optional}								
1. www.math.niu.edu 2. nm.mathforcollege.com								
Reference Books:								

Department : Chemistry				**Programme :** B.Tech. (CH)				
Semester : Four				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CY106	Organic Chemistry	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To introduce basics of organic chemistry • To familiarize students with mechanisms of various reactions							
Outcome	At the end of the semester the student should be able to • Various types of organic compounds and their properties • Various types of chemical reactions • Biologically and industrially important organic molecules • Gives the foundation to understand advanced chemical engineering concepts							
UNIT – I	**Fundamentals of Organic Reactions**				**Hours: 12**			
Bond types, Concept of hybridization – sp3, sp2, sp. Factors affecting a covalent bond – inductive effect, mesomeric effect, electromeric effect and hyperconjugation. Reaction Intermediates - Free radicals, carbanion, carbonium ion – stability, carbenes, electrophiles and nucleophiles. General Reaction Mechanisms – Free radical, Electrophilic substitution, Nucleophilic substitution, E1, E2, Electrophilic addition and Nucleophilic addition mechanisms.								
UNIT – II	**Monohydric Alcohols**				**Hours: 12**			
General methods of preparation, general properties – Saytzeff rule, methods of distinguishing the three classes of alcohols – Lucas test, Dichromate test **Aldehydes and ketones –** General methods of preparation, physical and chemical properties – aldol condensation, Clemmensen reduction, Wolf-Kishner reduction, Haloform reaction, Cannizzaro reaction, Reformatsky reaction, Wittig reaction. Saturated monocarboxylic acids- Preparation, phsical and chemical properties- Hell-Volhard-Zelinsky reaction.								
UNIT – III	**Benzene**				**Hours: 12**			
Aromaticity- Huckel rule, general methods of preparation of benzene, electrophilic substitution reactions of benzene, theory of directive effects of mono-substituted benzene derivatives. Aromatic amino compounds – general methods of preparation and properties – carbyl amine reaction. Monohydric phenols – general methods of preparation and properties – Reimer – Tiemann reaction, Kolbe reaction, Fries rearrangement.								
UNIT – IV	**Carbohydrates**				**Hours: 12**			
Classification. Monosaccharides- reaction of Glucose and fructose, open chain and cyclic structures of glucose and fructose, mutarotation, epimerzation, Killiani- Fisher synthesis, Ruff degradation, conversion of aldoses to ketoses and Ketoses to aldoses. Disaccharides – properties and structure of sucrose. Polysaccharides – properties and structure of starch and cellulose.								
UNIT-V	**Heterocyclic compounds**				**Hours: 12**			
Preparation and properties of furan, thiophene, pyrrole and pyridine. Dyes – colour and constitution, Classification of dyes by structure, Classification of dyes based on application.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Arun Bhal and B.S. Bhal, A text book of Organic chemistry, S.Chand & Co., New Delhi, Revised Edition 2012.

Reference Books:

1. K.S. Tewari and N.K. Vishnoi, A textbook of organic chemistry, 3rd edition, Vikash Publishing house Pvt. Ltd., New Delhi, 2007.
2. R.T.Morrison and R.N. Boyd, Organic chemistry, 6th Edition, Pearson Education, New Delhi, 2004.
3. I.L. Finar, Organic chemistry (Vol.1), 6th Edition, Pearson Education, New Delhi, 2006.
4. I.L. Finar, Organic Chemistry (Vol.2), 5th edition, Pearson Education, New Delhi, 2006.

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Four					**Category :** TA			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH103	Chemical Engineering Thermodynamics	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Chemical engineering Thermodynamics needed for Chemical Engineers.							
Outcome	At the end of the semester the student should be able to • Thoroughly understand the properties of ideal and non-ideal solutions. • Understand the equilibrium between vapor-liquid, liquid-liquid, solid-liquid and solid-vapor systems. • Understand and apply the various activity coefficient models to solve a non-ideal solution problem.							
UNIT – I					**Hours: 09**			
The behavior of fluids - PVT properties of fluids, equations of state, ideal and non-ideal gas, the and compressibility factor, critical properties, generalized equations of state.								
UNIT – II					**Hours: 09**			
First law of thermodynamics - Types of energy, work, heat and energy changes, application of first law to different processes. Second law of thermodynamics and its applications - Entropy, reversible and irreversible processes, Carnot cycle, T-S diagrams, enthalpy of mixing and disorder, refrigeration ,liquefaction .								
UNIT – III					**Hours: 09**			
Thermodynamic properties and relations among them, mathematical relationships among basic properties, Maxwell relations, changes in properties, temperature and pressure effects, thermodynamic diagrams, construction of thermodynamic diagrams.								
UNIT – IV					**Hours: 09**			
Solution properties - partial molal properties and chemical potential, concept of fugacity and activity and their calculations, ideal and nonideal solutions, Gibbs - Duhem equations, property change of mixing and excess properties.								
UNIT-V					**Hours: 09**			
Phase equilibria - Phase rule, fundamentals of vapour - liquid equilibria, Vanlaar, Margules and Wilson equations for binary mixture, liquid - liquid, solid - liquid and solid - vapour equilibria, Introduction to group contribution methods (UNIFAC).								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 45**			
Text Books:								
1. J.Richard Elliot, Carl T Lira, Introductory Chemical thermodynamics, Prentice Hall International Series, 2nd Edition,2012. 2. J.M. Smith,H.C.Van Ness and M.M.Abbot adapted by B.I.Bhatt, Introduction to Chemical Engineering Thermodynamics(In SI Units), McGraw-Hill,7th Edition, 2013. 3. K.V.Narayanan, .A textbook of Chemical Engineering Thermodynamics, PHI learning private limited, 2nd Edition, 2013.								
Reference Books:								
1. B.G.Kyle,Chemical and Process Thermodynamics, PHI learning private limited , 2nd Edition, 1999. 2. Y.V.C.Rao, An Introduction to Thermodynamics, Wiley Eastern, 1994.								

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Four				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH104	Process Heat Transfer	3	1	-	4	40	60	100

Prerequisite	-
Objectives	• To Provide Solid background in the fundamental concepts of Process Heat Transfer needed for Chemical Engineers
Outcome	At the end of the semester the student should be able to • Model basic heats transfer processes and identify modes and calculate thermal resistances, and write an algorithm to solve it. • Perform an energy balance to determine temperature and heat flux • Solve lumped parameter transient heat transfer problems and heat exchanger problems

UNIT – I	**Hours: 09**
Steady state conduction - Fouriers law, thermal conductivity, conduction through composite multilayer plane walls, spherical walls and cylindrical walls, insulation and critical thickness of insulation, heat conduction in rods with heat generation. Heat transfer in extended surfaces - equation for heat transfer in rectangular and cylindrical fins, fin effectiveness and fin efficiency. Unsteady state heat conduction – lumped parameter model, Derivation of unsteady state equation with boundary condition (Solution not included).	
UNIT – II	**Hours: 09**
Principles of heat transfer in fluids - laminar flow and boundary layer theory in heat transfer, heat transfer in turbulent flow, eddy thermal diffusivity, prandtl mixing length theory, analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, Correlations for the calculation of heat transfer coefficients, heat transfer coefficient for flow through a pipe, flow through a non circular conduit, flow past flat plate, flow through packed beds. Heat transfer by natural convection.	
UNIT – III	**Hours:09**
Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, effect of non-condensable gasses on rate of condensation. Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.	
UNIT – IV	**Hours: 09**
Radiation heat transfer - Emissive power, Black body radiation, Emissivity, Stefen - Boltzman law, Plank's law, radiation between surfaces, View factor calculations - view factor for infinitely parallel grey planes, view factor from a plane to a hemisphere, Radiation in absorbing gases.	
UNIT-V	**Hours: 09**
Heat exchange equipments - Double pipe and shell and tube heat exchangers, concept of log mean temperature difference (LMTD), LMTD correction factor, overall heat transfer coefficient, dirt factor, heat exchanger effectiveness.Evaporators - single effect and multiple effect evaporators, boiling point rise, capacity and economy of multiple effect evaporators, evaporation equipments.	

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Binay K.Dutta , Heat Transfer, Prentice Hall Publications, 2006.
2. W.L.Mc.Cabe, J.C.Smith and P.Harriot, Unit operations of chemical engineers, McGraw Hill International edition, 7th edition, 1995.

Reference Books:

1. Holman.J.P, Heat Transfer, 9 th Edition, McGraw Hill International, 2004.
2. Kern D.Q, Process Heat Transfer, Mc.Graw Hill, 1950.
3. Krieth, Fundamentals of Heat Transfer, Harper and Row Publishers, 6th Edition, 1986.
4. C.J.Geankoplis, Transport Processes and Unit Operations, Prentice Hall, 3rd Edition, 1993.
5. Coulson J.M and Richerdson J.F, Chemical Engineering - Volume 1, Elsevier Press, 6th Edition, 2006.

Department : Chemical Engineering			**Programme :** B.Tech. (CH)					
Semester : Four			**Category :** TB					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH105	Mass Transfer I	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Mass Transfer I needed for Chemical Engineers							
Outcome	At the end of the semester the student should be able to • Read any problem, understand it, analyze it, and write an algorithm to solve it. • Apply the laws of conservation of mass and energy, and chemical, and physical concepts to solve problems. • Understand the use of each of the chemical engineering unit operations.							
UNIT – I						**Hours: 09**		
Molecular diffusion in gases and liquids, measurement and calculation of diffusivities, steady state diffusion in multi component mixtures. Diffusion in solids, molecular and Knudsen diffusion in porous solids, unsteady state diffusion in solids.								
UNIT – II						**Hours: 09**		
Mass transfer in turbulent flow, eddy diffusion, mass transfer coefficients, film theory, penetration theory and surface renewal theories of mass transfer, estimation of mass transfer coefficient in wetted wall column, correlations for the calculation of mass transfer coefficients. Theory of interface mass transfer, Individual and overall mass transfer coefficients, steady state co-current and countercurrent mass transfer processes, stages and stage efficiencies, cross flow and counter current cascades of stages, Kremser equations for the calculation of number of theoretical stages.								
UNIT – III						**Hours: 09**		
Equipments for gas-liquid contact operations – Gas dispersed – Sparged vessels, mechanically agitated vessels, Tray towers; Liquid Dispersed – Venturi Scrubber, Wetted Wall Tower, Spray Tower, packed Towers; Correlations for Mass Transfer Coefficients.								
UNIT – IV						**Hours: 09**		
Gas Absorption - Tray tower absorber, absorption factor, calculation number of theoretical stages, Murphree efficiency - point efficiency, tray efficiency and overall tray efficiency, calculation of actual number of trays. Packed tower absorber - HETP, HTU and NTU calculations Non-isothermal absorber, absorption with chemical reaction.								
UNIT-V						**Hours: 09**		
Adsorption – Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Freundlich equation. Adsorption operation – stage wise operations, steady state moving bed adsorbers, unsteady state fixed bed adsorbers, break through curves, rate of adsorption in fixed beds, design of fixed bed adsorbers. Ion exchange – Principle of Ion exchange.								
Total contact Hours: -45	**Total Tutorials: -15**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. R.E. Treybal, Mass Transfer Operations, McGraw Hill, 3rd Edition, 1981. 2. Binay K Dutta, Principles of Mass Transfer and Separation Process, PHI learning private limited, 2007.								
Reference Books:								
1. C.J.Geankoplis, Transport Processes and Unit Operations, Prentice Hall, 4th Edition, 2003. 2. Badger and Banchero, Introduction to Chemical Engineering, Tata Mc.Graw Hill, 2006. 3. Coulson J.M and Richerdson J.F, Chemical Engineering - Volume 2, Elsevier Press, V Edition, 2006. 4. W.L.McCabe, J.C.Smith and P.Harriot, Unit Operations of Chemical Engineers, McGraw Hill International Edition, 7th Edition, 2009. 5. A.P.Sinha and Parameswar De, Mass Transfer Principles and Operations, PHI learning private limited, 2012.								

Department : Chemistry					**Programme :** B.Tech. (CH)			
Semester : Four					**Category :** LB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CY107	Organic Chemistry Laboratory	-	-	3	2	60	40	100
Prerequisite								
Objectives	• To provide on hand on experience on various organic reactions.							
Outcome	At the end of the semester the student should be able to • Understand the concepts of organic chemistry through experiments							

List of experiments: (Any 10 experiments)

1. Organic preparations:
   Preparations of compounds involving the following reactions (a) Oxidation (b) Reduction (c) Bromination (d) Nitration (e) Acetylation (f) Hydrolysis
2. Organic qualitative analysis:
   The following classes of compounds are to be analysed (a) Aldehydes (b) Ketones (c) Acids (d) Amides (e) Esters (f) Amines (g) Ethers (h) Alcohols (i) Hydrocarbons (j) Sugar (k) Phenols
3. Determination of physical constants:
   Boiling point and melting point determination.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemistry, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Four				**Category :** LB				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH106	Momentum Transfer Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved in momentum transfer through experiments. • To provide practical knowledge of handling fluid flow systems.							
Outcome	At the end of the semester the student should be able to • Students will be able to understand momentum transfer and its usefulness in industry. • Students will gain laboratory skills and that will give confidence in analyzing sample data in engineering.							

List of experiments: (Any 10 experiments)

1. Laminar flow of Newtonian and non Newtonian fluids;
2. Flow through pipes and fittings;
3. Flow through annulus;
4. Orifice meter;
5. Venturi meter;
6. Rotameter;
7. Weirs and notches;
8. Packed bed;
9. Fluidized bed;
10. Centrifugal pump characteristics.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemical Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Five				**Category :** TB				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH107	Mass Transfer II	3	1	-	4	40	60	100

Prerequisite	-
Objectives	• To Provide Solid background in the fundamental concepts of Mass Transfer II needed for Chemical Engineers
Outcome	At the end of the semester the student should be able to • Read any problem, understand it, analyze it, and write an algorithm to solve it. • Apply the laws of conservation of mass and energy, and chemical, and physical concepts to solve problems. • Understand the use of each of the chemical engineering unit operations.

UNIT – I	**Hours: 09**

Vapour liquid equilibria - Raoult's law, relative volatility, vapour liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential or simple distillation, steam distillation, multistage continuous rectification, calculation of number of ideal stages by Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio.

UNIT – II	**Hours:09**

Number of ideal stages by Mc.Cabe - Thiele method, effect of operating conditions on the number of ideal stages, Murphree stage and overall efficiency, calculation of actual number of stages, batch distillation with reflux, packed bed distillation, NTU and HTU calculations. Introduction to Multicomponent distillation - key components, minimum number of plates, minimum reflux ratio, Azeotropic and Extractive distillation.

UNIT – III	**Hours: 09**

Liquid - liquid extraction - ternary liquid liquid equilibrium, solvent characteristics, equipments for liquid liquid extraction, stage wise contact - cross current and counter current extraction, continuous contact extraction, packed bed extraction with reflux. Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

UNIT – IV	**Hours: 09**

Humidification operations - humidity chart, adiabatic saturation curves, wet bulb temperature and measurement of humidity, Lewis relation, equipments for humidification operations, water cooling towers and spray chambers. Theory and calculation of humidification processes - gas liquid interaction, conditions in the top and bottom of cooling towers, design of cooling towers and dehumidifiers.

Drying - equipments for batch and continuous drying of solids, principles and theories of drying - drying rate curve, critical and equilibrium moisture content, calculation of drying time under constant drying conditions. Mechanism of batch drying - cross-circulation drying, through circulation drying. Continuous drying - material and energy balances in continuous dryers, rotary dryer - design of rotary dryer.

UNIT-V	**Hours: 09**

Crystallization - principles of crystallization, types of crystals, nucleation theories, crystal growth and L law, particle size distribution of crystals, Yields, heat and material balances in crystallization, equipments for crystallization.

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. R.E. Treybal, "Mass Transfer Operations", McGraw Hill, 3rd Edition, 1981.
2. Binay K Dutta, "Principles of Mass Transfer and Separation Process", PHI learning private limited, 2007.

Reference Books:

1. C.J.Geankoplis, Transport Processes and Unit Operations, Prentice Hall, 4th Edition, 2003.
2. W.L.McCabe, J.C.Smith and P.Harriot, Unit Operations of Chemical Engineers, McGraw Hill International Edition, 7th Edition, 2009.
3. A.Anantharaman and K.M.Meera Sheriffa Begum, Mass Theory and Practice, PHI learning private limited, 2011.
4. A.P.Sinha and Parameswar De, Mass Transfer Principles and Operations, PHI learning private limited, 2012.

Department : Chemical Engineering			**Programme :** B.Tech. (CH)					
Semester : Five			**Category :** TA					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH108	Mechanical Operations	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Mechanical Operations needed for Chemical Engineers							
Outcome	At the end of the semester the student should be able to • To provide necessary background in handling of solid particles • To Provide training to choose methods and solve problems relevant to general practice of chemical engineering							
UNIT – I						**Hours: 09**		
Particle Size Analysis - Methods of representation of size analysis, shape factor, subsieve methods of analysis, surface area determination. Industrial screening - Theory of screening, screen efficiency, types of screening equipments and their performances. Storage and Conveyance of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, conveyer selection, different types of conveyers and their performance characteristics.								
UNIT – II						**Hours: 09**		
Size reduction - Energy relationships in size reduction, size reduction equipment and selection, closed circuit and open circuit operation. Size enlargement - Principle of granulation, briquetting, pelletisation, flocculation, typical equipments used.								
UNIT – III						**Hours: 09**		
Classification - Application of Stoke's equation, types of classifiers - gravity settling, settling tanks, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - Principles, separation of solids from fluids, separation of immiscible liquids, continuous centrifuges, super centrifuges, design of basket centrifuges, cyclones and hydro cyclones. Gas cleaning - Gravity and momentum separators, cyclone separators, design of cyclones, liquid washing, electrostatic precipitators.								
UNIT – IV						**Hours: 09**		
Solid - Liquid separation-Filtration, flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids. Thickening - Batch and continuous thickeners, design of continuous thickeners.								
UNIT-V						**Hours: 09**		
Froth flotation - Principles and theories of collection, flotation cell and typical circuit.Magnetic separation, Electrical separation. Sorting (separation of solids) - principles of jiggers, types of jiggers, performance characteristics, principles of flowing film concentrators, tabling, heavy liquid and heavy media separation. Mixing and agitation - Mixing of liquids (with or without solids) which are viscous but are pourable after mixing, mixing of liquids (with solids) which form stiff pastes, mixing of powders, selection of suitable mixers, power requirement for mixing.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Anup K Swain, Hemlata Patra and G.K.Roy ,Mechanical Operations,Tata McGraw-Hill Education Private Limited, 2011. 2. Badger and Banchero, Introduction to Chemical Engineering, Tata McGraw-Hill, 2006. 3. McCabe, J.C.Smith and P.Harriot, Unit Operations of Chemical Engineers, McGraw Hill International Edition, VII edition, 2009.								
Reference Books:								
1. Foust Wenzel, Principle of Unit Operations, John Wiley and sons, II Edition, 1980. 2. Coulson J.M and Richerdson J.F, Chemical Engineering - Volume 2, Elsevier Press, V Edition, 2006.								

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Five					**Category :** TB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH109	Chemical Reaction Engineering I	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Chemical Reaction Engineering I needed for Chemical Engineers							
Outcome	At the end of the semester, the student should be able to • Understand the concept of equilibrium involving chemical reactions in the gas, liquid and solid phases • Apply the law of conservation of mass to develop the performance equation for single ideal isothermal homogeneous reactors • Decide suitable reactor for the given reaction system							
UNIT – I						**Hours: 09**		
Chemical equilibria - Free energy and chemical reactions, feasibility of chemical reaction, calculation of free energy of homogeneous reactions, equilibrium constants and evaluation from thermodynamic data, effect of different variables on reaction equilibria, calculation of equilibrium composition for single and multiple reactions, equilibria of heterogeneous reactions.								
UNIT – II						**Hours: 09**		
Kinetics of homogeneous reactions - introduction, single and multiple reactions, elementary and nonelementary reactions, rate equations, kinetic models for nonelementary reactions, testing kinetic models, temperature dependence of rate - Arrhenius, collision and activated complex theories, Interpretation of batch reactor data for single and complex reactions under constant volume and variable volume conditions, differential and integral analysis, half life period.								
UNIT – III						**Hours: 09**		
Design of single homogeneous reactors - ideal reactors, design equations for ideal batch reactor, PFR and CSTR, size comparison of single reactors, optimum reactor size problems.								
UNIT – IV						**Hours: 09**		
Multiple reactor systems - plug flow reactors in series and / or parallel, CSTRs in series, reactors of different types in series, recycle reactor, auto catalytic reactions, optimum recycle ratio for an auto catalytic reaction.								
UNIT – IV						**Hours: 09**		
Multiple reaction systems - series and parallel reactions in CSTRs and PFRs, product distribution, fractional yields, maximization of fractional yield in multiple reactions, series - parallel reactions.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Octave Levenspiel, Chemical Reaction Engineering, John Wiley Publications Ltd., 3rd Edition, 2007. 2. Lanny D. Schmidt, The Engineering of Chemical Reactions, Oxford University Press, 2nd Edition, 2010.								
Reference Books:								
1. H.S.Fogler, Elements of Chemical Reaction Engineering, Prentice Hall of India Ltd., 4th Edition, 2009. 2. J.M.Smith, Chemical Engineering Kinetics, McGraw Hill, III Edition, 1981.								

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Five					**Category :** LB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH110	Heat Transfer Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved in heat transfer through experiments. • To provide practical knowledge of handling heat transfer systems.							
Outcome	• Students will be able to understand basic principles of heat transfer through experiments. • Students will gain laboratory skills and that will give confidence in analyzing samples in engineering and other fields.							

List of experiments: (Any 10 experiments)

1. Heat Transfer through Composite Wall;
2. Transient Heat Conduction;
3. Heat Transfer in a Shell and Tube Heat Exchanger;
4. Heat Transfer through Packed Bed;
5. Heat Transfer in a Double Pipe Heat Exchanger;
6. Heat Transfer in a Vertical Condenser;
7. Heat Transfer in a Horizontal Condenser;
8. Heat Transfer in Helical Coils;
9. Heat Transfer with Natural Convection;
10. Heat Transfer by Radiation.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemical Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department : Chemical Engineering		**Programme :** B.Tech. (CH)						
Semester : Five		**Category :** LB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH111	Mass Transfer Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved in Mass Transfer. • To provide practical knowledge of handling mass transfer systems.							
Outcome	• Students will be able to understand basic principles of mass transfer through experiments. • Students will gain laboratory skills and that will give confidence in data analyzing in engineering.							

List of experiments: (Any 10 experiments)

1. Stefan's tube experiment-diffusivity of vapour in air;
2. Liquid liquid diffusion-diffusivity of salt in water;
3. Surface Evaporation;
4. Sublimation of naphthalene ball;
5. Packed bed absorber;
6. Hydrodyanmic /flooding characterization of packed tower;
7. Hydrodynamic /flooding characterization of tray tower;
8. Adsorption isotherm;
9. Multistage adsorption ;
10. Vapour liquid equilibrium;
11. Simple distillation;
12. Steam distillation I and II;
13. HETP;
14. Lquid liquid equilibrium ;
15. Liquid liquid extraction;
16. Leaching.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemical Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Five					**Category :** LB			
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH112	Mechanical Operations Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved in Mechanical Operations. • To provide practical knowledge of handling size reduction equipments.							
Outcome	• Students will be able to understand practically the basic principles of Mechanical Operations • Students will gain laboratory skills and report writing skills							

List of experiments: (Any 10 experiments)

1. Screen effectiveness;
2. Jaw crusher;
3. Ball mill;
4. Drop weight crusher;
5. Beaker decantation;
6. Air elutriation;
7. Vacuum leaf filter;
8. Plate and frame filter press;
9. Batch sedimentation;
10. Terminal settling velocity-Stokes law.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemical Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department : Mechanical Engineering				**Programme :** B.Tech (CH)				
Semester : Six				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ME129	Industrial Engineering and Management	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To provide the students with the knowledge of productivity techniques and systems, industrial engineering and management disciplines so as to fully equip them to take up challenging assignments as industrial engineers, systems managers, productivity advisers, managers of management services or training officers							
Outcomes	• Competently employ broad-based analytical tools and computers for decision-making and system design, analysis and performance • Assume managerial and leadership roles in their chosen professional careers while working in multidisciplinary teams. • Engage in continuous learning by seeking out opportunities for higher education or ongoing training related to their employment. • Effectively adapt to the changing demands in workplace and are able to perform increasingly complex tasks, and tasks outside their field of expertise.							
Unit - I						**Hours : 12**		
Plant Location : influencing factors - evaluation of location alternatives for Single facility location problems – solving simple problems.Plant Layout : classification of production systems – principles of layout – basic types of layout – line balancing – simple problems in line balancing using Ranking Positional Weight Method.Material Handling : functions – principles – classification of material handling equipments (only classification and no description) - factors to be considered in selection of material handling equipment.								
Unit - II						**Hours : 12**		
Method Study : objectives - basic procedure - various recording techniques – process charts, multiple activity charts, SIMO chart, Flow diagram, string diagram, cyclegraph and chronocyclegraph - principles of motion economy – Therbligs - micromotion study & memomotion study.Work Measurement : purpose - basic procedure – various techniques of work measurement – analytical estimation – stop watch time study – time study equipments – different systems of performance rating – time allowances – PMTS - work sampling – simple problems involving the determination of standard time and compensation.								
Unit - III						**Hours : 12**		
Production Planning and Control : functions – qualitative and quantitative techniques of forecasting – simple problems in forecasting using moving average, weighted moving average, simple exponential smoothing and regression methods - routing – loading and scheduling – different methods of scheduling – expediting – dispatching – functions and objectives of materials management – Introduction to inventory control and ABC								
Unit - IV						**Hours : 12**		
Management : Basic Concepts – Introduction to modern management – Taylor's contribution - Fayol's principles - functions of management.Financial Management : fixed and working capital - sources of finance - evaluation of investment alternatives using present worth / future worth / annuity / rate of return methods – different methods of determining depreciation – Elements of cost & cost ladder - break-even analysis – simple problems.								
Unit - V						**Hours : 12**		
Marketing Management: Concepts of Marketing - products and markets – pricing - channels of distribution - sales promotion - advertising - basics of market research. Human Resources Management : individual and group behaviour – Maslow's hierarchy of needs – motivation and morale - fatigue - causes & remedy - manpower planning – job analysis – job evaluation and merit rating - management by objectives .								
Total Contact Hours : 60	**Total Tutorials : -**	**Total Practical Classes : -**			**Total Hours : 60**			
Text Books :								
1. Panneerselvam, R., Production and Operations Management, PHI Learning Pvt. Ltd., 2nd Edition, 2006. 2. Martand Telsang, Industrial Engineering and Production Management, S.Chand & Co., 2nd Revised Edition, 2006. 3. Khanna, O.P., Industrial Engineering and Management, Dhanpat Rai Sons (P) Ltd., 2010.								
Reference Books:								

1. Joseph Monks, Operations Management: Theory and Problems, McGraw Hill Education, ISE Edition, 1987.
2. Barnes, R.M., Motion and Time Study: Design and Measurement of Work, John Wiley & Sons, 7th Edition, 1980.
3. Roger G.Schroeder Susan Meyer Goldstein and M. Johnny Rungtusanatham, Operations Management : Contemporary Concepts and cases, McGraw Hill, New York, 5th Edition, 2011.

Web Sites:

1. www.nptel.ac.in

Department : Chemical Engineering		**Programme :** B.Tech. (CH)						
Semester : Six		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH113	Chemical Reaction Engineering II	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Chemical Reaction Engineering II needed for Chemical Engineers							
Outcome	At the end of the semester the student should be able to • Understand non-ideal fluid mixing and flow patterns in reactors and account for it calculating the conversion. • Write heat balance equations to account for effect of temperature on conversion in batch and flow reactors and to analyze the stability of non-isothermal reactors. • Apply the principle of rate controlling step in deducing global rate expressions for heterogeneous chemical reactions involving reaction kinetic rates and mass transfer rates							
UNIT – I						**Hours: 09**		
Non-isothermal reactions - temperature effects on chemical reaction rates, design procedures for adiabatic and non-isothermal operation of batch and flow reactors, optimum temperature progression, operating temperature for favorable product distribution in multiple reactions, reactor stability.								
UNIT – II						**Hours: 09**		
Non-ideal reactors - Reasons for non-ideal flow behaviours, concept of mixing - micro and macro mixing, residence time distribution (RTD) functions, C, E and F curves, calculation of mean residence time from E and F curves, Tanks in series models, Axial dispersion model, segregated flow model, conversion in non-ideal reactors, introduction to multi-parameter models.								
UNIT – III						**Hours: 09**		
Fluid-solid noncatalytic reactions - shrinking core model, determination of the rate controlling step, conversion in reactors with constant fluid composition, conversion in reactors with variable fluid composition - fixed bed reactor, moving bed reactor. Gas-liquid non-catalytic reactions - models for transfer at gas-liquid interface, enhancement factor, Hatta number, Derivation of overall rate equation for first order irreversible reaction and instantaneous reaction, design of packed bed reactors for gas-liquid non-catalytic reactions (simple cases).								
UNIT – IV						**Hours: 09**		
Solid catalysts - characteristics, classification of catalysts, selection and preparation of industrial catalysts, promoters and inhibitors, catalyst deactivation. Kinetics of solid catalysed reactions - Langmuir-Hinshelwood-Hougen-Watson mechanism, interpretation of kinetic data, redox rate equation, kinetics of catalyst deactivation.								
UNIT – V						**Hours: 09**		
Reaction and diffusion in porous catalysts - effectiveness factor, Thiele modulus, non-isothermal effectiveness factor, Global rate equations. Heterogeneous catalytic reactors - Fixed bed reactors, fluidized bed reactors, slurry reactors, Trickle bed reactors, design aspects with some simple examples.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Octave Levenspiel, Chemical Reaction Engineering, Johon Wiley Sons Ltd., 3rd Edition, 2007. 2. J.M.Smith, Chemical Engineering Kinetics, McGraw Hill, 3rd Edition, 1981.								
Reference Books:								
1. H.S.Fogler, Elements of Chemical Reaction Engineering, PHI learning private limited, 4th Edition, 2012. 2. G.F.Froment and K.B.Bischoff, Chemical Reactor Analysis and Design, John Wiley and Sons, 3nd Edition 2011.								

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Six				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH114	Chemical Process Industries	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Chemical Process Industries needed for Chemical Engineers							
Outcome	At the end of the semester the student should be able to • Read, understand, and use process flow diagrams. • Apply the basic principles of chemistry and engineering to design a chemical plant. • Choose an economic and environment friendly method of industrial production • Draw a flow chart for converting the raw material into end product							
UNIT – I						**Hours: 12**		
Water Conditioning methods, Demineralisation, Precipitation Process. Industrial Gases: Carbondioxide, Nitrogen, Hydrogen, Oxygen and Acetylene.								
UNIT – II						**Hours: 12**		
Alkalies :Chlor-alkali Industries: Manufacture of Soda ash, Manufacture of Caustic Soda and chlorine-common salt. Sulphur and Sulphuric acid: Mining of Sulphur and manufacture of Sulphuric acid. Manufacture of hydrochloric acid and Nitric Acid.								
UNIT – III						**Hours: 12**		
Cement, Glass and Paper; Cement: Types and Manufacture of Portland cement, Glass: Manufacture of Glasses and Special Glasses, Ceramics: Refractories, Production of pulp, paper and Rayon.								
UNIT – IV						**Hours: 12**		
Sugars and Paints:Manufacture of sugar, starch and starch derivatives-Manufacture of paints – Pigments. Vegetable oil, Cottonseed Oil and Soybean Oil by Solvent Extraction.								
UNIT – V						**Hours: 12**		
Fertilisers :Nitrogen Fertilisers: Synthetic Ammonia, Urea, Ammonium chloride, CAN, Ammonium Phosphate-Phosphorus fertilizers: Phosphate rock, Phosphoric, Acid, Super Phosphate and Triple Super phosphate –MAP, DAP.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. N.Shreve, Chemical Process Industries , 5th Edition, McGraw Hill, New York, 1984. 2. R.Gopal and M.Sittig, Dryden's outlines of Chemical Technology, 2nd Edition, 1965.								
Reference Books:								
1. S.D.Shukla and G.N.Pandey,Textbook of Chemical Technology, Volume I, 1977.								

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Six					**Category :** POD			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH115	Process and Mechanical Design of Chemical Equipment	2	-	3	4	60	40	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Process and Mechanical Design of Chemical Equipment needed for Chemical Engineers							
Outcome	At the end of the semester the student should be able to • Understand the roles and responsibilities of a process design engineer • Read any problem, understand the design logic and write an algorithm to solve it. • Apply the basic concepts of material and energy balances, heat transfer and mass transfer to design various related equipments.							

Detailed Process Design and Mechanical Design of the following equipments:

(i)	Heat exchangers	Double pipe heat exchangers Shell and Tube heat exchangers
(ii)	Condensers	Horizontal Condenser Vertical Condenser
(iii)	Evaporators	Multiple Effect Forward feed Evaporator (with and without boiling point rise) Multiple Effect Backward feed Evaporator (with and without boiling point rise)
(iv)	Absorption Tower	Plate Column Packed column
(v)	Distillation Tower	Plate Column Packed column
(vi)	Rotary Drier	
(vii)	Cooling Tower	
(viii)	Reactors	
(ix)	Storage Tanks	

Total contact Hours: 30	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 75**

Text Books:

1. S.B.Thakore and BI Bhatt, Introduction to Process Engineering and Design, Mc Graw-Hill Education (India) Private Limited, 2013.
2. Kern D.Q, Process Heat Transfer, Mc Graw Hill, 1950.

Reference Books:

1. J.M.Coulson and J.F.Richardson, Chemical Engineering - Volume VI, Elsevier Press, 6th Edition, 2006.
2. R.H.Perry and Don Green, Chemical Engineer's Handbook, McGraw Hill, 8th Edition, 2009.
3. R.E. Treybal, Mass Transfer Operations, Mc Graw Hill, II Edition, 1981.

Department : Chemical Engineering		**Programme :** B.Tech. (CH)						
Semester : Six		**Category :** LB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH116	Chemical Reaction Engineering Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved chemical reaction engineering. • To provide practical knowledge of handling chemicals.							
Outcome	• Students will be able to understand basics of chemical reactions engineering. • Students will able to validate various theoretical model studied • Students will gain laboratory skills and report writing skills.							

List of experiments: (Any 10 experiments)

1. Isothermal Batch reactor – Determination of order and reaction rate constant;
2. Semi batch reactor- Determination of conversion and reaction rate constant;
3. Determination of activation energy;
4. CSTR- Determination of conversion and reaction rate constant;
5. PFR- Determination of conversion and reaction rate constant;
6. PFR and CSTR in series- Comparison of conversion;
7. Three CSTRs in series- Comparision of conversion;
8. Residence Time Distribution in CSTR;
9. Residence Time Distribution in packed bed reactor;
10. Heterogeneous catalytic reaction.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemical Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Six					**Category :** LB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH117	Computational Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the role of computer in solving iterative problems • To provide practical knowledge of handling chemical engineering problems with modern tools.							
Outcome	• Students will be able to understand coding of iterative calculations. • Students will gain confidence in analyzing chemical problems using computers							

List of experiments: (Any 10 experiments)

- Solutions to linear equations
- Solutions to non linear equations
- Solutions to Simultaneous Equations (Material and Energy Balances)
- Cubic Equation solving(EoS Equations)
- Bubble point and dew point Calculations
- VLE calculations
- Interpolation of chemical data from steam table etc
- Regression Analysis of linear data systems
- Regression Analysis of non linear data systems
- Solutions to Transient state problems (Heat and Mass Transfer examples)
- One dimensional optimization problems (Simplex algorithm, LM algorithm)

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemical Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department: Humanities and Social Sciences		**Programme:** B. Tech. (CH)						
Semester : Six		**Category :** PR						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
HS102	General Proficiency	-	-	3	1	100	-	100
Prerequisite	-							
Objectives	• To enhance the students' communication and language skills and make them industry-ready. • To encourage brain storming discussions and team work. • To train students to master soft skills through various activities.							
Outcomes	On successful completion of the module students will be able to: • Communicate in English effectively and confidently. • Imbibe the requisite soft skills. • Improve critical thinking and analytical skills.							

Art of communication: Verbal and Non-verbal Communication – Barriers to Communication – Importance of Body Language (Proxemics, kinesics, haptic, chronemics and paralanguage) – Effective Listening – Feedback – presentation skills.

Introduction to soft skills: Self-Confidence – Leadership Qualities – Emotional Quotient – Time Management – Stress Management – Interpersonal Skills.

Comprehension and Analysis: British and American English – GRE based comprehension – analytical writing – analyzing contemporary issues – current English usage.

Adapting to corporate life: Group discussions – meetings – Public Speaking – Debate – Intercultural communication – etiquettes –interviews-email writing.

Aptitude: Vocabulary building - Verbal and Numerical aptitude.

Total contact Hours:	**Total Tutorials:**	**Total Practical Classes: 45**	**Total Hours: 45**

Reference Books:

1. Nicholls, Anne. Mastering Public Speaking. Jaico Publishing House,2003.
2. Agrawal, R.S. Quantitative Aptitude,S.Chand and Co., 2004.
3. Sherfield M Robert. Developing Soft Skills Pearson Education, 2005.
4. Hair O' Dan, Friedrich W. Gustav and Lynda Dee Dixon. Strategic Communication in Business and the Professions, Pearson Education, 2008.
5. Chaney Lilian and Jeanette Martin. Intercultural Business Communication, Pearson Education, Fourth Edition, 2008.
6. Dignen, B. Fifty ways to improve your presentation skills in English. Orient Blackswan, 2014.

Websites:

1. www.cambridgeenglish.org

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Seven					**Category :** TB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH118	Transport Phenomena	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Transport Phenomena needed for Chemical Engineers							
Outcome	At the end of the semester, the student should be able to • Understand the various coordinate systems such as rectangular and curvilinear coordinates • Transform one coordinate system to another • Comprehend the transport of momentum, heat and mass transport through different geometries							
Note: Table containing the Transport Phenomena equations is permitted in the examination.								
UNIT – I						**Hours: 09**		
Viscosity, temperature effect on viscosity of gases and liquids, Newton's law, mechanism of momentum transport, Velocity distribution in laminar flow- shell momentum balance-flow through tubes-surfaces-flow of Newtonian fluid.								
UNIT – II						**Hours: 09**		
Equation of change for isothermal process – one dimensional equation of motion and continuity – Euler and Navier Stokes equation, dimensional analysis of equation of change.								
UNIT – III						**Hours: 09**		
Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow with electrical, nuclear, viscous heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.								
UNIT – IV						**Hours: 09**		
Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.								
UNIT – V						**Hours: 09**		
Diffusivity, temperature and pressure effect, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow: Stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes:**				**Total Hours: 60**		

Text Books:

1. R.B.Bird, W.E.Stewart and E.N.Lightfoot, Transport Phenomena, John Wiley and Sons, 2nd Edition, 2003.

Reference Books:

1. Willim Thomas, Introduction to Transport phenomena, Perason Education, 1st Edition ,2000.
2. R.S.Brodkey and H.C. Herskey, Transport Phenomena, Mc Graw Hill, 1988.
3. J.R.Welty, C.E.Wicks, R.E.Wilson and Roggers , Fundamentals of Momentum, Heat and Mass transfer, John Wiley and Sons, 5th Edition, 2007.
4. Willim Deen, Analysis of Transport Phenomena, Oxford University Press, 2nd Edition, 2007.

Department : Chemical Engineering			**Programme :** B.Tech. (CH)					
Semester : Seven			**Category :** TB					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH119	Process Dynamics and Control	3	1	-	4	40	60	100

Prerequisite	-
Objectives	• To Provide Solid background in the fundamental concepts of Process Dynamics and Control needed for Chemical Engineers
Outcome	At the end of the semester the student should be able to • Write unsteady state material and energy balance equations for a number of systems and deduce transfer function models. • Deduce closed loop transfer function models for feedback control systems with PID controller and analyze the transient behavior. • Analyze the stability of control systems using Routh, Bode and Nyquist criteria.

UNIT – I	**Hours: 09**
Introduction - Control system, components of a feed back control system, Lags in the control system – transfer lag, transportation lag, Pneumatic PID controller, control valve – valve characteristics Laplace transforms - properties of laplace transform, solution of linear differential equations using laplace transform techniques, piecewise continuous functions.	
UNIT – II	**Hours: 09**
Dynamic behaviour of systems - derivation of transfer functions for first and second order systems, liquid level, temperature, pressure, flow and concentration control processes, linearisation of nonlinear systems, interacting and non-interacting systems.Transient response of first and second order systems, natural frequency, damping factor, overshoot, decay ratio, rise time and settling time.	
UNIT – III	**Hours: 09**
Transient analysis of control systems - block diagram algebra, overall transfer function of closed loop control systems, regulator and servo problems, transient response of first and second order systems with P, PI and PID controller.Definition of stability of control systems, Routh test , limitations of Routh test, Pade's approximation of time delay systems.	
UNIT – IV	**Hours: 09**
Root-locus technique - rules for plotting the root locus diagram, application of root locus to control systems. Introduction to frequency response - Bode diagrams, Bode diagrams for first and second order systems, P, PI, PID controllers, transportation lag. Bode stability criteria, phase margin and gain margin, Nichols chart, Ziegler - Nichols Optimum controller settings.	
UNIT – V	**Hours: 09**
Nyquist stability criteria, calculation of phase margin, gain margin, peak gain and resonant frequency using nyquist plot.Introduction to advanced control techniques - feed forward control, cascade control, ratio control, adaptive control, inferential control, selective control.	

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. D.R. Coughanour, Process Systems analysis and Control, Mc.Graw Hill Eduction (India), 3rd Edition, 2013.
2. Stephanopoulos, Chemical Process Control – Theory and Practice, PHI learning private limited, 1984.

Reference Books:

1. B.Wayne Bequette, Process Control Modeling, Design and Simulation, PHI learning private limited, 2003.
2. D.W.Seborg, T.F.Edger, and D.A.Millichamp, Process Dynamics and Control, John Wiley and Sons,2nd Edition, 2004.
3. Thomas E. Marlin, Process Control Designing Processes and Control Systems for Dynamic Performance, TATA McGraw-Hill, 2nd Edition, 2012.
4. Peter Harriot, Process Control, Tata McGraw Hill Publishing Co., 1964.

Department : Chemical Engineering		**Programme :** B.Tech. (CH)						
Semester : Seven		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH120	Process Engineering Economics	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To Provide Solid background in the fundamental concepts of Process Engineering Economics needed for Chemical Engineers							
Outcome	At the end of the semester, the student should be able to • Estimate the capital investment, cost of production, depreciation and cash flows of Chemical Engineering Processes. • Make decisions about the profitability of Chemical Engineering Processes by applying discounted profitability analysis including net present value, internal rate of return and discounted payback period. • Analyze and calculate depreciation of processes equipments and take decisions on the replacement of existing equipments.							
UNIT – I						**Hours: 09**		
Time value of money - simple and compound interest - discrete, nominal and continuous rate of return and their relationships, issue and evaluation of bonds, concept of equivalence.								
UNIT – II						**Hours: 09**		
Depreciation and Amortization - classification of depreciation and methods of uniform, rapid and slow write off techniques and their comparison, depreciation accounting procedures, taxes and insurance, implication of taxes in selecting alternates.								
UNIT – III						**Hours: 09**		
Economics of selection of alternates - criteria, annual cost, present worth, rate of return, capitalized cost methods, extra investment analysis, mutually exclusive basis, replacement economy.								
UNIT – IV						**Hours: 09**		
Cost estimation - equipment costs, cost indices, William's point sixth rule, methods of estimation of fixed capital, product cost estimation. Bookkeeping - ledgers and journals, financial statements, balance sheet, principles and application of project execution techniques, PERT and CPM, preparation of project feasibility reports, selection of plant location and layout.								
UNIT – V						**Hours: 09**		
Optimization - procedure involving single and two variables, optimum number of units required for maximum profit and minimum cost, determination of optimum parameters in selected unit operations - fluid flow (optimum pipe diameter), heat transfer (optimum thickness of insulation), evaporation, filtration, break-even analysis.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Max S. Peters, Klaus D Timmerhaus and Ronald E. West, Plant Design and Economics for Chemical Engineers, McGraw Hill (Indian Edition), 5th Edition 2013.								
Reference Books:								
1. Jelen's, Cost and Optimization Engineering, McGraw Hill, 2nd Edition, 1992. 2. Nandhini Chemical Journal.								

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Seven					**Category :** LB			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH121	Process Control and Simulation Laboratory	-	-	3	2	60	40	100
Prerequisite	-							
Objectives	• To educate the principles involved in Process Control. • To provide practical knowledge of handling data.							
Outcome	• Students will be able to understand Process Control concepts. • Students will gain laboratory skills and working knowledge about various simple systems							

List of experiments: (Any 10 experiments)

Process Dynamics and Control Experiments

1. Time constant of a thermometer;
2. Transient response of a mercury manometer;
3. Transient response of a pressure vessel system;
4. Transient response of a mixing vessel;
5. Transient response of an interacting liquid level system;
6. Transient response of a non-interacting liquid level system;
7. Control valve characteristics;
8. On –Off Control system behaviour.
9. Level controller
10. Temperature controller

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Text Books:

1. Lab Manual, Department of Chemical Engineering, Pondicherry Engineering College, Puducherry, 2014.

Reference Books:

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Seven					**Category :** PR			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH122	Project Work (Phase I)	-	-	3	2	100	-	100
Prerequisite	-							
Objectives	• To learn the technique of collecting literature pertaining to the propose project • To gain knowledge to summarize the literature							
Outcome	At the end of the semester the student should be able to • Reinforce classroom theory by collecting literature pertaining to the propose project • write technical report • Work in teams.							
The objective of the project is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental, design or combination of these in the area of Chemical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem.								
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**			**Total Hours: 45**			

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester : Seven					**Category :** PR			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH123	Professional Ethics and Practice	-	-	3	1	100	-	100
Prerequisite	-							
Objectives	• To provide the need of ethics in technical profession • To gain importance of safety							
Outcome	At the end of the semester the student should be able to • Know the code of ethics and safety • To gain proficiency in writing technical reports • Work in teams							
The course should cover the following topics by way of Seminars, Expert Lecturers and Assignments. • Engineering Ethics – Moral Issues, Ethical theories and their uses • Engineering as Experimentation – Code of Ethics • Engineer's Responsibility for Safety • Responsibilities in Rights • Global issues of engineering ethics								
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**			**Total Hours: 45**			
Text Books:								
1. R.Subramanian , Professional Ethics, Oxford University Press,2013. 2. Mike Martine and Roland Schinzinger, Ethics in Engineering, McGraw Hill, 2005. 3. Charles E Harris Michael S Pritchard and Michael J Rabins, Engineering Ethics-Concepts and Cases, Thompson Learning,2000.								
Reference Books:								
1. Charles D.Fleddermann, Engineering Ethics , Prentice Hall, New Mexico, 1999.								

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Eight				**Category :** PR				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH124	Comprehensive Test and Viva-Voce	-	-	3	1	60	40	100
Prerequisite	-							
Objectives	• To recollect the basic concepts learn in the curriculum • To help the student in preparing for competitive examinations							
Outcome	At the end of the semester the student should be able to • Understand all basic principles of core chemical engineering • Fine tune their fundamentals							
The student will be tested for his/her understanding of the basic principles of the core chemical engineering subjects through a series of tests and viva voce.								
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**			**Total Hours: 45**			

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester : Eight				**Category :**PR				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CH125	Project Work (Phase II)	-	-	9	6	60	40	100
Prerequisite	-							
Objectives	• To learn the technique of collecting literature pertaining to the propose project • To gain knowledge to summarize the literature and findings							
Outcome	At the end of the semester the student should be able to • Reinforce classroom theory by collecting literature pertaining to the propose project • To gain proficiency in writing technical reports • Work in teams							
Project work phase II will be an extension of the project work phase I started in the seventh semester. On completion of the work, a project report should be prepared and submitted to the department.								
Total contact Hours: 135	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 135**			

SYLLABUS (Elective Subjects)

Department : Chemical Engineering		**Programme :** B.Tech. (CH)						
Semester :		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP01	Energy Technology and Management	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To Understand & utilize the various forms of energies. • To have a knowledge to function on various combustion equipments.							
Outcome	At the end of the semester the student should be able to • Understand about Energy Technology and Management. • Understand various processes, and equipments							
UNIT – I						**Hours: 12**		
Fuels - Classification, Properties, tests and analysis. Solid Fuels - Coal, origin, classification, storage and handling, carbonization, gasification and briquetting - gasification of biomass.								
UNIT – II						**Hours: 12**		
Liquid fuels - Petroleum based fuels, synthetic fuels, alcohol and blended fuels, storage and handling. Gaseous fuels - Water gas, carbureted water gas, producer gas, coal gas and natural gas.								
UNIT – III						**Hours: 12**		
Combustion - Air requirement for solid, liquid and gaseous fuels, Combustion equipment Solar energy, Wind energy, Tidal energy.								
UNIT – IV						**Hours: 12**		
Geothermal energy, Magneto hydrodynamics, Nuclear energy. Energy Management-Principles need, initiating and managing an energy management program.								
UNIT – V						**Hours: 12**		
Energy audit – elements, and concepts, types of energy audits, energy audit with respect to industries like sugar, paper etc., Energy Conservation-Thermodynamics of energy conservation, cogeneration, waste heat recovery technologies. Industrial insulation - material selection, economical thickness.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. S.Sarcar, Fuels and combustion, Orient Longman, 1990. 2. G.D.Rai, Non conventional energy sources, Khanna Publishers, IV edition, New Delhi, 2004.								
Reference Books:								
1. S.P.Sharma and ChanderMohan, Fuels and Combustion, Tata McGraw Hill, 2004.								

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP02	Bioprocess Engineering	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of bio process engineering • To outline the various practices in the bio process industry							
Outcome	At the end of the semester the student should be able to • Understand about bio processes engineering principles. • Understand various processes, products , reactions and equipments involved							
UNIT – I						**Hours: 12**		
Introduction to bioprocess engineer, story of Penincillin,regulatory constraints of bioprocess engineering, microbial diversity, biomolecules, Recombinant DNA technology, Cell Mutation								
UNIT – II						**Hours: 12**		
Enzymes: Introduction, types, industrially and medically important enzymes,Enzyme kinetics for SSSE system,Methods of Enzyme Immobilisation.								
UNIT – III						**Hours: 12**		
Metabolic Pathways: Bioenergetics , glucose metabolism, glucolysis, TCA cycle, Respiration, Anaerobic Metabolism, Batch Cellular growth kinetics, cell growth nutrients.								
UNIT – IV						**Hours: 12**		
Principles of Fermentation: types of industrial fermentation, fermentation media, sterilization, inoculum development, instrumentation and control of Fermentor, bioreactor types, down stream processing.								
UNIT – V						**Hours: 12**		
Traditional Industrial Bioprocess: Ethanol Production, Bakers Yeast production, Penincillin Production, Beer Production, wine production and cheese production.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Michael Shuler and F.Kargi, Bio Process Engineering Basic Concepts, PHI learning private limited,2nd Edition,2002 . 2. Biswajit Mukherjee, Bio process Engineering, Black Prints,2012.								
Reference Books:								
1. Doran, Bioprocess Engineering Principles, Elsevier India private LTD,2011								

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester :					**Category :** TA			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP03	Risk and Safety Management in Process Industries	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Risk and Safety Management • To outline the various practices in process industry							
Outcome	At the end of the semester the student should be able to • Understand about risk and safety management practices in process Industries. • Legal aspects							
UNIT – I						**Hours: 12**		
Hazard identification methodologies, risk assessment methods - PHA, HAZOP, MCA, ETA, FTA, consequence analysis, probit analysis								
UNIT – II						**Hours: 12**		
Hazards in work places - nature and type of work places, types of hazards, hazards due to improper house-keeping, hazards due to fire in multi-floor industries and buildings, guidelines and safe methods in the above situations.								
UNIT – III						**Hours: 12**		
Workers' exposures to hazardous chemicals, TLVs of chemicals, physical and chemical properties of chemicals leading to accidents like fire explosions, ingestion and inhalation, pollution in work places due to dangerous dusts, fumes and vapours, guidelines, fundamentals of pressure relief devices and safe methods in chemicals handling, storage and entry into confined spaces.								
UNIT – IV						**Hours: 12**		
Hazards peculiar to industries like fertilizer, heavy chemicals, petroleum, pulp and paper, tanneries, dyes, paints, pesticides, glass and ceramics, dairy and sugar industries, guidelines for safeguarding personnel and safeguarding against water, land and air pollution in the above industries.								
UNIT – V						**Hours: 12**		
Safety education and training - safety management, fundamentals of safety tenets, measuring safety performance, motivating safety performance, legal aspects of industrial safety, safety audit.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. F. P. Lees, Loss prevention in process industries, 2nd ed, Butterworth-Heinemann, 1996.								
Reference Books:								
1. W. Handley, Industrial safety handbook, 2nd ed., McGraw-Hill, 1977. 2. S. P. Levine, 1985, Protecting personnel at hazardous waste sites, Martin- Butterworth, 1971. 3. R. P. Blake, Industrial safety, Prentice Hall, 1953. 4. D. Patterson, Techniques of safety management, McGraw-Hill, 1978.								

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP04	Nano Technology	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Nano science and technology • To outline the various products & practices in the Nano technology							
Outcome	At the end of the semester the student should be able to • Understand about Nano materials, Nano tubes. • Various application of Nano materials and characterization techniques							
UNIT – I						**Hours: 12**		
Background and Definition of Nanotechnology. Why Nano? Applications in Different Fields, Chemical Approaches to Nanostructured Materials, Molecular Switches and Logic Gates, Solid State Devices.								
UNIT – II						**Hours: 12**		
Carbon Nanotubes - Structure of Carbon Nanotubes, Synthesis of Carbon Nanotubes, Growth Mechanisms of Carbon Nanotubes, Properties of Carbon Nanotubes, Carbon Nanotube-Based Nano-Objects, Applications of Carbon Nanotubes, Nano wires – Synthesis, Characterization and Physical Properties of Nanowires, Applications.								
UNIT – III						**Hours: 12**		
Basic Microfabrication Techniques, MEMS Fabrication Techniques, Nanofabrication Techniques, Stamping techniques - High Resolution Stamps, Microcontact Printing, Nanotransfer Printing, Applications.								
UNIT – IV						**Hours: 12**		
Material aspects of NEMS and MEMS – Silicon, Germanium-Based Materials, Metals, GaAs, InP, and Related III-V Materials, MEMS Devices and Applications - Pressure Sensor, Inertial Sensor, Optical MEMS, RF MEMS, NEMS Devices and Applications, Current Challenges and Future Trends.								
UNIT – V						**Hours: 12**		
Microscopy - Scanning Tunneling Microscope, Atomic Force Microscope, ScanningElectron Microscopy, Principles of Noncontact Atomic Force Microscope (NC-AFM).								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes:**				**Total Hours: 60**		
Text Books:								
1. B. Bhushan, (in Eds.) , Springer handbook of nanotechnology, Springer – Verlag, 2004.								
Reference Books:								
1. Charles P. Poole; Frank K. J Owens, Introduction to Nanotechnology, A John Wiley and Sons, Inc, Publication.								

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester :					**Category :** TCP			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP05	Process Modeling and Simulation	3	-	2	4	50	50	100
Prerequisite	-							
Objectives	• To educate basics of principles of modeling& Simulation • To outline the various modeling aspects in process engineering							
Outcome	At the end of the semester the student should be able to • Understand about fundaments of process modeling and simulation. • Write modeling equations for various processes from first principles							
UNIT – I						**Hours: 09**		
Introduction - models and model building, principles of model formulation, fundamental laws - continuity equation, energy equation, equations of motion, transport equations, equations of state, equilibrium and kinetics, classification of mathematical models. Numerical solutions of model equations – Linear and non linear algebraic equations in one and more than one variables, ordinary differential equations in one and more than one variables.								
UNIT – II						**Hours: 09**		
Lumped Parameter Models: Formulation and solution techniques to be discussed for Vapour liquid equilibrium models, dew point and flash calculations for multicomponent systems, boiling operations, batch and continuous distillation models, tank models, mixing tank, stirred tank with heating, CSTR with mutiple reactions. Non-isothermal CSTR - mutiplicity and stability, control at the unsteady state. Non-ideal CSTR models - multi-parameter models with dead space and bypassing, staged operations.								
UNIT – III						**Hours: 09**		
Distributed Parameter Models (Steady State): Formulation and solution of split boundary value problems - shooting technique, quasi-linearization techniques, counter current heat exchanger, tubular reactor with axial dispersion, counter current gas absorber, pipe line gas flow, tubular permeation process, pipe line flasher.								
UNIT – IV						**Hours: 09**		
Unsteady State Distributed Parameter Models: Solution of partial differential equations using finite difference method, convective problems, diffusive problems, combined convective and diffusive problems. Unsteady state conduction and diffusion, unsteady state heat exchangers, dynamics of tubular reactor with dispersion. Transfer function models for distributed parameter systems.								
UNIT – V						**Hours: 09**		
Model Parameters Estimation: Introduction, method of least squares, curve fitting, parameter estimation of dynamic transfer function models – step and impulse response models, Auto regressive Moving Average models, least square and recursive least square methods, and parameter estimation of RTD models - moment's method.								
Practice: It will Include case studies involving the various application discussed in theory								
Total contact Hours: 45	**Total Tutorials: 30**	**Total Practical Classes: -**				**Total Hours: 75**		

Text Books:

1. W.F.Ramirez, Computational Methods in Proces Simulation, Butterworth Publisher,1989.
2. Roger E Franks, Modeling and Simulation in Chemical Engineering, John Wiley and Sons, 1972.

Reference Books:

1. Seinfeld and Lapidus, Mathematical Methods in Chemical Engineering, Prentice Hall, 1974.
2. W.L.Luyben,Process Modelling Simulation and Control for Chemical Engineers,McGraw-Hill,1990.
3. S.K.Gupta, Numerical methods for Engineers, TATA McGraw-Hill, 1995.
4. Thomas E. Marlin, Process Control designing processes and control systems for dynamic performance, 2nd Edition, "TATA McGraw-Hill , 2012.

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP06	Polymer Science and Technology	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Polymer Science & Technology • To outline the various practices in polymer process							
Outcome	At the end of the semester the student should be able to • Understand about Polymer Industry. • Understand various processes, products , reactions and equipments involved							
UNIT – I						**Hours: 12**		
Introduction - Definitions and concepts, polymerisation reactions, polymer structure, functionality and degradation, Characterisation of polymers.								
UNIT – II						**Hours: 12**		
Different types of polymers - natural and modified natural products, synthetic polymers, addition and condensation products and their preparations.								
UNIT – III						**Hours: 12**		
Methods of polymerisation - mass, solution, emulsion and suspension polymerisation processes, reactions and equipments used.								
UNIT – IV						**Hours: 12**		
Polymer processing - Molding, cold and hot compression molding, injection and jet type molding, extruding, calendering and skiving.								
UNIT – V						**Hours: 12**		
Polymer processing - sheet forming, atmospheric and fluid pressure forming, lamination and impregnating, coating, expanding, casting, embedding, spinning and finishing.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Fred.W.Billmeyer, Text Book of Polymer Science, John Wiley and sons, 1980. 2. V.R.Gowarikar, Polymer Science, New Age International, Second Edition,2006.								
Reference Books:								
1. David J. Williams, Polymer Science and Engineering, Prentice Hall, 1971. 2. Stanley Middleman, Fundamentals of Polymer Processing, McGraw Hill, 1977. 3. Herman S. Kaufman and Joseph J Falcetta, Introduction to Polymer Science and Technology, JohnWiley and sons, 1977. 4. Rakesh K.Gupta and Anil Kumar, Fundamentals of Polymers, International edition, 1998.								

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP07	New Separation Techniques	4	-	-	4	40	60	100

Prerequisite	-
Objectives	• To educate basics of principles of New Separation Technique • To outline the various membrane processes and models
Outcome	At the end of the semester the student should be able to • Understand various new separation techniques. • Write performance equations for various processes from first Principle.

UNIT – I	**Hours: 12**
Adsorption separations - Review of fundamentals, mathematical modeling of column contactors, pressure swing adsorption, ion chromatography, affinity chromatography, gradient chromatography, parametric pumping, counter-current, simulated counter-current and multidimensional chromatography.	
UNIT – II	**Hours: 12**
Membrane separation processes – basic concepts, membrane modules, structure and characteristics of membranes, design considerations of Reverse Osmosis, Ultra Filtration, Electro Dialysis, Gas permeation membranes, Pervaporation,Nano filtration and micro filtration.	
UNIT – III	**Hours: 12**
Detailed theories for membrane separations – concentration polarization, gel formation and fouling, mathematical models for membrane systems with and without concentration polarization, Transport inside the membranes, solution diffusion membranes, porous membranes.	
UNIT – IV	**Hours: 12**
Surfactant based separations - fundamentals of surfactants at surfaces and in solution, liquid membrane permeation, and foam separations, micellar separations.	
UNIT – V	**Hours: 12**
Supercritical fluid extraction - Physicochemical principles, thermodynamic modeling, process synthesis and energy analysis	

Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. R.T. Yang, Gas Separation by Adsorption Processes, Imperial College Press, 1997.
2. P.C. Wankat, Rate Controlled Processes, Springer Publications, 2005.
3. Seader and Henley, Separation Process Principles, Wiley Publication, Second Edition, 2008.
4. P. C. Wankat, Large scale adsorption and chromatography, CRC Press, 1986.

Reference Books:

1. R. W. Rousseau, Handbook of separation process technology, John Wiley and Sons, 1987.
2. M. C. Porter, Handbook of industrial membrane technology, Noyes publication, Park Ridge, New Jersey, 1990.
3. J. F. Scamehorn and J. H. Harwell, Surfactant based separation processes, T. A. Hatton in Vol. 23 of Surfactant science series, Marcel-Dekker., 1989.
4. M. A. McHugh and V. J. Krukonis, Supercritical fluid extraction, Butterworth, 1985.

Department : Chemical Engineering				**Programme :** B.Tech. (CH)				
Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP08	Petrochemical Technology	4	-	-	4	40	60	100

Prerequisite	-
Objectives	• To educate basics of principles of Petrochemical Technology • To outline the various products & processes
Outcome	At the end of the semester the student should be able to • Understand about petrochemical Industry. • Understand various processes, products , reactions and equipments involved

UNIT – I	**Hours: 12**
General Introduction - History, economics and future of petrochemicals, energy crisis and petrochemical industry, sources and classification of petrochemicals.	
UNIT – II	**Hours: 12**
First generation petrochemicals - alkanes - C1, C2, C3, C4 petrochemicals, alkenes - C2,C3,C4 petrochemicals, alkynes - C2,C3,C4 petrochemicals, B-T-X auromatics, diene based petrochemicals.	
UNIT – III	**Hours: 12**
Second generation petrochemicals - synthesis gas, methanol, formaldehyde chloromethanes, ethanol, acetaldehyde, acetic acid, acetic anhydride, isopropyl alcohol, ethylene oxide, propylene oxide, acetone, vinyl chloride, phenol, aniline and styrene.	
UNIT – IV	**Hours: 12**
Third generation petrochemicals - plastics, rubbers and fibres, olefinic polymers, polyethylene, polypropylene, polyisobutylene, diene polymers - polybutadiene, neoprene, polyisoprene, SBR, synthetic fibres.	
UNIT – V	**Hours: 12**
Miscellaneous petrochemicals - petroleum proteins, synthetic detergents, resin and rubber chemicals, explosives - TNT and RDX.	

Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. S.Maiti, Introduction to petrochemicals, Oxford and IBH publishing Co., 1992.

Reference Books:

1. H.Steines, Introduction to petrochemical Industry, Pergamon, 1961.
2. G.D.Hobson and W.Pohl, Modern Petroleum Technology, Applied Science Publisher,4th Edition,1975.
3. Richard Frank Goldsten and A.Lawrence Waddams, The Petroleum Chemical Industry, E & FN Spon Ltd.,1967.
4. G.T.Austin, Shreves Chemical Process Industries, 5th Edition, McGraw-Hill, 1986.

Department : Chemical Engineering		**Programme :** B.Tech. (CH)						
Semester :		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP09	Nuclear Technology	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Nuclear Engineering • To outline the various technical aspects Nuclear processes							
Outcome	At the end of the semester the student should be able to • Understand about Nuclear Engineering. • Understand various processes, products , reactions , equipments and safety involved							
UNIT – I						**Hours: 12**		
Nuclear energy fundamentals: Atomic structure, and radio isotopes, radio activity, nuclear fission, nuclear fission reactors. History of reactor development, reactors for power production.								
UNIT – II						**Hours: 12**		
Nuclear reactions and radiations: Radio activity, interaction of alpha and beta particles, with matter, interaction of beta particles with matter, interaction of neutrons with matter, neutron cross section.								
UNIT – III						**Hours: 12**		
Nuclear reactor theory: The neutron cycle, critical mass, neutron diffusion, the diffusion equation, slowing down of neutrons, reactor period, transient conditions and reflectors.								
UNIT – IV						**Hours: 12**		
Engineering Considerations of Nuclear Power: Extension of theory to design, design criteria, selection of materials, reactor fuel, moderator materials, coolant system, reactor control and operation, fuel preparation, reprocessing of spent fuel.								
UNIT-V						**Hours: 12**		
Environmental effects and safety: Radiation hazards, radiation monitoring, radio waste treatment systems, reactor shielding. General principles of reactor safety, reactor protection system, reliability and risk assessment.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Samuel Glasstone and Alexander Seasonske, Nuclear reactor engineering , 3rd Edition, CBS Publishers, USA. 2. Glenn Murphy, Elements of Nuclear Engineering, John Wiley and sons Inc.								
Reference Books:								
1. K.Sriram, Basic Nuclear Engineering, Wiley eastern Ltd., 1990. 2. W.Marshall, Nuclear Power Technology, Vol 1,2 & 3, Oxford University Press, New York, 1983.								

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Semester :			**Category :** TA					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP10	Drugs and Pharmaceutical Technology	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Drugs and Pharmaceutical Technology • To outline the various technical aspects Pharmaceutical processes							
Outcome	At the end of the semester the student should be able to • Understand various unit processes involved in drug and pharmaceuticals. • Understand various products , reactions and equipments involved							
UNIT – I						**Hours: 12**		
Development of drugs and pharmaceutical industry – organic therapeutic agents uses and economics. Drug metabolism physio chemical principles – radio activity-pharma kinetics –action of drugs of human bodies.								
UNIT – II						**Hours: 12**		
Chemical conversion processes – Alkylation – carboxylation – condensation and cyclisation –dehydration, esterfication (alcohoysis) halogenation – oxidation sulforation – complex chemical conversion – fermentation.								
UNIT – III						**Hours: 12**		
Compressed tablets – wet granulation – dry granulation – direct compression – tablet presses formulation – coating – pills – capsules sustained action dosage forms – parenter solutions –oral liquids – injections – cirtmerts – standard of hygienes and good manufacturing practice.								
UNIT – IV						**Hours: 12**		
Vitamins – cold remedies – laxatives – analgesic – non steroical contraceptives – external antiseptics – antacids and others.								
UNIT – V						**Hours: 12**		
Antibiotics – biologicals – harmones – vitamins – preservations – analytical methods or test for various drugs and pharmaceuticals packing – packing techniques – quality control.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. E.A. Rawlines Bertleys,Text books of pharmaceuticals III Edition, Billlieere Tincall, London, 1977.								
Reference Books:								
1. S.H. Yalkorsky and J. Swarbrick, Drug and pharmaceutical Science Volume I, II, III, IV, V, VI, and VII Marcel Dekar Inc. New York 1975. 2. Remingtons, Pharmaceutical Science, Mack Publishing Co, 1975.								

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Semester :				**Category :** TA			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**	
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP11	Pinch Technology	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Pinch Technology • To outline the various strategies in the design and implementation							
Outcome	At the end of the semester the student should be able to • Understand basics of pinch technology. • Understand pinch application to various processes.							
UNIT – I						**Hours: 12**		
Pinch Technology-an overview: Introduction, Basic concepts, How it is different from energy auditing, Roles of thermodynamic laws, problems addressed by Pinch Technology Key steps of Pinch Technology: Concept of ΔT_{min} , Data Extraction, Targeting, Designing, Optimization-Supertargeting								
UNIT – II						**Hours: 12**		
Basic Elements of Pinch Technology: Grid Diagram, Composite curve, Problem Table Algorithm, Grand Composite Curve. Targeting of Heat Exchanger Network**:** Energy Targeting, Area Targeting, Number of units targeting, Shell Targeting and Cost targeting.								
UNIT – III						**Hours: 12**		
Designing of HEN: 1. Pinch Design Methods, Heuristic rules, stream, splitting, design of maximum energy recovery(MER). Use of multiple utilities and concept of utility pinches,Design for multiple utilities pinches, Concept of threshold problems and design strategy.3. Network evolution and evaluation-identification of loops and paths, loop breaking and path relaxation.								
UNIT – IV						**Hours: 12**		
Design tools to achieve targets, Driving force plot,remaining problem analysis, diverse pinch concepts, MCp ratio heuristics. Targeting and designing of HENs with different ΔTmin values, Variation of cost of utility, fixed cost, TAC, number of shells and total area with ΔTmin Capital-Energy tradeoffs.								
UNIT – V						**Hours: 12**		
Process modifications-Plus/Minus principles, Heat Engines and appropriate placement of heat engines relative to pinch.Heat pumps, Appropriate placement of heat pumps relative to pinch. Steam Rankin Cycle design, Gas turbine cycle design, Integration of Steam and Gas turbine withprocess.Refrigeration systems, Stand alone and integrated evaporators. Heat integrations and proper placement of Reactorsfor batch Processes.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Shenoy U. V.; Heat Exchanger Network Synthesis, Gulf Publishing company.1990 2. Smith R.; Chemical Process Design, McGraw-Hill,2005 .								
Reference Books:								
1. Linnhoff B., Townsend D. W., Boland D, Hewitt G. F., Thomas B. E. A., Guy A. R., and Marsland R. H.; A User Guide on Process Integration for the Efficient Uses of Energy, Inst. Of Chemical Engineers. 2. http://www.nptel.iitm.ac.in/syllabus/103107094/ accessed on 22.10.2013.								

Department : Chemical Engineering					**Programme :** B.Tech. (CH)			
Semester :					**Category :** TA			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP12	Chemical Process Synthesis	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Chemical Process Synthesis • To outline the various strategies in the product design							
Outcome	At the end of the semester the student should be able to • Understand principles of Chemical Process Synthesis. • Understand Chemical Process Synthesis application to various processes.							
UNIT – I						**Hours: 12**		
Introduction, Approach to Process Development, Development of New Process, Different Considerations, development of Particular Process, Overall Process design, Hierarchy of Process Design, Onion Model, Approach to Process Design.								
UNIT – II						**Hours: 12**		
Reaction Path, Types of Reaction Systems, Reactor Performance, Idealized Reactor Models, Reactor Concentration, Temperature, Pressure, Phase, Catalyst .Separation of Heterogeneous Mixtures, Separations of Homogeneous Mixtures,Distillation, Azeotropic Distillation, Absorption, Evaporation, Drying etc.								
UNIT – III						**Hours: 12**		
Energy Targets, Composite Curves, Heat Recovery Pinch, Threshold Problems, Problem Table Algorithm, Process Constraints, Utility Selection, Furnaces, Combined Heat and Power								
UNIT – IV						**Hours:12**		
Integration of Heat Pump, Integration of Refrigeration Cycles, Overall Heat Exchanger Network and Utilities								
UNIT – V						**Hours: 12**		
Fire, Explosion, Toxic Release, Intensification of hazardous Materials, Attenuation of Hazardous Materials, Quantitive Measures of Inherent Safety, Overall Safety and Health Considerations.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Robin Smith , Chemical Process Design,. McGraw Hill Publication ,1998 2. James Douglas , Conceptual Design of Chemical Process- Mc Graw Hill Publication,2002								
Reference Books:								
1. P.H. Grogins , Unit process in organic synthesis , 5th Edition, Mc Graw Hill Publications,1958.								

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Semester :			**Category :** TA					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP13	Enzyme Engineering	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of principles of Enzyme Engineering • To outline the various parameters and their effects							
Outcome	At the end of the semester the student should be able to • Understand about basics principles of enzyme engineering. • Understand various processes, products and reactions involved							
UNIT – I						**Hours: 12**		
Classification of enzymes. Enzyme specificity, Enzyme units and turnover number. The mechanismof enzyme catalysis. Important industrial enzymes and their sources. General aspects of enzyme production¾ solid state fermentation and submerged culture methods.								
UNIT – II						**Hours: 12**		
General aspects of enzyme Purification. Commercial applications of enzymes in industrial, analytical and medical fields. Genetically engineered enzymes in commerce								
UNIT – III						**Hours: 12**		
Simple enzyme kinetics- Michaelis-Menten and Briggs-Haldane approach. Evaluation of parameters in Michaelis-Menten equation. Kinetics for two substrate reactions. Inhibition of enzyme reactionscompetitive and non-competitive inhibition. Substrate activation and inhibition. Influence of pH, temperature, shear, chemical agents and irradiation on enzyme activity.								
UNIT – IV						**Hours: 12**		
Deactivation models and kinetics. Strategies for enzyme stabilization Enzyme immobilization, covalent binding, cross-linking, adsorption, matrix entrapment,microencapsulation. Advantages and disadvantages of different immobilization techniques. Overview of applications of immobilized enzyme systems Mass transfer effects in immobilized enzyme systems. Analysis of film and pore-diffusion effects on kinetics of immobilized reactions.								
UNIT – V						**Hours: 12**		
Zero order kinetics and first order kinetics- effectiveness factors. Effective diffusivities in biological gels. Design of batch and continuous reactors for soluble enzyme reaction. Immobilized enzyme reactor design- CSTR, PFR, packed bed, fluidized bed and membrane reactors. Bioconversion calculations in free-enzyme and immobilized enzyme reactors. Enzyme biosensors.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Bailley and Ollis, Biochemical Engg Fundamentals, McGraw Hill 2. James M Lee, Biochemical Engineering, Prentice Hall.								
Reference Books:								
1. B.G.Rao, Bio Chemical Engineering, TATA McGraw-Hill Publication, 2012.								

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Semester :		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP14	Chemical Engineering Practice	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basics of Chemical Engineering Practice • To outline the various parameters such as materials selection, pumps and their effects							
Outcome	At the end of the semester the student will be able • Know the role and responsibility of a process engineer • To read and interpret the data and symbols from a P &I diagram. • Understand the various material of construction used in process industries and its corrosion resistant abilities.							
UNIT – I						**Hours: 12**		
Role of a process Engineer, Process documentation, flow sheets – types, preparation, flow sheet presentation, symbols, line and equipment symbols, Piping and Equipment identification, Standards and codes, time planning and Scheduling.								
UNIT – II						**Hours: 12**		
Materials selection: mechanical properties, materials- metals, polymeric materials, ceramic materials, graphite, glasses, Corrosion, Factors affecting corrosion, Causes and cures, types, material selection for corrosion resistances, novel engineering materials.								
UNIT – III						**Hours: 12**		
Pumps classification and types, Pump performance characteristics and selection of pumps, packing and mechanical seals, pumping systems design, pump priming. Fans, blowers, compressor, ejectors and mechanical vaccum systems.								
UNIT – IV						**Hours: 12**		
Piping calculations, available piping, tubing and other flow conduits, economical sizing of pipe, Valves: types, sizing and selection. Thermal insulation, usages for thermal insulation, types of insulation, recommended thickness of insulation, Tracing- steam tracing, electric tracing, jacketing,.								
UNIT – V						**Hours: 12**		
Utilities of a chemical plant, Boilers, Cooling tower, DM water plants, Industrial water Treatment, Turbines, Chillers, Process Safety and Pressure relieving devices, Storage tanks.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Henry J. Sandler, Edward T. Luckiewicz, Practical process engineering – A working approach to plant design, McGraw Hill Book Company,1987.								
Reference Books:								
1. Ernest E. Ludwig, Applied Process Design, Vol I, II & III, 3rd Edition, Gulf Professional Publishing, 1999.								

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Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP15	Pollution Control in Process Industries	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To educate basic of Chemical Engineering Practice • To outline the various parameters such as materials selection, pumps and their effects							
Outcome	At the end of the semester the student will be • Able to realize the importance of the sustainable use of natural resources. • Aware of the impacts of human actions on environment. • Able to give solutions for environmental problems created by local, national and global developmental activities							
UNIT – I						**Hours: 12**		
Man and Environment, Types of pollution, Pollution control aspects, Pollution monitoring and analysis of pollutant. Air pollution: Sources and effects, particulate control, control of gaseous pollutants (SOx, NOx, oxides of carbon, hydrocarbon pollutants), Air Quality Management , Carbon Trading.								
UNIT – II						**Hours: 12**		
Water Pollution: Types of water pollution, sources, water pollution control.Waste water treatment technologies and Recycle.								
UNIT – III						**Hours: 12**		
Solid waste management: Sources, processing methods, waste disposal methods, energy recovery from solid waste and land pollution.								
UNIT – IV						**Hours: 12**		
Noise Pollution: Hazardous noise exposure, noise measuring instruments and noise pollution control technology. Regulations: ISO 14000, 9000, pollution Acts and Regulations.								
UNIT – V						**Hours: 12**		
Case Study: Pollution (Air, Water & Solid) control in the following process industries - Fertilizers, Petroleum Refinery and Petrochemical, Pulp and Paper, Cane Sugar, Tannery, Distilleries and Pharmaceutical Industry .								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. S.C. Bhatia, Environmental Pollution and control in chemical process industries, Khanna Publishers, 1st edition, 2001. 2. C.S.Rao, Environmental Pollution Control Engineering, Wiley Eastern, 1992.								
Reference Books:								
1. S.P.Mahajan, Pollution control in Process Industries, Tata McGraw Hill, 1990. 2. F. P. Lees, Loss prevention in process industries, 2nd edition., Butter worth- Heinemann, 1996. 3. Martin Crawford, Pollution Control Theory, McGraw Hill, 1976. 4. Marell, Solid Wastes, John Wiley, 1975.								

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Semester :			**Category :** TA					
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP16	Sugar Technology	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To Introduces concepts of Sugar Technology • To introduces the role of solubility ,steam economy, energy and equipment							
Outcome	At the end of the semester the student will be • Able to realize the importance of various unit operations in industry. • Understand the various equipments and material used in sugar industries							
UNIT – I						**Hours: 12**		
Introduction – Sugar Industry in India. Chemical and physical properties of sucrose and reducing sugars, Source for Sucrose, Formation of sucrose plants, Non sugar compounds of sugar cane. Inorganic constituents of sugar cane juices and sugars. Analytical methods used in sugar industry.								
UNIT – II						**Hours: 12**		
Purification: chemical technology of purification process, fundamental reactions and physical chemistry aspects of clarification, Liming, Sulphitation and carbonation processes, Filtration of sugar juice.								
UNIT – III						**Hours: 12**		
Evaporation: Evaporation of sugar juice. Heat transfer in evaporators, evaporation equipment and auxiliaries, Method of obtaining steam and quality of steam, Steam economy, chemistry of the evaporation process, scale formation and cleaning of evaporators.								
UNIT – IV						**Hours: 12**		
Solubility of Sucrose- nucleation in super saturation solutions –kinetics and growth of crystallization, chemistry of crystallization. Control methods and equipment in sugar crystallization, technology of sugar crystallization, evaporation and circulation in vacuum pans.								
UNIT – V						**Hours: 12**		
Centrifugation- Theory of the centrifugal process, centrifugal operation, Engineering principles of sugar centrifugals and the centrifugal processes, Centrifugal equipment and auxiliaries, Production of final molasses and molasses utilization, grading of sugar.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Honig P et al , Principles of sugar technology, Vol.1 to 3 Elsevier Publishing company, 1953 2. D.W. Van der Poel, H.Schwartz, Sugar Technology (Beet and Cane Sugar Manufacture) 1st Edition , Elsevier Publishing								
Reference Books:								
1. Payne J.H, Sugarcane factory Analytical control, Elsevier Publishing,1990 2. Jenkens, Introduction to Sugar cane Technology, Elsevier Publishing,1986 3. Hoing.P, Principle of Sugar cane Technology, Elsevier Publishing,1996								

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Semester :		**Category :** TA						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP17	Membrane Technology	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To Introduces concepts of Membrane Technology • To show the various Models and their applications							
Outcome	At the end of the semester the student should be able to • Understand about membrane technology. • Understand various processes of membrane technology and their design aspects.							
UNIT – I						**Hours: 12**		
Basic principle of membrane separation. Classification of membrane separation processes. Advantages and disadvantages of membrane processes, Retention or rejection coefficient, Factors affecting the separation processes- concentration polarization and fouling.								
UNIT – II						**Hours: 12**		
Membrane types, materials and modules. General methods of membrane manufacture. Application of membrane separation processes in pharmaceutical, food, dairy, bioprocess and chemical industry. The concept of reverse osmosis, flux equations. Design and operating parameters, concentration polarization and membrane plugging								
UNIT – III						**Hours: 12**		
Design of an RO Module. Applications of reverse osmosis.The principle of nanofiltration, nanofiltration membrane, parameters affecting the performance of NFmembranes. Industrial applications.								
UNIT – IV						**Hours: 12**		
The basic principle of ultra filtration, ultra filtration membranes, configuration of UF unit, Types of devices in ultra filtration. Factors affecting the performance of ultrafiltration. Fouling and flux decline. Affinity ultrafiltration in protein purification and other applications.								
UNIT – V						**Hours: 12**		
The basic principle of microfiltration. Cross flow and dead end microfiltration. Microfiltration membranes, mechanism of transport, membrane plugging and throughput, Fouling in microfiltration membranes and factors affecting fouling, Applications of microfiltration. Dialysis, Dialysis membranes, mass transfer in dialysis, applications. Elecrodialysis- principles and applications.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Kaushik Nath , Membrane Separation Processes , PHI learning private limited, 2011. 2. P.C. Wankat, Rate Controlled Processes, Springer Publications, 2005.								
Reference Books:								
1. B.Sivasanker , Bioseparations , PHI learning private limited,2010. 2. R. W. Rousseau, Handbook of separation process technology, John Wiley and Sons, 1987.								

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Semester :				**Category :** TA				
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP18	Fluidization Engineering	4	-	-	4	40	60	100
Prerequisite:	-							
Objectives:	• To Introduces concepts of Fluidization • To show the various equipments and their applications							
Outcome:	At the end of the semester the student should be able to • Understand Fluidization concepts. • Understand various equipments and their use age in Process Industry							
UNIT – I						**Hours: 12**		
Introduction: Fluidized state, nature of hydrodynamic suspension, regimi-zation of the fluidized state, operating models for fluidization systems								
UNIT – II						**Hours: 12**		
Hydrodynamics of Fluidisation Systems: General bed behavior, pressue drop, empirical correlations for solid holdup,flow models								
UNIT – III						**Hours: 12**		
Solid Mixing and Segregation: Degree of Segregation, operation shifts, reversal points, mixing-segregation equilibrium generalized fluidzation of poly systems, liquid phase mixing and gas phase mixing								
UNIT – IV						**Hours: 12**		
Heat and Mass Transfer in Fluidization Systems: Mass Transfer-Gas-liquid Mass Transfer, liquid-solid mass transfer and wall to bed mass transfer. Heat Transfer-Column wall to bed Heat Transfer.								
UNIT – V						**Hours: 12**		
Miscellaneous Systems: Moving bed, slurry bubble column, two phase and three phase inverse fluidized bed, typical applications.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Kunii D and Levenspiel .O, Fluidization Engineering, Elsevier Publication,2005 2. Leva M, Fluidization, McGraw Hill Publications,1959.								
Reference Books:								
1. Davidson J.F and Harrison D, Fluidization, Academic Press,1971.								

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Semester :				**Category :** TCP				
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHP19	Process Optimization	3		2	4	50	50	100
Prerequisite	-							
Objectives	• To Introduces concepts of optimization • To develop analytical , numerical and iterative problem skills							
Outcome	At the end of the semester the student should be able to • Understand concepts of optimization. • Understand various optimization techniques that are relevant to chemical engineering.							
UNIT – I						**Hours: 9**		
Introduction – General concepts of optimization, classification of optimization problem – single variable and multivariable, constrained and unconstrained, continuous and discrete optimization problems; Mathematical representation, geometrical interpretation, degrees of freedom analysis, formulation of optimization problems – simple illustrations. Theory and concepts of optimization - functions and their properties – unimodal and multimodal functions, local and global minimum; Gradient vector, Hessian matrix, Positive and negative definiteness of symmetric matrix, test of convexity and concavity, Stationary points, Necessary and sufficient conditions for extremum of single and multivariable functions, illustrative problems.								
UNIT – II						**Hours: 9**		
Linear regression – method of least squares, fitting models to data, factorial design of experiments, illustrative problems. Introduction to one dimensional search – scanning and bracketing algorithms, two point equal interval search, golden section search, quadratic interpolation method, Newton and quasi Newton method, Illustrative problems.								
UNIT – III						**Hours: 9**		
Constrained optimization – Equality constrained optimization, Lagrange multiplier method, inequality constrained optimization, Kun-Tucker necessary condition, sufficient condition for constrained optimization, illustrative examples. Introduction to multivariable search – Gradient descent method (line search), Hessian based search algorithms, Newton's method, Conjugate gradient method, illustrative problems.								
UNIT – IV						**Hours: 9**		
Linear Programming – introduction, illustration of concepts using graphical approach, simplex algorithm, variables unrestricted in sign, degenerate LP problem, illustrative problems. Introduction to geometric programming, dynamic programming, and integer programming (*only illustration of concepts and no problems to be asked in the university examination*)								
UNIT – V						**Hours: 9**		
Application of optimization in chemical engineering – Optimal pipe diameter, optimal thickness of insulation, optimal inter stage pressure in multistage compression, optimal design of shell and tube heat exchanger, optimal reflux ratio in a binary distillation column, optimal batch time in a batch reactor, optimal temperature of progression for exothermic reversible reaction, Optimal scheduling of refinery operation, Optimum recovery of waste heat, optimal design and operation of staged distillation columns.								
Practice: It will Include case studies involving the application of optimization concepts discussed in theory								
Total contact Hours: 45	**Total Tutorials: 30**	**Total Practical Classes: -**				**Total Hours: 75**		
Text Books:								
1. T.F.Edger and D.M.Himmelblau, Optimization of Chemical Processes, McGraw-Hill, 2001.								
Reference Books:								
1. Kalyanmoy Deb, Optimization for Engineering Design, John Wiley, 1995. 2. V.Kafarov, Cybernetic Methods in Chemistry and Chemical Engineering, MIR Publishers, 1976.								

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Semester :		Category : TA						
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CHP20	Petroleum Refinery Engineering	4	-	-	4	40	60	100
Prerequisite:								
Objectives:	• To Introduce concepts of Crude Handling • To provide fundamental knowledge of Petroleum Refining							
Outcome:	At the end of the semester the student should be able to • Understand methods of handling Petroleum Crude • Understand various concepts of Petroleum Refining							
UNIT – I					Hours: 12			
Introduction – genesis, occurrence, drilling of crude oil, composition and Evaluation of crude oil. Testing of petroleum products. History of Refining								
UNIT – II					Hours: 12			
Separation: Pretreatment of crude oil – Handling – Heating of crudes Refining of petroleum- Atmospheric and vacuum distillation – Design aspects, blending process.								
UNIT – III					Hours: 12			
Breakdown Process: Cracking, Visbreaking, Coking – types and operation Rebuilding Process: Isomerisation, Alkylation, Polymerisation, Reforming – types and operation Asphalt Technology.								
UNIT – IV					Hours: 12			
Treatment Techniques for the removal of Sulphur Compounds to improve the performance, storage and stability Product Treatment processes – various solvent treatment processes, Dewaxing , clay treatment, hydro fining.								
UNIT – V					Hours: 12			
Introduction to Petrochemical – generation, Cracking of Naphtha and gas for the production of ethylene, propylene, isobutylene and butadiene. Production of acetylene from methane. Extraction of aromatics.								
Total contact Hours: 60	Total Tutorials:	Total Practical Classes:			Total Hours:60			
Text Books:								
4. B.K.Bhaskara Rao, "Modern Petroleum Refining processes", 5th Edition, Oxford and IBH Publishing Co.Pvt.Ltd, New Delhi,2008. 5. J.H.Harker and J.R.Backhurst, "Fuel and Energy", Academic Press Inc.(London) Ltd, 1981.								
Reference Books:								
4. W.L.Nelson, "Petroleum Refinery Engineering", 4th edition, McGraw Hill, New York, 1985. 5. Robert. A.Meyers, "Handbook of Petroleum Refining Processes", McGraw Hill, New York, 1986. 6. G.D.Hobson and W.Phol, " Modern Petroleum Technology", Applied Science Publlishers, 4th edition, 1975.								

Department : Chemical Engineering				**Programme :** B.Tech.				
Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHG01	Process Engineering Principles	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• Develop a mastery of the first principles involved in process engineering • Perform analyses of process problems by applying the first principles • Provide a fundamental understanding of process equipment's							
Outcome	At the end of the semester the student should be able to • An ability to apply knowledge of mathematics, science, and engineering • An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice • An ability to implement the engineering background to other related areas							
UNIT – I						**Hours: 12**		
INTRODUCTION - Chemical Process Industries - Batch and Continuous mode of operations – Process Flow Sheets – Material and Energy Balance Principles – Mass – Mole – Volume Conversions (Ideal Gas Law), Sensible and Latent Heat Calculations, Principles of Momentum, Heat and Mass Transport – Rate Laws (Newton's Law, Fourier's Law, Fick's law), Chemical Reactions – rate and equilibrium, Phase equilibrium, Vapour Pressures and Humidity.								
UNIT – II						**Hours: 12**		
FLUID TRANSPORT AND MECHANICAL OPERATION EQUIPMENTS – Laminar and Turbulent flow, Flow Characteristics of fluids – Newtonian and Non-Newtonian, Friction factor, Head loss due to fluid friction pumps – different types, pump characteristics, compressors. Size reduction of solids – crushing (Jaw crusher) and grinding (Ball mill), Size separation (screening), solid – liquid separation – filtration, settling and sedimentation, centrifuge.								
UNIT – III						**Hours: 12**		
HEAT TRANSFER EQUIPMENTS – Modes of heat transfer – conduction, convection and radiation, heat transfer without and with phase change (evaporation, condensation), heat transfer coefficient. Heat Exchangers – double pipe and shell and tube, condensers – vertical and horizontal, evaporators – single effect and multiple effect, reboilers								
UNIT – IV						**Hours: 12**		
MASS TRANSFER EQUIPMENTS – molecular and turbulent transport of mass – mass transfer coefficient, mass transfer principles in separation, gas – liquid operations – absorption, distillation, humidification – packed and tray towers.Fluid – solid operations – adsorption, drying, leaching, crystallization. Liquid- liquid operations – extraction.								
UNIT – V						**Hours: 12**		
CHEMICAL REACTORS – single and multiple reactions – conversion, yield, selectivity batch and flow reactors(PFR,CSTR), catalyses, multiphase non-catalytic (gas – solid, gas – liquid) and catalytic reactors, fixed bed, fluidized bed, slurry reactors. Process flow sheets for manufacture of standard chemicals - urea, sugar, crude distillation, cement, paper and pulp.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Walter. L Badger and Julius.T.Banchero , Introduction to Chemical Engineering, , Tata McGraw Hill.2001 2. Octave Levenspiel , Chemical Reaction Engineering, Wiley Eastern Ltd., II Edition, 2000.								
Reference Books:								
1. W.L.Mc.Cabe, J.C.Smith and P.Harriot , Unit operations of chemical engineers, , McGraw Hill International Edition, V edition,1998. 2. N.Shreve , Chemical Process Industries,5th edition, McGraw Hill, New York, 1984.								

Department : Chemical Engineering					**Programme :** B.Tech.			
Semester :					**Category :** TA			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHG02	Fundamentals of Momentum, Heat and Mass Transfer	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• Develop a mastery of the first principles involved in Heat transfer • Perform analyses of heat transfer problems by applying the first principles							
Outcome	*At the end of the semester the student should be able to* • Apply knowledge of Heat transfer in solving engineering problems • use the techniques necessary for heat transfer engineering practice							
UNIT – I						**Hours: 12**		
Essentials-Models, entity balances, the continuum assumption, fluid behavior, velocity, temperature and concentration averages, scalars, vectors and coordinate systems.								
UNIT – II						**Hours: 12**		
Derivation of Macroscopic Mass balances, Derivations of Macroscopic energy balances and Derivations of momentum balances equation.								
UNIT – III						**Hours: 12**		
Application of Dimensional Analysis-System measurement, Buckingham' Theorem examples in momentum heat and mass transfer(friction factors drag force ,								
UNIT – IV						**Hours: 12**		
Dimensionless numbers and their physical significance- Reynolds number, Nusselt number, Sherwood number, prandtl number, Schmidt number, Stanton number. Analogies of momentum heat and mass transfer- Reynolds analogy, Prandtl analogy, Chilton-Colburn analogy and their simple applications.								
UNIT – V						**Hours: 12**		
Fluid flow in boundary layers- Introduction to boundary layer flow, mass, momentum and kinetic energy deficits. Boundary layer equations for incompressible flow, von karman momentum integral. Laminar boundary layer growth on flat plate.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. David P Kessler and Robert A Greenkorn, Momentum heat and Mass Transfer, Marcel Dekker Inc,New York, 1999. 2. J.R.Welty, C.E.Wicks, R.E.Wilson and Roggers , Fundamentals of Momentum, Heat and Mass transfer, John Wiley and Sons, 5th Edition, 2007.								
Reference Books:								
1. A.T.Olson and K.A Shelstad, Introduction to fluid flow and the transfer of heat and Mass, Prentice Hall INC, Engle wood Cliffs, NJ, 1987.								

Department : Chemical Engineering				**Programme :** B.Tech.				
Semester :				**Category :** TA				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
CHG03	Heat Transfer Analysis	3	-	-	4	40	60	100
Prerequisite	-							
Objectives	• Develop a mastery of the first principles involved in Heat transfer • Perform analyses of heat transfer problems by applying the first principles							
Outcome	At the end of the semester the student should be able to • Apply knowledge of Heat transfer in solving engineering problems • Use the techniques necessary for heat transfer engineering practice							
UNIT – I						**Hours: 12**		
Introduction- the continuum postulate, the laws of continuum physics, mechanism of energy transport								
UNIT – II						**Hours: 12**		
Steady state one dimensional heat conduction-rectangular, cylindrical and spherical coordinates								
UNIT – III						**Hours: 12**		
Transient heat conduction –governing equation ,lumped parameter model, semi-infinite slab								
UNIT – IV						**Hours: 12**		
The Basic equation of momentum and energy transfer and boundary layer equations.								
UNIT – V						**Hours: 12**		
Thermal radiation and radiant energy exchange- radiation, black body, evaluation of view factor and radiant energy exchange between gray surfaces.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. Latif M Jiji, Heat Transfer Essentials, Jaico Publisher,2002 2. Incorpora etal,. Principles of Heat and Mass Transfer, John Wiley 7th Edition, 2011 3. James Sucec, Heat transfer, Jaico Publishing House,2005								
Reference Books:								
1. Stephen Whitaker, Elementary Heat Transfer Analysis, Pergamon Unifified Engineering Series,1981 2. Adrian Bejan, Heat transfer, John Wiley, 1993. 3. M. Ozisiki , Heat Transfer: A Basic Approach, Mcgraw Hill Publications, 1985.								

Department : Chemical Engineering		Programme : B.Tech.(CH)						
Semester :		Category : TA						
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CHG04	Non-Conventional Energy	4	-	-	4	40	60	100
Prerequisite:								
Objectives:	• To introduce various energy sources • To provide in-depth analysis of Non-Conventional Energy							
Outcome:	At the end of the semester the student should be able to • Understand various energy systems • Understand concepts of Non-conventional energy system							

UNIT – I	Hours: 12
Introduction to Energy studies: Energy science & Technology – Forms of Energy – Advantages and Limitations, Mechanical Energy, Chemical Energy and Fuels – Nuclear Energy- Hydro Energy. Renewable Energy- Energy Demand- Comparison of fuels on Calorific value and Cost basis- Efficiencies of various Energy.	
UNIT – II	**Hours: 12**
Solar Energy – Principles of solar radiation, measuring technology, Solar energy – collectors-general description & characteristics, storage – different methods, solar applications & limitations.	
UNIT – III	**Hours: 12**
Wind Energy- wind energy conversion: wind energy conversion principles, types & classification of WECS, site selection criteria – advantages – limitations Geothermal Energy- Resources- types of wells, methods of harnessing the energy, system development and limitations.	
UNIT – IV	**Hours: 12**
Ocean Energy: Ocean Thermal Energy Conversion, Principles, utilization, OTEC plants, cycles. Tidal and Wave energy: Potential & Conventional Techniques Magneto Hydro Dynamics: Principles of operation, classification, feature of MHD. Fuel Cells: Principles of operation.	
UNIT – V	**Hours: 12**
Nuclear Energy: Radioactivity – Fuel preparation, reprocessing of spent fuel, reactors for power production, reactor control and operation, protection system, environmental effects and safety. Biomass : Principles of Bio conversion, aerobic and anaerobic digestion, types of biogas digesters, characteristics of biogas, utilization.	

Total contact Hours: 60	Total Tutorials:	Total Practical Classes:	Total Hours:60

Text Books:

1. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publishers New Delhi, 1993.
2. B.H.Khan, "Non-Conventional Energy Resources", Tata McGraw Hill Edition, 2006
3. R.K.Rajput, "Non-Conventional Energy Sources & Utilization", S.Chand &Company Publishing Ltd.
4. R.H.Perry and Don Green, Chemical Engineer's Handbook, McGraw Hill, 8th Edition,2009.

Reference Books:

1. G.N.Tiwari, M.K.Ghosal, "Renewable Energy Resources: Basic Principles & Applications" Alpha Science International, 2005
2. D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources & Emerging Technologies", Eastern Economy Ed. 2nd Edition.

Websites:

1. Handbook on Renewable Energy Sources, www.ener-supply.eu