KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 052
(Autonomous)

VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Providing value based quality education for the development of students as competent and responsible citizens.
- Contributing to the nation and beyond through research and development
- Continuously improving our services

DEPARTMENT OF CHEMICAL ENGINEERING

VISION

To be a centre of excellence for development and dissemination of knowledge in Chemical Engineering for the Nation and beyond

MISSION

Department of Chemical Engineering is committed to

MS1: Impart knowledge to students at all levels through a vibrant, dynamic and state of the art intellectual delivery to ensure the creation of a complete Chemical Engineer with a high sense of social responsibility and professional ethics

MS2: Synergize the efforts of the students and faculty to evolve innovative engineering practices and teaching methodologies

MS3: Generate an environment of continuous learning and research

2011 REGULATIONS

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Chemical Engineering will

PEO1: Exhibit professional competency in design and development of chemical products, Processes and equipment in chemical and allied industries.

PEO2: Perform research and development work by utilizing the experimental skills. Mathematical tools and applied software and simulation practices.

PEO3: Demonstrate interpersonal skills and leadership qualities and contribute to solution of multidisciplinary problems

PEO4: Contribute to national and global economic growth through continuous education and by following socially responsible practices

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3	PEO4
MS1	3	2	1	2
MS2	2	2	2	2
MS3	1	3	-	3

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

a. Ability to apply knowledge of mathematics, science, and engineering

b. Ability to design and conduct experiments, as well as to analyze and interpret data

c. Ability to design a system, component, or process to meet desired needs within realistic constraints

d. Ability to function on multidisciplinary teams

e. Ability to identify, formulate, and solve engineering problems

f. Understanding the professional and ethical responsibility

g. Ability to communicate effectively

h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i. Recognition of the need for, and ability to engage in life-long learning

j. Knowledge of contemporary issues

k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

l. Ability to correlate theoretical concepts with real time experimental/field data through application of process simulation tools and techniques.

m. Familiarity and hands on experience with process equipment and improve process engineering, project and financial management skills through continuous interaction with industries and professional societies

MAPPING OF PEOs WITH POs

PEO\PO	a	b	c	d	e	F	g	h	i	j	k	l	m
PEO1	-	-	3	-	3	-	-	2	1	1	3	2	2
PEO2	3	3	2	2	-	1	2	1	2	-	2	2	1
PEO3	-	-	-	3	-	2	3	3	1	2	-	-	2
PEO4	-	-	2	1	1	3	2	3	2	2	2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

CURRICULUM BREAKDOWN STRUCTURE UNDER REGULATION 2011

Curriculum Breakdown Structure(CBS)	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total number of credits
Basic Sciences(BS)	20.44	47	37
Engineering Sciences(ES)	15.47	32	28
Humanities and Social Sciences(HS)	9.39	21	17
Program Core(PC)	42.55	90	77
Program Electives(PE)	6.63	12	12
Open Electives(OE)	-	-	-
Project(s)/Internships(PR)	5.52	10	10
Total			**181**

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B.Tech. DEGREE IN CHEMICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11EL101	Technical English	3	0	0	3	50	50	100	HS
11MA101	Engineering Mathematics-I	3	1	0	4	50	50	100	BS
11PH101	Applied Physics	3	0	0	3	50	50	100	BS
11CY101	Applied Chemistry	3	0	0	3	50	50	100	BS
11CS101	Problem Solving and Programming	3	0	0	3	50	50	100	ES
11EE101	Basics of Electrical and Electronics Engineering	3	0	0	3	50	50	100	ES
	PRACTICAL								
11PH102	Physical Sciences Laboratory-I	0	0	3	1	50	50	100	BS
11CS102	Programming Laboratory	0	0	3	1	50	50	100	ES
				Total	**21**				

CA- Continuous Assessment, ESE- End Semester Examination
CBS – Curriculum Breakdown Structure

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CURRICULUM

(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11EL201	Communication Skills	3	0	0	3	50	50	100	HS
11MA201	Engineering Mathematics-II	3	1	0	4	50	50	100	BS
11PH201	Materials Science	3	0	0	3	50	50	100	BS
11CY201	Environmental Science	3	0	0	3	50	50	100	BS
11ME101	Basics of Civil and Mechanical Engineering	3	0	0	3	50	50	100	ES
11ME102	Engineering Drawing	2	0	3	3	50	50	100	ES
	PRACTICAL								
11PH202	Physical Sciences Laboratory-II	0	0	3	1	50	50	100	BS
11ME103	Engineering Practices Laboratory	0	0	3	1	50	50	100	ES
11EL202	Communication Skills Laboratory	0	0	3	1	50	50	100	HS
				Total	**22**				

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CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11MA301	Engineering Mathematics - III	3	1	0	4	50	50	100	BS
11EE301	Electrical Machines	3	1	0	4	50	50	100	ES
11CH301	Heat Power Engineering	3	0	0	3	50	50	100	PC
11CH302	Physical Chemistry	3	0	0	3	50	50	100	PC
11CH303	Fluid Mechanics for Chemical Engineers	3	1	0	4	50	50	100	PC
11CH304	Chemical Process Calculations	3	1	0	4	50	50	100	PC
	PRACTICAL								
11CH305	Physical Chemistry Laboratory	0	0	3	1	50	50	100	PC
11ME307	Mechanical Engineering Laboratory	0	0	3	1	50	50	100	ES
11EE304	Electrical Machines Laboratory	0	0	3	1	50	50	100	ES
				Total	**25**				

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CURRICULUM
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SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11MA401	Numerical Methods	3	1	0	4	50	50	100	BS
11CH401	Organic Chemistry	3	0	0	3	50	50	100	PC
11CH402	Process Heat Transfer	3	1	0	4	50	50	100	PC
11CH403	Instrumental Methods of Analysis	3	0	0	3	50	50	100	PC
11CH404	Mechanical Operations	3	0	0	3	50	50	100	PC
11CH405	Chemical Engineering Thermodynamics- I	3	0	0	3	50	50	100	PC
	PRACTICAL								
11CH406	Fluid Mechanics Laboratory for Chemical Engineers	0	0	3	1	50	50	100	PC
11CH407	Technical Analysis Laboratory	0	0	3	1	50	50	100	PC
11CH408	Organic Chemistry Laboratory	0	0	3	1	50	50	100	PC
				Total	**23**				

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CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – V

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11MA502	Probability, Statistics and Linear Programming	3	1	0	4	50	50	100	BS
11CH501	Mass Transfer- I	3	0	0	3	50	50	100	PC
11CH502	Chemical Reaction Engineering –I	3	1	0	4	50	50	100	PC
11CH503	Process Dynamics and Control	3	1	0	4	50	50	100	PC
11CH504	Chemical Process Plant Safety	3	0	0	3	50	50	100	PC
11CH505	Chemical Engineering Thermodynamics – II	3	1	0	4	50	50	100	PC
	PRACTICAL								
11CH506	Mechanical Operations Laboratory	0	0	3	1	50	50	100	PC
11CH507	Process Heat Transfer Laboratory	0	0	3	1	50	50	100	PC
11EL501	Language Skills Laboratory	0	0	3	1	50	50	100	HS
				Total	**25**				

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CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – VI

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE601	Economics and Management for Engineers	3	0	0	3	50	50	100	ES
11CH601	Mass Transfer – II	3	1	0	4	50	50	100	PC
11CH602	Chemical Reaction Engineering – II	3	1	0	4	50	50	100	PC
11CH603	Chemical Equipment Design – I	2	0	3	3	50	50	100	PC
11CH604	Process Modelling and Simulation	3	1	0	4	50	50	100	PC
	Elective – I	3	0	0	3	50	50	100	PE
	PRACTICAL								
11CH605	Mass Transfer Laboratory	0	0	3	1	50	50	100	PC
11CH606	Process Dynamics and Control Laboratory	0	0	3	1	50	50	100	PC
				Total	**23**				

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CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – VII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE701	Total Quality Management	3	0	0	3	50	50	100	ES
11CH701	Chemical Process Industries	3	0	0	3	50	50	100	PC
11CH702	Transport Phenomena	3	1	0	4	50	50	100	PC
11CH703	Chemical Equipment Design - II	2	0	3	3	50	50	100	PC
11CH704	Material Technology for Process Industries	3	0	0	3	50	50	100	PC
	Elective – II	3	0	0	3	50	50	100	PE
	PRACTICAL								
11CH705	Process Simulation Laboratory	1	0	3	2	50	50	100	PC
11CH706	Chemical Reaction Engineering Laboratory	0	0	3	1	50	50	100	PC
11CH707	Industrial Training	-	-	-	1	-	100	100	PC
				Total	**23**				

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B.Tech. DEGREE IN CHEMICAL ENGINEERING

CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – VIII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE801	Professional Ethics and Human Values	3	0	0	3	50	50	100	ES
11CH801	Energy Technology	3	0	0	3	50	50	100	PC
	Elective – III	3	0	0	3	50	50	100	PE
	Elective – IV	3	0	0	3	50	50	100	PE
	PRACTICAL								
11CH802	Project work	0	0	18	9	100	100	200	PR
				Total	**21**				

CA - Continuous Assessment, ESE - End Semester Examination
CBS – Curriculum Breakdown Structure

LIST OF ELECTIVES						
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**CBS**
11CH011	Oil and Natural Gas Engineering	3	0	0	3	PE
11CH012	Polymer Science and Engineering	3	0	0	3	PE
11CH013	Process Optimization	3	0	0	3	PE
11CH014	Computational Fluid Dynamics in Chemical Engineering	3	0	0	3	PE
11CH015	Modern Separation Processes	3	0	0	3	PE
11CH016	Drugs and Pharmaceuticals Technology	3	0	0	3	PE
11CH017	Biochemical Engineering	3	0	0	3	PE
11CH018	Petroleum Refining Engineering	3	0	0	3	PE
11CH019	Process Instrumentation	3	0	0	3	PE
11CH020	Chemical Process Utilities	3	0	0	3	PE
11CH021	Piping Engineering	3	0	0	3	PE
11CH022	Food Technology	3	0	0	3	PE
11GE011	Entrepreneurship Development	3	0	0	3	PE
11CH023	Enzyme Engineering	3	0	0	3	PE
11CH024	Air Pollution and Control	3	0	0	3	PE
11CH025	Waste Water Treatment	3	0	0	3	PE
11CH026	Pulp and Paper Technology	3	0	0	3	PE
11CH027	Fundamentals of Nanoscience	3	0	0	3	PE
11CH028	Ecological and Ecosystems Engineering	3	0	0	3	PE
11CH029	Environmental Biotechnology	3	0	0	3	PE

11EL101 TECHNICAL ENGLISH

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **17**

Grammar and Vocabulary: Word formation with prefixes and suffixes – Synonyms and Antonyms – Verb Patterns – Tenses (simple and compound tenses) - Simple, Compound and Complex Sentences - Voice – Use of Conditionals - Comparative Adjectives (affirmative and negative) – Expanding Nominal compounds - Articles - Use of Prepositions – Identifying Odd Words – Acronyms.

MODULE – II **13**

Listening: Listening for General Content – Intensive Listening – Listening for Specific Information : Retrieval of Factual Information – Listening to Identify Topic, Context, Function, Speaker's Opinion, Attitude, etc. – Global Understanding Skills and Ability to infer, extract gist and understand main ideas – Note-taking: Guided and unguided- Listening to fill up gapped texts.

Writing: Introduction to the Characteristics of Technical Style - Writing Definitions and Descriptions - Paragraph Writing (topic sentence and its role, unity, coherence and use of cohesive expressions) - Process Description(use of sequencing connectives)– Comparison and Contrast - Classifying the data - analysing / interpreting the data – Personal letter - Formal letter writing (Inviting Guest Speakers, letter to the editor, letter for seeking practical training, and letter for undertaking project works in industries) – editing (punctuation, spelling and grammar) – Recommendations & Suggestions.

MODULE- III **15**

Reading: Exposure to different Reading Techniques - Reading for Gist and global meaning - Predicting the content - Skimming the text – Identifying the Topic Sentence and its role in each paragraph - Scanning - Inferring / identifying lexical and contextual meanings - Reading for structure and detail - Transfer of information / guided note-making - Understanding discourse coherence - Sequencing of sentences.

Speaking: Verbal and Non Verbal Communication - Pronunciation drills/ Tongue Twisters – Formal and Informal English - Oral practice – Developing Confidence - Introducing Oneself - Asking for or Eliciting Information - Describing Objects – Offering Suggestions and Recommendations – expressing opinions (agreement / disagreement.

TOTAL : 45

TEXT BOOK

1. "English for Engineers and Technologists", Combined Edition, Volume. I & II, Orient Longman, Oxford University Press, New Delhi, 2006.

REFERENCE BOOKS

1. Aysha Viswamohan, "English for Technical Communication", Tata McGraw-Hill, New Delhi, 2008.
2. Rizvi M Ashraf, "Effective Technical Communication", Fifth Edition, Tata McGraw- Hill, New Delhi, 2007.
3. Mark Ibbotson, "Cambridge English for Engineering", Cambridge University Press, New Delhi, 2009.
4. Rama Krishna Rao, A, "Learning English: A Communicative Approach" Orient Black Swan, Hyderabad, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Improve their vocabulary and appropriate usage of words in different academic and professional contexts.

CO2: Familiarize with different rhetorical functions of technical English.

CO3: Develop strategies that could be adopted while reading texts.

CO4: Speak effectively in English and career related situations.

CO5: Acquire knowledge in academic and professional writing.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1									2	3		1	
CO2									2	3			
CO3				2					2	3		1	
CO4									2	3			
CO5				1					1	3		1	

3 – Substantial, 2 – Moderate, 1 – Slight

11MA101 ENGINEERING MATHEMATICS – I

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Matrices: Linear independent and dependent of vectors – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of eigen values and eigen vectors (without proof) – Cayley – Hamilton theorem (without proof).

Diagonalisation: Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Nature of quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE – II **15**

Differential Calculus: Curvature – Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature. Involutes and evolutes – Envelopes – Properties of envelopes and evolutes.

Functions of several variables: Functions of two variables – Partial derivatives – Total differential – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method – Jacobians.

MODULE - III **15**

Differential Equations: Linear differential equations of Second and higher order with constant coefficients when the R.H.S is e^{ax}, x^n, $n > 0$, Sinax, Cosax, $e^{ax}x^n$, $e^{\alpha x}$ Sinβx, $e^{\alpha x}$ Cosβx, x^n Sinαx and x^n Cosαx– Differential Equations with variable coefficients (Cauchy's form). Method of variation of parameters - Simultaneous first order linear equations with constant coefficients.

Applications of Differential Equations: Solution of specified differential equations connected with electric circuits, simple harmonic motion (Differential equations and associated conditions need to be given).

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy. P, Thilagavathy. K and Gunavathy. K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2011, S.Chand and Co., New Delhi.
2. Veerarajan. T., "Engineering Mathematics, (for first year)", Reprint Edition 2011, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, New Delhi, 2007.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House, New Delhi, 2007.
3. Bali N.P and Manish Goyal, "Text Book of Engineering Mathematics", 3rd Edition, Laxmi Publications, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Solve engineering problems which needs matrix computations.

CO2: Utilize the geometrical aspects of differential calculus and extremal problems which arise in function of several variables.

CO3: Apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3	3										1	
CO3	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11PH101 APPLIED PHYSICS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Acoustics : Classification of sound – Characteristics of musical sound – Weber-Fechner law – Absorption Coefficient – Reverberation – Reverberation time – Sabine's formula (growth & decay) – Factors affecting acoustics of buildings (reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies.

Ultrasonics : Introduction – Production – Magnetostriction effect – Magnetostrictive generator - Inverse piezoelectric effect - Piezoelectric generator - Detection of ultrasonics - Properties – Cavitation - Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non destructive testing – Ultrasonic pulse echo system - Medical applications – A, B and C Scan displays – Ultrasonic imaging technique.

MODULE – II **15**

Lasers: Introduction – Principle of spontaneous emission and stimulated emission - Population inversion, Pumping, Einstein's Coefficients (A&B) - Types of lasers – Nd:YAG, CO_2, Semiconductor lasers: Homojunction and Heterojunction – Laser Applications – Industrial applications – Laser welding, Laser cutting, Laser drilling – Holography – Construction and reconstruction of images.

Fiber Optics & Applications: Principle – Classification based on materials, Modes of propagation, Refractive index profile - Crucible-crucible technique of fiber fabrication - Light sources for fiber optics – Detectors - Fiber optical communication links - Losses in optical fibers – Fiber optic sensors – Temperature, displacement, voltage and magnetic field measurement.

MODULE - III **15**

Quantum Physics and Applications: Black body radiation – Planck's theory (derivation)– Deduction of Wien's displacement law and Rayliegh – Jean's Law from Planck's theory – Compton effect – Theory and experimental verification - Matter waves – Uncertainty principle - Experimental verification – Schroedinger's wave equations – Time independent and time dependent equation – Physical Significance of wave function – Particle in a box (One dimensional) - Optical microscope – Limitations of optical microscopy - Scanning electron microscope - Transmission electron microscope.

TOTAL : 45

TEXT BOOKS

1. Avadhanalu M N and Kshirsagar P G, "A Text Book of Engineering Physics", S.Chand & company Ltd, New Delhi, 2007.
2. Palanisamy P K, "Engineering Physics", Scitech Publications, Chennai, 2008.

REFERENCE BOOKS

1. Gaur R K and Gupta S L , "Engineering Physics", Dhanpat Rai and Sons, New Delhi, 2006.
2. Rajendran V, "Engineering Physics", Prentice Hall of India, New Delhi, 2008.
3. Rajagopal K, "Textbook of Engineering Physics", Part I, PHI Learning Pvt. Ltd., New Delhi, 2008.
4. Personick S D, "Fibre Optics, Technology and Applications", Khanna Publishers New Delhi, 1987.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Get an insight into design of acoustically good buildings and applications of laser in engineering and technology

CO2: Gain basic knowledge in Fiber optic concepts and fiber optic communication link

CO3: Understand the applications of quantum physics to optical and electrical phenomena

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	1		2		1		3		2	2		
CO2	3	1		2		1		3		2	2		
CO3	3	1		2		1		3		2	2		

3 – Substantial, 2 – Moderate, 1 – Slight

11CY101 APPLIED CHEMISTRY

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Water: Introduction - Sources of water - impurities in water - Types of water - Water quality standards - Water quality parameters (Discussion not required) - Hardness of water- Expression of hardness - Units of hardness –Estimation of Hardness of water by EDTA method – Determination of alkalinity - Disadvantages of using hard water - Boiler troubles due to hard water - scale and sludge formation – Boiler corrosion – caustic embrittlement- priming and foaming-Softening of water- External treatment methods - Lime soda, zeolite and demineralization process (principle, process, advantages and disadvantages only) Internal treatment process - colloidal, carbonate, calgon and phosphate conditioning (brief discussion only) - desalination by reverse osmosis method. **Electrochemistry:** Introduction - Cells – Representation of a galvanic cell - EMF measurements and its applications – Electrode potential - Nernst Equation – Reference electrodes (hydrogen and calomel electrodes) – Electrochemical series and its applications – Conductometric titrations (strong acid Vs strong base only) - Batteries – Lead acid and Ni-Cd batteries.

MODULE – II **15**

Corrosion and Its Control: Introduction – Mechanism of dry and wet corrosion – galvanic corrosion - concentration cell corrosion – Galvanic series - Factors influencing rate of corrosion – corrosion control methods - Sacrificial anode and impressed current cathodic method – Corrosion inhibitors - Protective coatings - classifications - Pretreatment of metal surface - Metallic coating -electroplating and electrolessplating (General discussion) - Hot dipping (Tinning and galvanising) - Nonmetallic coating - surface conversion coating (phosphate coating and anodized coating) - Organic coating - paints – constituents and their function – Special paints (Fire retardant, temperature indicating, water repellant and luminescent paints) **Combustion:** Introduction – Calorific Values – Gross and net – Theoretical calculation of minimum air for combustion (Theoretical aspects only) – flue gas analysis – Orsat's method - Explosive range and Spontaneous Ignition Temperature.

MODULE - III **15**

Fuels: coal – proximate and ultimate analysis – their importance – metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - refining of petroleum - Straight run, cracked and polymer petrol – Manufacture of synthetic petrol - polymerization (thermal and catalytic methods) - Hydrogenation of coal (Fisher Tropsch and Bergius methods) - knocking - octane number – improving octane number by additives – Diesel – cetane number – Gaseous fuels (Water gas, producer gas and biogas)

Polymers: Introduction – Nomenclature of polymers – functionality – polymerization - types – addition, condensation and co-polymerization with examples – Effect of polymer structure on properties (strength, plastic deformation, crystallinity and chemical resistance) - plastics – types (thermo and thermosetting plastics) - individual polymers - Polyethylene, polypropylene, PVC, Teflon, Bakelite and epoxy resin (preparation, properties and uses only) - Compounding of plastics-Fabrication of plastics (compression, injection and extrusion moulding methods) – conducting polymers

TOTAL : 45

TEXT BOOK

1. Jain PC and Monica Jain, "Engineering Chemistry", 15th Edition, Dhanpat Rai publication Co., New Delhi, 2008.

REFERENCE BOOKS

1. Dara S.S., "A Text Book of Engineering Chemistry", S.Chand & Co. Ltd., New Delhi, 2006.
2. Sharma B.K., "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut, 2001.
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill, New Delhi, 2008.
4. Krishnamurthy N., "Engineering Chemistry", 2nd Edition, PHI Learning private Limited, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Acquire the basic knowledge of water treatment

CO2: Understand the principles of electro chemistry, electrochemical cells, EMF series and energy storing devices

CO3: Understand the types and prevention methods of corrosion

CO4: Understand the developments in polymers and plastics

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	3	1	-	-	-	-	-	2	-	-	1
CO2	3	2	3	1	-	-	-	-	-	2	-	-	1
CO3	3	2	3	1	-	-	-	-	-	2	-	-	1
CO4	3	2	3	1	-	-	-	-	-	2	-		1

3 – Substantial, 2 – Moderate, 1 – Slight

11CS101 PROBLEM SOLVING AND PROGRAMMING

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Basics: Evolution of computers- Generations of computers- Classification of computers- Applications of computers-Hardware - Software-Information Technology-Internet Problem-Solving Techniques- Program Control Structures-Programming Paradigms and Languages-Generations of Programming Languages.

Problem Solving: Introduction – Problem Solving Aspects- Top-Down Design-Implementation of Algorithms-Program Verification- Efficiency of Algorithms- Analysis of Algorithms- Fundamental algorithm- Factorial Computation - Generation of Fibonacci Sequence.

MODULE – II **15**

C Fundamentals and Arrays: Introduction to C – C programming structure – C character set – Identifiers – keywords. Data types – Constants – variables- Operators – Expressions – Library functions Managing Input and Output – formatted input and output. Control statements – Decision making and branching – Looping structures- Arrays – One dimensional array – Two dimensional arrays – Multidimensional arrays. Character arrays and strings.

MODULE - III **15**

Functions, Structures and Files: Functions - User defined functions: declaration, definition function call and parameter passing mechanisms – Recursion –Array and Functions - User defined data types –typedef - Structures – Unions –File operations in C- Introduction to pointer –Pointer Declaration and Initialization-Accessing a Variable through a pointer-Difference between array and Pointers.

TOTAL : 45

TEXT BOOKS

1. Kamthane, Ashok N. “Computer Programming”, Pearson Education, New Delhi, 2007.
2. Dromey, R.G., “How to solve it by Computers”, Pearson Publishers, New Delhi, 2007.

REFERENCE BOOKS

1. Gottfried Byron S, “Programming with C”, Second Edition, Tata McGraw-Hill, New Delhi, 2006.
2. Kanetkar Yashavant P., “Let us C”, Fifth Edition, BPB publications, New Delhi, 2005.
3. Schildt Herbert, “The Complete Reference C”, Fourth Edition, Tata McGraw-Hill, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Outline the changes in hardware and software technologies with respect to evolution of computers and programming languages

CO2: Apply fundamental principles of problem solving techniques

CO3: Develop programs using basic programming principles of C language

CO4: Design simple applications using structured programming techniques and file concepts

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	1	1		1				2		1		
CO2	3	2	2		3					1			
CO3		3			3						2		
CO4		3			3								

3 – Substantial, 2 – Moderate, 1 – Slight

11EE101 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to Civil, Mechanical, Chemical, Food Technology, Computer Science and Information Technology branches)

3 0 0 3

MODULE – I **15**

Electrical Systems: Kirchhoff's Laws – Resistors in series and Parallel, Voltage and Current division Rule, Mesh Analysis of Simple Resistive networks – Introduction to AC Circuits – Sinusoidal Voltage, Current, R.M.S and Average value.

Power System: Introduction- Structure of electric power system- Transmission and Distribution systems – Various levels of Transmission and Distribution Voltages.

Electrical Machines: DC Machines Construction, Principle of Operation, Basic Equation and Applications of: DC Generators (EMF equation), DC Motors (Torque equation).

MODULE – II **15**

AC Machines: Single Phase Transformer- Construction and Working Principle of Three Phase Induction Motors- Single Phase Induction Motors: Split Phase and Capacitor Start Motors.

Semiconductor Devices and Applications: Semiconductors and Junction Diodes : Distinction between Conductors, Semiconductors and Insulators – Properties of Semiconductors – PN Junction Diode- Rectifiers and Filters- Zener Diodes – Zener Diode Voltage Regulator– LEDs. Junction Transistors: Principle of Operation – CE,CB and CC Configurations – Static Characteristics – CE Transistor as an Amplifier – Characteristics and Applications of SCR and UJT.

Digital Electronics: Introduction– Binary Number Systems and Conversions – Binary Addition and Subtraction -Logic Gates and Truth tables.

MODULE - III **15**

Digital Electronics: Boolean Algebra: Basic laws and Demorgan's theorem – Simplification of Boolean Functions —Full Adder and Full Subtractor – Flip-Flops: RS,JK,D and T – Counter: 4 Bit Binary Ripple Counter.

Linear IC'S: OPAMPs: – Ideal Characteristics –Applications of OP-Amps: Inverting and Non-Inverting Amplifier, Voltage Follower, Adder and Subtractor.

Fundamentals of Communication Engineering: Introduction – Need for Modulation – Amplitude Modulation – Frequency Modulation – Comparison of AM & FM Communication Systems (Block Diagram approach): Radio, TV: Standards, Transmitter and Receiver- Satellite and Optical Fibre Communication

Powersupplies (Block Diagram Approach) : Regulators, UPS and SMPS

TOTAL : 45

TEXT BOOKS

1. Hughes Edward., Smith Mckenzie., Hiley John and Brown Keith., "Electrical and Electronic Technology", 9th Edition, Pearson Education, New Delhi.
2. Muthusubramanian, Salivahanan R.S. and Muraleedharan K.A., "Basic Electrical, Electronics and Computer Engineering", Tata McGraw-Hill, New Delhi, 2007.

REFERENCE BOOKS

1. Millman and Halkias, "Integrated Electronics", Tata McGraw-Hill, New Delhi, 1998.
2. Kennedy, David, "Electronic Communication Systems", Tata McGraw – Hill, New Delhi, 2000.
3. Gayakward, Ramakant A. "Op-Amps and Linear Integrated Circuits", Pearson Education, New Delhi, 2002.
4. Metha, V.K and Rohit Mehta, "Principles of Power System", S. Chand & Company Ltd., New Delhi, 2006.
5. Smarajit Ghosh, "Electrical and Electronics Engineering", Second Edition, Prentice Hall of India, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Develop a basic understanding of the concept of electrical systems

CO2: Illustrate the construction and working of different types of electric machines

CO3: Gain basic knowledge of analog and digital electronics

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	2									1	
CO2	3	1										1	
CO3	3											1	

3 – Substantial, 2 – Moderate, 1 – Slight

11PH102 PHYSICAL SCIENCES LABORATORY – I

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: APPLIED PHYSICS LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength and angle of divergence.
   (c) Determination of acceptance angle in an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
5. Determination of dispersive power of a prism using spectrometer.
6. Determination of Young's modulus of the material – non uniform bending.

PART-B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Estimation of Total, Temporary and Permanent hardness of water by EDTA method.
2. Estimation of Ca^{2+} and Mg^{2+} hardness separately by EDTA method.
3. Estimation of Alkalinity of a water Sample.
4. Conductometric titration - Mixture of acids.
5. Estimation of Hydrochloric acid using PH meter.
6. Estimation of Ferrous ion by Potentiometric titration.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Get the basic idea of diode and LASER Estimate the Laser parameters

CO2: Familiarize the concepts of ultrasonics

CO3: Get the basic idea about the analysis of hardness, amount of Ca2+ and Mg2+, presence of alkalinity in water

CO4: Get a basic idea about the handling of instruments like pH meter and conductivity meter for the estimation of unknown concentration of acids

Mapping of COs with POs

COs/POs	a	B	C	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2	-	1	-	-	-	-	-	2	2	3
CO2	2	3	2	-	1	-	-	-	-	-	2	2	3
CO3	2	3	2	-	1	-	-	-	-	-	2	2	3
CO4	2	3	2	-	1	-	-	-	-	-	2	2	3

3 – Substantial, 2 – Moderate, 1 – Slight

11CS102 PROGRAMMING LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

A) APPLICATION PACKAGES

1. To create an advertisement using word
2. To illustrate the concept of mail merging using word
3. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts using excel
4. To create the presentation for the department using power point
5. To create the presentation for digital computers using power point

B) C PROGAMMING (ANY TWO PROGRAMS IN EACH SECTION)

6. Simple programs using decision making and branching:
   a. Program to find biggest of three numbers
   b. Design of simple menu driven calculator
   c. Program to find the roots of the quadratic equation
   d. Program to convert the given decimal number to binary
   e. Program to print the prime numbers between 100 to 500
   f. Program to print the electricity bill in a specified format applying specified rules
7. Programs using arrays:
   a. Program to find the biggest number in the array
   b. Menu driven program to insert and delete a specified element from the array
   c. Program to arranged the elements of the array in ascending order
   d. Program to merge given two one dimensional arrays and to remove the duplicates
   e. Program for multiplication of two matrices
8. String manipulations:
   a. Program to find the length of the string, copy one string to another and compare two strings, concatenate two strings without using library functions.
   b. Program to check whether the given string is a palindrome or not without reversing
   c. Program to find the occurrence of a substring in a main string and replace the substring by another string.
   d. Arranging the list of names in alphabetical order
   e. Program to count the number of occurrences of vowels, consonants, words, white spaces and special characters in the given statement.
9. Functions:
   a. Program to swap the contents of two variables using functions (Pass by address and pass by reference)
   b. Program to print the Fibonacci series using recursive function
   c. Program to print the average and standard deviation of the elements of the one- dimensional array using function.
   d. Program to print the transpose of a matrix using functions
   e. Menu driven program to perform string operations using functions
10. Structures and file operations:
    a. Define a structure to store the student details viz., Roll no, name, marks in three subjects, total, avg and class obtained. Read the first three fields and write your logic to calculate the total, average and class obtained for ten students. Print the results in the order of ran obtained.
    b. Structure based program to print the pay slip of an employee.
    c. Program using files to copy the contents of one file to another

REFERENCES / MANUALS/SOFTWARE:

Software requirements

Operating System : Windows / Linux

Compiler : C compiler

Packages: MS office or Equivalent

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Utilize the features of MS office package to create documents, presentation and reports

CO2: Write and execute programs to illustrate decision making and branching

CO3: Develop programs using 1D and 2D arrays

CO4: Create programs for manipulating strings

CO5: Demonstrate the use of functions and structures to develop applications

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1											3		
CO2	3	2			2								
CO3	3	2			2								
CO4	3	2			2								
CO5	3	1			3								

3 – Substantial, 2 – Moderate, 1 – Slight

11EL201 COMMUNICATION SKILLS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Focus on language: Cause and effect expressions - indicators of purpose and function - connectives -imperatives - modal verbs - infinitives and gerunds - reporting verbs - homonyms - commonly confused (mispronounced and misspelt) words - phrasal verbs - British and American Vocabulary.- rules for writing SI [system international] units - concord.

MODULE – II **15**

Listening: Listening practice - Radio / TV news - documentaries - listening to short and long conversations in different domains of activity/ live speech - new inventions, products, announcements, casual conversation, and academic lectures.

Writing: Formal letter writing (letter of application - job application) , Business (calling for quotation, placing orders , letter of complaint) - structure of memorandum and technical reports (reports on visits made to industries, report on an accident in the factory, meeting report) – notices - agenda - instructions - e-mails - Preparing Checklist- note taking and note making.

MODULE- III **15**

Speaking: Communication – accuracy, fluency, appropriateness – levels of formality – oral practice activities related to professional skills – role play using different functions (persuasion, negotiation, giving directions and guidance) – conversational etiquette (greetings, making requests, permission, accepting, denying, declining, politeness strategies, turn-taking, body language) – making speeches – describing people, place, things and events.

Reading: Reading comprehension – guided note- making – providing a suitable title - identifying main points, supporting ideas – evaluating the style (argumentative / descriptive etc) – drawing inferences separating facts from opinions – interpreting text in different genres.

TOTAL : 45

TEXT BOOK

1. Department of Science and Humanities, Anna University, Chennai. “English for Engineers and Technologists”, Combined Edition Volumes (I & II), Orient Longman, Oxford University Press, New Delhi, 2006.

REFERENCE BOOKS

1. Kiranmai. Dutt P, Geetha Rajeevan and Prakash, C. L. N., “A Course in Communication Skills”, Cambridge University Press, New Delhi, 2007.
2. Meenakshi Raman and Sangeetha Sharma, “Technical Communication”, Oxford University Press, New Delhi, 2006.
3. Sangeetha Sharma and Binod Mishra, “Communication Skills for Engineers and Scientists”, PHI Learning, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Improve their vocabulary and appropriate usage of words.

CO2: Familiarize with different rhetorical functions of technical English.

CO3: Speak effectively in English in real-life and career-related situations.

CO4: Acquire knowledge in academic and professional writing.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1									2	3		1	
CO2									2	3			
CO3									1	3			
CO4				1					1	3		1	

3 – Substantial, 2 – Moderate, 1 – Slight

11MA201 ENGINEERING MATHEMATICS – II

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Multiple Integrals: Double integration in Cartesian coordinates – Change of order of integration – Area between two curves – Area as double integrals – Triple integration in Cartesian coordinates –Volume as Triple integrals (Simple problems only).

Vector Calculus: Gradient, divergence and curl – Line, surface integral (Concept Only) and volume integrals (Concept Only) – Green's, Gauss divergence and Stoke's theorems (without proof) – Verification of the above theorems and evaluation of integrals using them (Simple problems only).

MODULE – II **15**

Analytic Functions: Functions of a complex variable – Analytic functions – Necessary conditions and Sufficient conditions (excluding proof) – Cauchy– Riemann equations — Properties of analytic function (Statement only) – Harmonic functions – Construction of Analytic functions – Conformal mapping: $w = z + a$, az, $\frac{1}{z}$ - Bilinear transformation.

Complex Integration: Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor and Laurent's series (without proof) – Singularities – Classification – Cauchy's residue theorem (Statement only) – Contour integration – circular and semi-circular contours (excluding poles on real axis).

MODULE – III **15**

Laplace Transforms: Conditions for existence – Transform of elementary functions –Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of unit step function – Transform of periodic functions.

Inverse Laplace transforms: Inverse Transform of elementary functions – Partial fraction method – Convolution theorem (without proof) – Solution of linear ODE of second order with constant coefficients.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy. P, Thilagavathy. K and Gunavathy. K, "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2011, S.Chand and Co., New Delhi.
2. Veerarajan. T., "Engineering Mathematics, (for first year), Reprint Edition 2011, Tata McGraw-Hill New Delhi.

REFERENCE BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, New Delhi, 2007.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Third Edition, Narosa Publishing House, New Delhi, 2007.
3. Bali. N.P and Manish Goyal, "Text Book of Engineering Mathematics", Third Edition, Laxmi Publications, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify problems involving vectors, double and triple integrals

CO2: Measure the knowledge of analytic functions.

CO3: Evaluate complex integrals which are extensively applied in engineering.

CO4: Adapt Laplace transforms to solve practical problems.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3											1	
CO3	3	3		1	2							1	
CO4	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11PH201 MATERIALS SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Crystal Physics: Introduction – Lattice – Unit cell – Crystal systems – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal imperfections : Point, line and surface imperfections.

Conducting Materials: Conductors – Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – Carrier concentration in metals.

MODULE – II **15**

Semiconducting Materials: Intrinsic semiconductor – Carrier concentration derivation – Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications - Semiconductor devices – Solar cells - LDR.

Magnetic and Dielectric Materials: Types of magnetic materials – Domain theory – Hysteresis – Soft and hard magnetic materials - Magnetic devices – Transformer core - Magneto optical recording - Dielectric constant - Qualitative study of polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Uses of dielectric materials (capacitor and transformer) – Ferro electric materials.

MODULE- III **15**

Smart Materials : Metallic glasses: Preparation, properties and applications - Shape memory alloys (SMA): Characteristics, properties, applications, advantages and disadvantages of SMA – Superconductors: Properties – Types of superconductors – BCS theory of superconductivity(Qualitative) - High T_c superconductors – Applications of superconductors – SQUID – cryotron - magnetic levitation.

Nano Materials: Synthesis: Lithographics – Vapour phase physical and chemical deposition methods - Colloidal and solgel methods - Properties of nanoparticles and applications - Carbon nanotubes: Structure – Properties – Fabrication by Laser ablation – Applications.

TOTAL : 45

TEXT BOOKS

1. Kittel. Charles, “Introduction to Solid State Physics”, Seventh Edition, John Wiley & sons, Singapore, 2007.
2. Poole. Charles P and Ownen. Frank J., “Introduction to Nanotechnology”, Wiley India, 2007. (For Module III).

REFERENCE BOOKS

1. Pillai. S O, “Solid State Physics”, Fifth Edition, New Age International, New Delhi, 2003.
2. Rajendran. V, “Engineering Physics”, Prentice Hall of India, New Delhi, 2008.
3. Palanisamy. P K, “Engineering Physics - II”, SciTech publications (India), Chennai 2008.
4. Raghavan. V, “Materials Science and Engineering: A first course”, Fifth Edition, Prentice Hall of India, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Gain basic knowledge in concepts like crystal physics, conducting and superconducting materials.

CO2: Understand the concepts of semiconducting materials, devices, magnetic and dielectric materials

CO3: Acquire basic knowledge of Smart materials, Nano materials and its applications

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		2						1			1	
CO2	3											1	
CO3	3		1										1

3 – Substantial, 2 – Moderate, 1 – Slight

11CY201 ENVIRONMENTAL SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Introduction to Environmental Studies and Natural Resources: Introduction to Environmental Science – Forest resources: Use and over-exploitation, deforestation, case studies. – Water resources: Use and over-utilization of surface and ground water, dams - benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture - effects of modern agriculture, fertilizer and pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource – Conservation Practices - Role of an individual in conservation of natural resources. **Ecosystems:** Concept of an ecosystem – Structural features – Functional attributes (Food chain and Food web only) – Introduction, types, characteristic features, structure and functions of the (a) Forest ecosystem (b) Aquatic ecosystems (ponds, rivers and oceans). **Biodiversity:** Introduction to Biodiversity – Definition - genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic, option values and ecosystem service value– Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife – Endangered and endemic species of India – In-situ and Ex-situ conservation of biodiversity.

MODULE – II **15**

Pollution: Definition – Causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b) Water pollution (c) Soil pollution (d) Radioactive Pollution - Solid waste Management - Disaster management: floods, earthquake, cyclones and landslides - Role of an individual in prevention of pollution - Case studies. **Water Treatment methods**: Treatment of Water for Domestic Supply (Screening, Aeration, Sedimentation with Coagulation, Filtration and Disinfection methods) - Break point chlorination –Estimation of dissolved oxygen, BOD and COD - Bacteriological examination of water - Sewage treatment (Primary, Secondary & Tertiary methods) - Miscellaneous methods of Sewage treatments (Oxidation Ponds, Aerated Lagoons, Oxidation ditch, Anaerobic Lagoons, Septic tanks) – Methods of Sewage treatment by activated sludge process – Introduction to industrial waste water treatment using Reverse Osmosis Technology- Self purification of Natural Waters - Membrane Technology for wastewater treatment - Activated carbon in pollution abatement of wastewater.

MODULE- III **15**

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people - case studies – Environmental ethics - Issues and possible solutions - Wasteland reclamation – Consumerism and waste products – Environment Production Act – Air (Prevention and control of pollution) Act – Water (Prevention and control of pollution) Act – Wildlife protection Act – Forest conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.**Human Population and the Environment:** Introduction - Population growth - Variation of population based on age structure - Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child welfare – Role of Information Technology in Environment and human health – Case studies.

TOTAL : 45

TEXT BOOK

1 Anubha Kaushik, and Kaushik C P, "Environmental Science and Engineering", Third Edition: 2008, (Reprint 2010), New Age International (P) Ltd, New Delhi.

REFERENCE BOOKS

1 B.K.Sharma, **"** Industrial Chemistry",Tenth Edition, Krishna Prakashan Media(P) Ltd,Meerut-250001(UP), India.

2 B Uppal M M revised by S C Bhatia, "Environmental Chemistry", Sixth Edition Khanna Publishers, New Delhi, 2002.

3 Trivedi R.K. and Goel P. K., "Introduction to Air Pollution", Techno-Science Publications, Jaipur, 2003.

4 Masters. Gilbert M, "Introduction to Environmental Engineering and Science", Second Edition, Pearson Education, New Delhi, 2004.

5 Miller, T.G., "Environmental Science", Wadsworth Publishing Co.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Appreciate the importance of conservation of resources and our role in maintaining the clean environment

CO2: Develop an understanding of ecological balance and preservation of bio-diversity

CO3: Acquire the awareness about the different types of pollution and know about the impact of population explosion

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	-	2	-	1	1	2	3	-	3	-	-	-
CO2	3	-	2	-	1	1	2	3	-	3	-	-	-
CO3	3	-	2	-	1	1	2	3	-	3	-	-	-

3 – Substantial, 2 – Moderate, 1 – Slight

11ME101 BASICS OF CIVIL AND MECHANICAL ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **7**

Construction Materials: Introduction – Civil Engineering – Materials – bricks – stones – sand – cement – concrete – steel sections – Site selection for foundations – Bearing capacity – loads – Types of foundations – requirements.

MODULE – II **7**

Elements of Structures: Superstructure – brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Types of Bridges and Dams.

MODULE - III **8**

Elements of Surveying: Surveying – Objects – types – classification – principles – measurements of distances – Determination of areas –Building area calculation – illustrative examples – Basics of Interior and Landscaping.

PART–B: BASIC MECHANICAL ENGINEERING

MODULE – I Metal Forming and Joining Processes **7**

Foundry: Introduction- patterns – molding –casting - cupola furnace.

Forming: Introduction-Classification- Rolling, extrusion, and drawing.

Welding: Introduction-Classification - TIG, MIG welding, Gas welding, soldering and brazing.

Machining process: Introduction-Classification – lathe and drilling machines.

MODULE – II Boilers and Power Plants **8**

Steam Boilers: Introduction-Classification- Working Principle of Cochran boiler, Babcock and Wilcox boiler- Benson boiler - Boiler Mountings and accessories.

Power Plants: Classification of power plants – working principle of steam, Diesel, Hydro-electric and Nuclear Power plants-Merits and Demerits.

MODULE – III IC Engines, Refrigeration and Air-conditioning **8**

IC Engines: Classification-components - Working principle of Petrol and Diesel Engines- Four stroke and two stroke cycles- Comparison of four stroke and two stroke engines. Working principle of carburetor, fuel pump and multi point fuel injector.

Refrigeration and Air Conditioning System: Terminology of Refrigeration and Air conditioning, Properties of refrigerant -Principle of vapour compression and absorption system - Layout of typical domestic refrigerator - Window and Split type room Air conditioner.

TOTAL : 45

TEXT BOOKS

1. Palanichamy, M S., "Basic Civil Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Shanmugam, G, "Basic Mechanical Engineering", 4th Edition, Tata McGraw-Hill, New Delhi, 2011.

REFERENCE BOOKS

1. Rao, M.S., "Basics of Civil Engineering", Dhanpat Rai and Co, New Delhi, 2006.
2. Venugopal, K and Prabhu Raja, V, "Basic Mechanical Engineering", Sixth Edition, Anuradha Publishers, Kumbakonam, 2005.
3. Rao, P N, "Manufacturing Technology: Foundry, Forming And Welding", Tata McGraw-Hill, New Delhi, 2008.
4. Rajan, T.S, "Basic Mechanical Engineering, 3rd Edition, New Age International Publishers, NewDelhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: select the suitable construction materials and foundation required for a building
CO2: recall the various elements of the super structure
CO3: point out the various elements of surveying and landscaping
CO4: demonstrate the ability to describe the basics of metal forming and joining processes.
CO5: demonstrate the knowledge on patterns, molding, casting, rolling, extrusion, drawing, TIG, MIG welding, gas welding, soldering and brazing.
CO6: describe basics of boilers and power plants.
CO7: explain the working principle of steam, Diesel, Hydro-electric and Nuclear power plants.
CO8: demonstrate the working of IC engines, Refrigeration and Air-conditioning systems.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	2	2	2	1							2
CO2	3	2	2	2	2	1							2
CO3	3	2	2	2	2	1							2
CO4	3				2			1				3	
CO5	3				2			3				2	
CO6	3				2			1				3	
CO7	3				3			2				3	
CO8	3				2			1				3	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME102 ENGINEERING DRAWING

(Common to all Engineering and Technology branches)

2 0 3 3

Concepts (Not for Exam)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

MODULE – I **15**

Projections of Points, Lines, Planes and Solids:

General principles of orthographic projection – First angle projection – Layout of views – Projection of points, located in all quadrant and straight lines located in the first quadrant – Determination of true lengths and true inclinations and location of traces – Projection of polygonal surface and circular lamina inclined to both reference planes.

Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

MODULE – II **15**

Sectioning and development of solids:

Sectioning of solids- prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cone with cutout, perpendicular and inclined to the horizontal axis.

15

MODULE- III

Isometric projection, and Perspective projection:

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones

Conversion of isometric projection into orthographic projection.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL: 45

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V. "Engineering Graphics", New Age International (P) Limited, New Delhi, 2008.
2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD", Tata McGraw Hill, New Delhi, 2008.

REFERENCE BOOKS

1. Bhatt N.D, "Engineering Drawing", 46th Edition, Charotar Publishing House, Anand, 2003.
2. Gopalakrishnana K.R., "Engineering Drawing", Volume. I & II, Subhas Publications, Bangaluru, 2006.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw-Hill, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: prepare elementary sketches of 2D and 3D objects with correct interpretation and mark dimensions properly.

CO2: draw multi-view orthographic and other projections including isometric, sectional, true and perspective.

CO3: read, understand, interpret drawings and communicate effectively.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3				2				3				
CO2	3				2				2				
CO3	3				2				2				

3 – Substantial, 2 – Moderate, 1 – Slight

11PH202 PHYSICAL SCIENCES LABORATORY – II

(Common to all Engineering and Technology branches)

0 0 3 1

PART - A: APPLIED PHYSICS LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Determination of band gap of a semiconductor material.
2. Determination of wavelength of mercury spectrum – spectrometer grating.
3. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
4. Determination of hysteresis loss in a ferromagnetic material.
5. Determination of Young's modulus of the material – uniform bending.
6. Determination of viscosity of liquid – Poiseuille's method.

PART - B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Estimation of Chloride in a given water sample.
2. Determination of Dissolved Oxygen in a sample of water / sewage.
3. Estimation of Chromium in Industrial waste water.
4. Estimation of Ferrous ion in rust solution.
5. Estimation of percentage of Copper present in brass.
6. Estimation of ferric ion by Spectrophotometer method.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Determine the features of conducting materials

CO2: Familiarize the concepts of thermal conductivity

CO3: Estimate DO, chloride, chromium, ferrous ion and copper in wastewater

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2	-	1	-	-	-	-	-	2	2	3
CO2	2	3	2	-	1	-	-	-	-	-	2	2	3
CO3	2	3	2	-	1	-	-	-	-	-	2	2	3

3 – Substantial, 2 – Moderate, 1 – Slight

11ME103 ENGINEERING PRACTICES LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: CIVIL & MECHANICAL

LIST OF EXPERIMENTS

1.FITTING

Tools & Equipments – Practice in Filing and Drilling.
Making Vee Joints, Square, dovetail joints, Key Making.

2. PLUMBING

Tools & Equipments - Pipe connection for a bath room, Pipe connection for multi-storey building,
Pipe connection with different components like valves, tap, coupling, union, reducers, elbows etc.
Plumbing work with metal, PVC and flexible hoses (Threading, joining of pipes)

3.CARPENTRY

Tools and Equipments- Planning practice. Making Half Lap, dovetail, Mortise & Tenon joints, a mini model of a single door window frame.
Making of Pen stand, Box, etc. from plywood. (Use of modern power tools for cutting)

4.SHEET METAL

Tools and equipments - Fabrication of a small cabinet, Rectangular Hopper, etc.

5.WELDING

Tools and equipments - Arc and Gas welding of butt joint, Lap Joint and Tee Fillet.

REFERENCES / MANUALS / SOFTWARE:

1. Suyambazhahan, S, "Engineering Practices Laboratory Manual", PHI Learning, NewDelhi, 2010.
2. John, K. C., "Mechanical Workshop Practice", Second Edition, PHI Learning, NewDelhi, 2009.

PART-B: ELECTRICAL & ELECTRONICS

1. Safety aspects of Electrical wiring.
2. Wiring circuit for a lamp using single and two way switches (stair case).
3. Wiring circuit for fluorescent lamp.
4. Study of Electronic components and equipment – Resistor-colour coding, measurement of AC Signal parameter (Peak-Peak, RMS Value, Frequency and Power factor) using CRO
5. Assembling electronic components on a small PCB (Etching, Fabrication and Testing)
6. Measurement of earth resistance and insulation resistance of an electrical equipment
7. Study of Telephone, FM radio & Transducers.
8. Study of Mixie, Iron box, Ceiling & Table Fans.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the functions of different tools used in fitting, carpentry, sheet metals and welding.

CO2: prepare different types of joints in metal pieces, sheet metals and wooden pieces.

CO3: plan and fabricate simple models.

CO4: utilize the basic laboratory equipment

CO5: build the layout of domestic wiring circuits and troubleshoot it.

CO6: estimate Earth Resistance, assemble electronic components in PCB and understand operation of various domestic appliances

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	2							2			1		
CO2	2							3			2		
CO3	3							2			2		
CO4	3		1		3						2	3	
CO5	3	2			2	3						3	
CO6	3					2						3	

3 – Substantial, 2 – Moderate, 1 – Slight

11EL202 COMMUNICATION SKILLS LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS

English Lab

1. Listening Comprehension
   Listening to instructional software packages in the communication laboratory, using them, understanding the mechanics of language like grammar, listening to native speakers' presentation, and developing oral communication by imitating the model dialogues. Listening for specific information – listening to improve pronunciation – Listening and typing – Filling the blanks – TV programmes and News.
2. Reading comprehension and vocabulary:
   Reading for getting information and understanding; scanning, skimming and identifying topic sentences – reading for gaining knowledge, looking for transitions, understanding the attitude of the writer – Filling the blanks – Cloze exercises – vocabulary building – Comprehension.
3. Speaking:
   Group discussion; verbal and non-verbal communication; speaking on situational topics – maintaining eye contact, speaking audibly, clearly and with confidence – Common errors in English
   Conversations – face-to-Face conversation – Telephone Conversation – Roll play.
4. Writing Skills:
   Writing job application: resume, applications for jobs, making complaint letters – Projects: report writing – editing and proof reading – research paper and translating numerical data from charts and diagrams into verbal communication.

Career Lab

1. Letter Writing / Resume / Report preparation:
   Structuring Letter Writing / Resume / Report preparation / E-Mail
2. Presentation skills
   Elements and structure effective presentation – presentation tools – voice Modulation – Body language – Video samples
3. Group Discussion
   Structure of Group Discussion – Strategies in GD – Team work – Video Samples
4. Interview skills
   Kinds of Interview- corporate culture – video samples
5. Soft Skills
   Time management – stress management – assertiveness – case study

Communication Software Package:

a. Presentation Skills
b. Interview Skills
c. Group Discussion
   - From Globarena Software

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Write, read and listen English effectively
CO2: Communicate efficiently in English in real life and career related situations
CO3: Demonstrate good presentation skill.
CO4: Use the modern communication software package to enhance the soft skills

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1				2					2	3		1	
CO2				2					2	3		1	
CO3				2					2	3		1	
CO4									2	3			

3 – Substantial, 2 – Moderate, 1 – Slight

11MA301 ENGINEERING MATHEMATICS – III

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Fourier Series: Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Change of interval - Parseval's Identity - Harmonic analysis.

MODULE - II **15**

Partial Differential Equations: Formation – By elimination of arbitrary constants and arbitrary functions – Standard types– Lagrange's linear equation- Linear partial differential equations of second order with constant coefficients.

Applications of Partial Differential Equations: Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded).

MODULE - III **15**

Fourier transform: Fourier integral theorem (Statement only) – Fourier transform pair – Properties – Transforms of simple functions – Sine and Cosine transforms – Convolution theorem and Parseval's identity (Statement only).

Z-transform: Elementary properties – Transforms of simple functions - Inverse Z – transform(Partial Fraction Method and Residue method) – Convolution theorem (Statement Only) – Solution of Difference Equations.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics", Volume - III, S. Chand & Co, New Delhi, 2008.
2. Veerarajan, T., "Engineering Mathematics", Tata McGraw-Hill, New Delhi, Reprint 2010.

REFERENCE BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics", Thirty Sixth Edition, Khanna Publishers, New Delhi, 2007.
2. Wylie, C. Ray and Barrett, Louis, C., "Advanced Engineering Mathematics", Sixth Edition, McGraw-Hill, New York, 2004.
3. Andrews, L. A. and Shivamoggi, B. K., "Integral Transforms for Engineers and Applied Mathematicians", Macmillan, New York, 2004.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Utilize Fourier series to solve engineering problems.

CO2: Formulate and solve higher order partial differential equations.

CO3: Interpret the basic knowledge of Fourier transforms and Z-transforms in engineering field.

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3	3		2	2							1	
CO3	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11EE301 ELECTRICAL MACHINES

(Common to Mechatronics, ECE, EIE and Chemical)

3 1 0 4

MODULE - I **15**

DC Machines: DC Generator: Constructional details – EMF equation – Methods of excitation – Self and separately excited generators – Characteristics of series, shunt and compound generators – Principle of operation of DC motor – Back emf and torque equation – Characteristics of series, shunt and compound motors - Starting of DC motors – Types of starters – Speed control of DC shunt motors- Applications.

MODULE –II **15**

Transformers: Construction – Principle of operation – EMF equation –– Equivalent circuit – Transformer on load – Regulation Transformer Testing: Load test, open circuit and short circuit tests- Auto transformers.

Alternator: Construction of Synchronous Generators – Principles-EMF equation- Voltage regulation- EMF and MMF methods.

MODULE -III **15**

Induction Motors: Construction – Types – Principle of operation of three-phase induction motors –Starting and speed control – Single-phase induction motors - Applications.

Synchronous Motor: Construction-Principle- Methods of starting of synchronous motors

Electric Drives: Basic Elements of electric drive – Types of Electric Drives – factors influencing the choice of electrical drives –Classes of duty – Selection of motors for various industrial applications: Textile mills, Steel rolling mills, Cement mills, Machine tools.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOK

1. Theraja, B.L and Theraja, A.K., "A Text Book of Electrical Technology", Volume-II, S. Chand & Co, New Delhi, 2008.
2. Vedam Subramaniyam, "Electric Drives: Concepts and Applications", Tata McGraw-Hill, New Delhi, 2004.

REFERENCE BOOKS

1. Rajput, R. K., "Electrical Machines", Third Edition, Laxmi Publications (P) Ltd, New Delhi, 2002.
2. Kothari, D. P and Nagrath, I. J, "Basic Electrical Engineering", Second Edition, Tata McGraw-Hill, New Delhi, 2002.
3. Bhattacharya, S.K., "Electrical Machines", Second Edition, Tata McGraw-Hill, New Delhi, 1998.
4. Mittle, V.N. and Mittle, Aravinth., "Basic Electrical Engineering", Second Edition, Tata McGraw-Hill, New Delhi, 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Interpret the construction, working principle, and applications of Electrical Machines

CO2: Analyze the performance of the Electrical machines

CO3: Choose the various electrical drives for industrial applications

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3									1	
CO2	3		3									1	
CO3		3	3									1	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH301 HEAT POWER ENGINEERING

3 0 0 3

MODULE – I **15**

Air Standard Cycles: Introduction, Efficiency of Air standard Cycle and Engine, Carnot cycle, Otto cycle, Diesel Cycle, combined cycle , Brayton, Stirling, Rankine and Joule cycles - Simple problems.

Testing of Engines: Performance and testing of I.C engines, Morse test, Measurement of air supply for IC engines, Heat balance for IC engines.

MODULE - II **15**

Boilers: Types and classification of boilers, water tube, fire tube, coal, oil and gas fired boilers. Packaged, Stoker fired pulverized, fluidized bed and Supercritical boilers. Boiler mountings, Accessories Performance and energy efficiency of boilers. Simple calculation of Boiler efficiency Importance of boiler water treatment and blow down.

Properties of Steam and Industrial furnaces:

Properties of steam, Mollier chart, determination of dryness fraction of steam- Different types of calorimeters. Steam ejectors. Concept of Steam distribution systems. Types of steam traps and their characteristics. Industrial furnaces-Types.

MODULE - III **15**

Turbines: Types and principles of working of steam turbines. Reaction, impulse turbines, Back pressure sets for process industries, calculation of turbine efficiency. Gas turbines, principle and working of simple gas turbine systems, Practical gas turbines.

Cryogenics and Vacuum Systems:

Cryogenic processes, Properties of Materials at low temperature, Safety in cryogenic systems. Production of Vacuum Systems & Equipment - Vacuum Pumps, Blower pumps, Instrumental methods of Vacuum measurement.

TOTAL : 45

TEXT BOOKS

1. Kothandaraman, C.P., Khajuria, P.R., Arora, S.C. and Domkundwar, S.A., "Course in Thermodynamics and Heat Engines", Third Edition, Dhanpat Rai & Sons, New Delhi, 1990.
2. Balaney, P.L. "Thermal Engineering (Heat Engines)", Eighteenth Edition, Khanna Publishers, New Delhi, 1991.

REFERENCE BOOKS

1. Sarao, A.S., "Thermal Engineering", Fifth Edition, Satya Prakash, New Delhi, 1992
2. Kuriakose, J.C. and Rajaram, J., "Chemistry in Engineering and Technology", Volume - I, Tata McGraw-Hill, New Delhi, 1984.
3. Gupta, O.P., "Elements of Fuels, Furnaces and Refractories", Third Edition, Khanna Publishers, New Delhi, 1997.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1: Understand and analyse different thermodynamic cycles, calculate their thermal efficiencies and the testing of I.C engines.

CO2: Understand the basics of boilers and perform simple calculations of boiler efficiencies; understand the Steam distribution and utilisation systems

CO3: Comprehend principles of steam turbines and calculation of turbine efficiencies; understand the basics cryogenics vacuum pumps and instrument for measurement of vacuum

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		1	1	3					1	2		2
CO2	3		2		3			2		1	3		2
CO3	3		2	1	3			1		1	2		2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH302 PHYSICAL CHEMISTRY

3 0 0 3

MODULE – I **15**

Electrochemistry: Faraday's law and its application-Electrical Conductance - Specific conductance -Equivalent conductance - Variation with dilution - conductance measurement -kohlrausch's law applications -Transport Number determination - Galvanic cells -EMF and its measurement applications - Principle and practice of electro synthesis - potassium chlorate and calcium gluconate.

Colloids: Introduction to colloids - Preparation - properties – optical and electrical stabilization of colloids - Electrokinetic phenomena - Donnan Membrane equilibrium - Emulsions - Gels -Associated colloids.

MODULE – II **15**

Kinetics: Kinetics of parallel and opposing reactions - concept of activation energy - Arrhenius equation - Theory of absolute reaction rates - Enzymatic Reactions -Michaelis -Menten Kinetics - Evaluation of Michaelis - Menten parameters.

Catalysis and Adsorption: Homogeneous catalysis - Heterogeneous catalysis, acid - base catalysis, Oxidation, Hydrogenation, Cracking - Applications of catalysis in industries. Physical and chemical adsorption - Types and properties of adsorbents - characteristics and application of adsorbents-Types of adsorption isotherm, Langmuir isotherm BET method.

MODULE – III **15**

Phase Rule: Phase rule -Definition - Derivation - Application of phase rule to water system - Thermal Analysis - Cooling curves - Two component system - Eutectic and compound formation.

Photochemistry: Laws of Photochemistry, Quantum efficiency, Photochemical reactions, consequences of photochemical reactions, Actinometry, Kinetics and mechanism of Hydrogen -Bromine and Hydrogen -chloride reactions.

TOTAL : 45

TEXT BOOKS

1. Puri, B.R. and Sharma, L.R., "Principles of Physical Chemistry", Shoban Lal Nagin Chand & Co, Jalandhar, 2000.
2. Bahl B.S., Tuli, G.D. and Arun Bahl, “Essentials of Physical Chemistry", S.Chand & Company Ltd., New Delhi, 2004.

REFERENCE BOOKS

1. Carl H.Hamann, Andrew Hamnett, and Wolf Vielstich “Electro-Chemistry", Wiley-VCH, GmbH 2007.
2. Berry, S.R., Rice, S.A., Ross, J. "Physical Chemistry", Second Edition, Oxford University Press, Oxford, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the basic principles of electrochemistry and colloids to apply for their application in Chemical Engineering practice.

CO2: Understand kinetics and theory of reaction rates for application in reactor design and to identify adsorption types and isotherms and select adsorbents for different applications/ absorber designs.

CO3: Apply the phase rule concepts to material technology, thermodynamics systems and equilibria.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3						1			2	
CO2	3		3									1	
CO3	3		3									2	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH303 FLUID MECHANICS FOR CHEMICAL ENGINEERS

3 1 0 4

MODULE – I **15**

Fluid Statics: Introduction - Nature of fluids – physical properties of fluids – Types of fluids – Newtonian and Non – Newtonian fluids. Compressible and incompressible fluids. Pressure – density – height relationships. Pressure measurements – manometers. Units and dimensions.

Basic Equations of Fluid Flow: Dimensional analysis and similitude applications. Stream line – stream tube – velocity potential. Concept of boundary layer and conditions. Continuity, momentum and mechanical energy equations. Velocity profiles and friction factor for smooth and rough pipes .Flow in circular pipe – losses in piping system.

MODULE - II **15**

Flow Past Immersed Bodies-Packed bed: Flow around solids and through packed beds. Form drag, Skin drag, Drag coefficient, Stoke's law, and drag curves for regular and irregular solids. Pressure drop, flooding and loading. Friction factor for packed beds. Ergun's equation and application. Specific surface of packed column, Classification of packing and Industrial application.

Flow Past Immersed Bodies-Fluidized bed: Fluidization – Classification and pressure drop across the fluidized bed, – minimum fluidization velocity, and comparison of fluidized bed with packed bed.

MODULE - III **15**

Measurement of Fluids: Principles, working and applications of orifice meter, Venturi meter, Pitot tube, rotameter. Weirs and notches. Principles and applications of Doppler Effect in flow measurement. Mass flow meter – High viscous flow meter.

Transportation of Fluids: Fluid moving machinery. Performance – selection and specification – Air lift and diaphragm pump- Positive displacement pump-Reciprocating and rotary pumps- centrifugal pump-pump characteristics, Introduction to Fans, blowers, compressors and steam jet ejectors

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. McCabe, W.L. Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering", Seventh Edition, McGraw-Hill International Edition, New York, 2006.
2. Noel de Nevers., "Fluid Mechanics for Chemical Engineers", Second Edition, McGraw-Hill, New York, 1991.

REFERENCE BOOKS

1. Shaughnessy Edward J., Katz, Ira M and Schaffer, James P., "Introduction to Fluid Mechanics", Second Edition, Oxford University Press", Indian Edition, New Delhi, 2007.
2. Cengel, Yunus A. and Cimbala, John M., "Fluid Mechanics Fundamentals and Applications", Tata McGraw–Hill, New Delhi, 2006.
3. Zappe, R.W., "Valve Selection Handbook", Fourth Edition, Gulf Professional Publishing Company, USA, 2000.
4. Perry, Robert H. and Green, Don., "Perry's Chemical Engineers' Handbook", Eighth Edition, McGraw Hill International Editions, New York, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Comprehend the principles of fluid properties and fluid flow problems like pressure drop, power and loss coefficient and apply the same in Chemical process industries.

CO2: Analyze flow behavior of solid and liquids and to demonstrate the understanding of packed bed and fluidization concepts

CO3: Understand and select characteristics of pumps, flow meter(s) and valves for different applications in Chemical Process Industries

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3			3	2							3	2
CO2	3			3	3							3	2
CO3	3	2		3	3							2	2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH304 CHEMICAL PROCESS CALCULATIONS

3 1 0 4

MODULE – I **15**

Units and Dimensions: Fundamental Calculations: Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions.

Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

Humidity and Saturation: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying.

MODULE - II **15**

Material Balance-without chemical reaction: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying etc.,

Material Balance-with chemical reaction: Material balance for the systems involving chemical reaction - Limiting and excess reactants - recycle - bypass and purging

MODULE - III **15**

Energy Balance: Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction.

Fuels and Combustion: Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Bhatt, B.L and Vora, S.M., "Stoichiometry", Tata McGraw-Hill, New Delhi, 2004.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", Sixth Edition, Prentice Hall India, New Delhi, 2003

REFERENCE BOOKS

1. Venkataramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall of India, New Delhi, 2003.
2. O.A. Hougen, K. M. Watson, and R. A. Ragatz, "Chemical Process Principles. Part I. Material and Energy Balances", 2nd Edition, John Wiley & Sons, New York, 1956.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1: Apply and manipulate different systems of Units and dimensions, determine compositions of mixtures and understand the applications of real gas equations of state.

CO2: Analyse different unit operations with help of material/energy balances and evaluate yield, conversion, recycle ratio /purge /bypass of chemical reactors.

CO3: Analyze flue gas composition and determine theoretical air / excess air requirement.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	J	k	l	m
CO1	3		2	1	3			1	1			3	
CO2	3				3			1				3	
CO3	3		2		3				1			3	

1 – Slight, 2 – Moderate, 3 – Substantial

11CH305 PHYSICAL CHEMISTRY LABORATORY

0 0 3 1

LIST OF EXPERIMENTS*

1. Molecular weight determination by Rast' s Method.
2. Determination of Transition temperature
3. Determination of partition co-efficient.
4. Association factor of benzoic acid.
5. Critical Solution Temperature: Phenol water system.
6. Simple Eutectic system.
7. Acid catalyzed hydrolysis of an ester.
8. Kinetics of persulphate- iodide reaction.
9. Conductometric titrations.
10. Freundlich Adsorption isotherm.
11. Dissociation constant of a weak acid.
12. Polarimetry-inversion of cane sugar.
13. Determination of relative viscosity of liquid.

*Minimum 10 Experiments shall be offered.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Perform experiments to determine molecular weight, transition temperature, partition coefficient and association factor for different organic compounds and systems

CO2: Perform experiments to determine CST, eutectic points of different organic compounds and conduct simple experiments on kinetics to evaluate the rate of reactions

CO3: Perform simple experiments in conductometry and adsorption to determine the strength of acids and bases and validate the Freundlich isotherms

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2		1			1			3	1	1
CO2	2	3			1			1		1	3		1
CO3	2	3	2							1	3	1	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME307 MECHANICAL ENGINEERING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Preparing valve timing diagram for Diesel engine.
2. Preparing port timing diagram for petrol engine.
3. Performing load test & emission test on single cylinder diesel engine using electrical / mechanical loading arrangement.
4. Performing Heat Balance test on single cylinder diesel engine using electrical /mechanical loading arrangement.
5. Performing Morse test on multi cylinder petrol engine.
6. Performing load test & emission test on single cylinder petrol engine using eddy current dynamometer.
7. Performing characteristics study (Flash point & Fire point) on lubricating oil.
8. Performing test on a single acting multi cylinder reciprocating air compressor.
9. Performance study on vapor compression refrigeration system.
10. Performance study on air conditioning system.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Test the liquid fuel properties

CO2: Examine the performance and plot heat balance sheet for internal combustion engines

CO3: Carry out performance test on air compressors, refrigeration and air conditioning system

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3		2	1	2	2					
CO2	3	3	3		2	1	2	2					
CO3	3	3	3		2	1	2	2					

3 – Substantial, 2 – Moderate, 1 – Slight

11EE304 ELECTRICAL MACHINES LABORATORY

(Common to Mechatronics, Chemical and EIE branches)

0 0 3 1

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of separately excited and self excited DC generator.
2. Load test on DC shunt motor.
3. Load test on DC series motor.
4. Swinburne's test.
5. Speed control of DC shunt motor.
6. Load test on single phase transformer.
7. Open circuit and short circuit test on single phase transformer.
8. Regulation of three phase alternator by EMF and MMF methods.
9. Load test on three phase induction motor.
10. Load test on single phase induction motor.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Experiment with different electrical machines and transformers

CO2: Analyze the performance of the Electrical machines

CO3: Apply the different speed control methods for DC motor

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	3			3					2	1			
CO2	3			3					2	1			
CO3	3			3					2	1			

3 – Substantial, 2 – Moderate, 1 – Slight

11MA401 NUMERICAL METHODS

(Common to all Engineering and Technology branches except ECE & CSE)

3 1 0 4

MODULE – I **15**

Linear Algebraic Equations: Method of false position - Newton's method - Solution of linear system of equations by Gaussian elimination and Gauss - Jordan methods – Iterative methods: Gauss Jacobi and Gauss – Seidel methods.

Interpolation: Newton's forward and backward difference formulae – Bessel's formula - Lagrange's interpolation formula - Newton's divided difference formula.

MODULE – II **15**

Numerical Differentiation: Differentiation Using Newton's forward , backward and divided difference interpolation formula - Single step Methods - Taylor Series, Euler and Modified Euler methods - Fourth order Runge-Kutta method for solving first order equations - Multistep methods – Milne's and Adam's predictor and corrector methods.

Numerical Integration: Trapezoidal rule – Simpson's 1/3 – Double integrals using Trapezoidal and Simpson's rules.

MODULE - III **15**

Boundary Value Problems in PDE: Finite difference approximations to partial derivatives - Two dimensional Laplace equations - Poisson equations – One dimensional heat equation by implicit and explicit methods – One dimensional wave equation.

Lecturer: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy, P., Thilakavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand & Co, New Delhi, reprint 2010.
2. Venkatraman, M. K, "Numerical Methods", National Publishing Company, Chennai, 2000.

REFERENCE BOOKS

1. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill, New Delhi, 1999.
2. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., "Numerical Methods for Scientific and Engineering Computation", Fourth Edition, New Age International (P) Ltd., New Delhi, 2006.
3. Sankara Rao, K., "Numerical Methods for Scientists and Engineers", Second Edition, Prentice Hall India, New Delhi, 2004.
4. Thangaraj, P, "Computer – Oriented Numerical Methods", Prentice Hall of India, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Discuss the various methods of solving linear algebraic and transcendental equations.

CO2: Estimate the intermediate values using interpolation concepts.

CO3: Interpret the knowledge of numerical differentiations and integration

CO4: Apply various numerical techniques in solving complex partial differential equations.

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3	3										1	
CO3	3	3		1	2							1	
CO4	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH401 ORGANIC CHEMISTRY

3 0 0 3

MODULE – I **15**

Carbohydrates: Introduction - Mono and Disaccharides - Important reactions - Polysaccharides -Starch and Cellulose - Derivatives of Cellulose - Carboxyl Methyl Cellulose and gun cotton - Structural aspects & industrial uses of starch & cellulose.

Amino Acids: Classification and properties of Amino acids - composition and classification of proteins - Tests for proteins - Amino acids in Proteins - estimation of General properties and reactions of proteins - Hydrolysis of proteins - polypeptides

MODULE - II **15**

Organic Reactions: Mechanism of following Organic Reactions:Electrophilic reaction- Friedel craft reaction-Riemer Timenn Reaction-Beckmann rearrangements Nucleophilic reactions- Aldol condensation-Perkins reaction-Benzion condensation Free radical reaction- Halogenations of Alkanes-Addition HBR on Alkenes in presence of peroxide Alylic halogenations- Using N-Bromo succinamide (NBS)-Thermal halogenations of Alkene (CH3 - CH = CH-).

Synthesis: (i).Azo dyes - Congo red.(ii) Triphenylmethane dyes -Malachite green, Para Rosaniline.(iii) Anthraquinone dyes -Alizarin.(iv)Phthalein dyes-Eosin.

MODULE - III **15**

Heterocyclic Compounds: Five membered ring systems :Nomenclature, preparation properties and uses of (1) Furan-derivatives: furfural, Tetrahydrofuran (2) Thiophene (3) Pyrrole, (4) Indole – derivatives: Isatin ,Dioxyindole

Six membered ring systems: Nomenclature, preparation properties and uses of (1) Pyridine- derivatives: piperidine, (2) Quinoline and (3) Iso quinoline.

TOTAL : 45

TEXT BOOKS

1 Bahl, B.S. and Arun Bhal, "Advanced Organic Chemistry", Third Edition, S.Chand & Company, New Delhi, 2005.

2 Tiwari, K.S., and Vishnoi, N.K. "A Textbook of Organic Chemistry", Third Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2007.

REFERENCE BOOKS

1 Morrison. R.T. and Boyd. R.N., **"**A Textbook of Organic Chemistry", Sixth Edition, Prentice Hall of India, New Delhi, 1996.

2 Paula Y Bruice, "Organic Chemistry", Fifth Edition, Prentice Hall of India, New Delhi, 2007.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1: Understand the classification and composition of carbohydrates and amino acids.

CO2: Gain Good knowledge about dyes and organic reactions that help them to develop new types of resins and products.

CO3: Understand about Nomenclature, preparation properties and uses of heterocyclic compounds

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	2		1		1							1	
CO2	2										1		
CO3	2		1		1				2		1	1	

1 – Slight, 2 – Moderate, 3 – Substantial

11CH402 PROCESS HEAT TRANSFER

3 1 0 4

MODULE - I **15**

Conduction: Concept of heat conduction - Fourier's law of heat conduction - thermal conductivity, one dimensional steady state heat conduction equation for flat plate, hollow cylinder, and hollow sphere - Heat conduction through a series of resistances - Thermal conductivity measurement- effect of temperature on thermal conductivity.

Film Coefficients and Their Application: Individual and overall heat transfer coefficients and the relationship between them – extended surface heat transfer - Transient heat conduction.

MODULE - II **15**

Convection: Concept of heat transfer by convection - Natural and forced convection –Application of dimensional analysis for convection - Equations for forced convection under laminar and turbulent conditions - Equations for natural convection.

Radiation: Concept of thermal radiations - Black body concept - Radiation Properties. Stefan Boltzmann law, emissivity and absorptivity. -Concept of grey body – radiation between surfaces.

MODULE - III **15**

Heat Exchangers: Parallel and counter flow heat exchangers -. LMTD - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Fouling factors and Wilson's plot.

Evaporators: Types of evaporation - single effect and multiple effect evaporation.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. McCabe, W.L. and Smith, J.C., "Unit Operations in Chemical Engineering", McGraw-Hill, 7th Edition, 2005.
2. Dutta, Binay K. "Heat Transfer Principles and Applications", Prentice Hall of India, New Delhi, 2001

REFERENCE BOOKS

1. Yunus A.Cengel., "Heat Transfer:A practical approach",McGraw-Hill,2nd Edition,2003.
2. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill - Revised Edition -.1999

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1: Apply heat transfer concepts to different process equipment and determine the optimum/critical thickness of insulation of steam pipes; estimate wall temperature of furnaces and calculate the efficiency of fins.

CO2: Evaluate film coefficients and understand the fundamental concepts of radiations.

CO3: Understand the applications of heat transfer equipments and determine the efficiency and effectiveness of heat exchangers, evaporators and condensers.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		1	3	3							3	
CO2	3		1	3	3							3	
CO3	3		2	3	3							3	

1 – Slight, 2 – Moderate, 3 – Substantial

11CH403 INSTRUMENTAL METHODS OF ANALYSIS

3 0 0 3

MODULE – I **15**

Electromagnetic Radiation: Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance, & transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, classification of instrumental methods based on physical properties.

Thermal Methods: Thermogravimetry: Instrumentation, factors affecting shapes of thermo grams, and applications. Thermogram of important compounds ($CaSO_4.5H_2O$; $CaC_2O_4.2H_2O$) Differential Thermal Analysis: Principle, instrumentation and applications. Differences between DSC & DTA. Application of DSC (Inorganic & Polymer samples). TGA - Principle, instrumentation and applications.

MODULE - II **15**

Molecular Spectroscopy : Various electronic transitions in organic and inorganic compounds effected by UV, visible and infra red radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations, Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds) Effects of auxochromes and effects of conjugation on the absorption maxima

Instrumentation and applications: Instrumentation for UV, VISIBLE and IR spectroscopies (source, Optical parts and Detectors), Multicomponent analysis, Photometric titration (Experimental set-up and various types of titrations), Applications of UV, VISIBLE and IR spectroscopies.

MODULE - III **15**

AAS, NMR Spectroscopy: Atomic Absorption Spectrophotometry: Principle instrumentation and applications. Nuclear Magnetic Resonance: Introduction to NMR, principle and instrumentation (Proton NMR only). Relaxation, Chemical shift and its causes, reference compounds.

Chromatographic Methods: Classification of chromatographic methods; Column, Thin layer, Paper, Gas, High Performance Liquid Chromatography (principle, mode of separation and technique). Separation of organic compounds by Column and Thin Layer. Mixture of Cu, Co and Ni by Paper. Separation of amino acids by Paper. Estimation of organic compounds by GC and HPLC.

TOTAL : 45

TEXT BOOKS

1. Willard. H.H., Merritt. I., Dean. J.A. and Settle. F.A., "Instrumental Methods of Analysis", Seventh edition, CBS publishers, New Delhi, 1986.
2. Parikh V.M, "Absorption Spectroscopy of Organic Molecules", Addison –Wesley Publishing company, New York, 1994.

REFERENCE BOOKS

1. Ewing, Galen W., "Instrumental Methods of Chemical Analysis", Seventh Edition, McGraw-Hill Company, New Delhi, 1985.
2. Skoog D.A. and West D.M., "Fundamentals of Analytical Chemistry", Seventh Edition, Saunders College Publishing, New York, 1996.
3. Banwell. G. C., "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill, New Delhi, 2006.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1 Understand the working principle and applications of various instruments based on electromagnetic radiation and thermal methods.

CO2 Understand well about spectroscopic methods of testing and its applications to identify structures of organic and inorganic compounds.

CO3 Apply spectroscopic and chromatographic techniques for the analysis of chemical compounds.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2		1	3			1			3	2	
CO2	2	2		1	3			1			3	2	
CO3	2	2		1	3			1			3	2	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH404 MECHANICAL OPERATIONS

3 0 0 3

MODULE – I **15**

Particle Characteristics and Size Analysis: General characteristics of solids, their behaviour under different external forces, agglomeration, techniques for size analysis.

Size Reduction: Laws of size reduction, classification of equipment, methods of size reduction, disintegration, preparation of colloids.

MODULE - II **15**

Mechanical Separations: Screening and Screening equipment, effectiveness of screens, gravity settling, sedimentation, thickening, centrifugal separation, impingement methods, industrial dust removing equipment with special reference to electrostatic and magnetic separators, heavy media separations, floatation.

Filtration: Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration.

MODULE - III **15**

Mixing and Agitation: Equipment for blending and kneading, dispersion, power for agitation, correlations.

Storage and Conveying of Solids: Conveyors, Elevators, Pneumatic conveying, Different methods for storage of solids.

TOTAL : 45

TEXT BOOKS

1. McCabe, W.L. Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering", Seventh Edition, McGraw-Hill International Edition, New York, 2006.
2. Alan S Foust, "Principles of Unit Operations", Second Edition, Wiley International Edition, 1960.

REFERENCE BOOKS

1. Coulson, J.M., and Richardson, J.F., "Chemical Engineering", Volume 2, Fifth Edition, J.M. Butterworth Heinemann, 2002.
2. Badger, Walter L. and Banchero, Julius T., "Introduction to Chemical Engineering", Tata McGraw Hill Publishers, New Delhi, 1997.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1	Apply the principles of size analysis and size reduction techniques of solids by selecting proper equipments such as crushers, grinders, etc.,
CO2	Understand the working principles of thickeners, gravity settling tanks, cyclone separators, Filters and other mechanical separation devices
CO3	Select mixing and agitation equipments, storage and transportation equipments used for handling solids in Chemical process industries.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3	1								3	1
CO2	3		3	1								3	2
CO3	3		3	1								3	2

1 – Slight, 2 – Moderate, 3 – Substantial

11CH405 CHEMICAL ENGINEERING THERMODYNAMICS – I

3 0 0 3

MODULE – I **15**

Basic Concepts of Thermodynamics: Fundamental concepts of thermodynamics – categorization of systems and processes, properties, energy classifications, point and path functions, energy in transition, heat and work, reversible and irreversible processes, phase rule , Zeroth law.

First Law of Thermodynamics: statement, first law for flow and non flow process, internal energy, enthalpy and heat capacities.

MODULE - II **15**

Second Law of Thermodynamics: Second Law of thermodynamics - Kelvin Plank and Clausius Statements, Carnot cycle and theorem – thermodynamic temperature scale. Entropy – Clausius theorem, Clausius inequality, Entropy changes in various processes. Available and unavailable energies.

Properties of Real Gases: The PVT behaviour of fluids, laws of corresponding states and equation of states. Approaches to the PVT relationships of non ideal gas, compressibility factors, generalized equations of state, property estimation via generalized equation of state.

MODULE – III **15**

Thermodynamic Formulations : Measurable quantities, basic energy relations, Maxwell relations, thermodynamic formulations to calculate enthalpy, internal energy and entropy as function of pressure and temperature, other formulations involving C_p and C_v.

Compression, Expansion of Fluids: Thermodynamic aspects and classification of compression process, equation for change of state of gases, work done calculation for different situations, factors affecting compressor performance, multistage compression, convergent divergent flow in nozzles, Ejectors.

TOTAL : 45

TEXT BOOKS

1. Smith, J M., Van Ness H C and Abbot, M M., "Introduction to Chemical Engineering Thermodynamics", 7th Edition, McGraw-Hill, , 2005.
2. Narayanan K.V, "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India pvt ltd, New Delhi, 2007.

REFERENCE BOOKS

1. Kyle, B.G., "Chemical and Process Thermodynamics", Second Edition, Prentice Hall of India, New Delhi, 1990.
2. Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles", Part - II: Thermodynamics", John Wiley & Sons, New York, 1970.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1: Understand the fundamental concepts of thermodynamics

CO2: Apply second law and analyze the feasibility of systems/devices; understand the real gas behavior

CO3: Understand thermodynamic formulations and the working of compressors and expanders

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	3				2							3	
CO2	3				3			3				3	
CO3	3				3							3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH406 FLUID MECHANICS LABORATORY FOR CHEMICAL ENGINEERS

0 0 3 1

LIST OF EXPERIMENTS*

1. Calibration of variable head flow meters
2. Calibration of variable area flow meters
3. Calibration of notches and weirs
4. Flow through straight pipe
5. Flow through valves and pipe fittings
6. Flow through concentric pipes
7. Pressure drop studies in packed column
8. Flow through fluidized bed
9. Open drum orifice
10. Flow through helical coil
11. Characteristics of centrifugal pump/Reciprocating pump
12. Viscosity measurement of non-Newtonian fluids
13. Flow of air through orifice meter

*Minimum 10 experiments shall be offered

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Use variable area flow meters and variable head flow meters

CO2: Analyze the flow of fluids through closed conduits, open channels and flow past immersed bodies

CO3: Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties

Mapping of COs with POs

COs/POs	a	B	C	d	e	f	g	h	i	j	k	l	m
CO1	3	3	1									3	3
CO2	3	3	1	2							1	3	3
CO3	3	3	1	2							1	3	3

3 – Substantial, 2 – Moderate, 1 – Slight

11CH407 TECHNICAL ANALYSIS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS*

1. Oil Analysis:
   a) Acid value
   b) Iodine value
2. Oil Analysis: Saponification Value
3. Soap Analysis:
   a) Alkali Content
   b) Fatty acid content of Soap
4. Analysis of water: COD and Turbidity.
5. Analysis of water: Chlorides and Hardness
6. Cement Analysis : Estimation of silica content and Moisture
7. Cement Analysis : Estimation of calcium oxide content and mixed oxide
8. Fertilizer Analysis: Estimation of Nitrogen in Urea by Kjeldahls method
9. Analysis of Ores
10. Analysis of Sugar
11. Analysis of Milk
12. Estimation of Ions in Given Solution using UV-Visible Spectrophotometer
13. Determination of Sodium and Potassium Ions present in water using Flame photometer

* Minimum 10 experiments shall be offered.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Analyse experimentally the various properties of oils and soaps

CO2: Analyse and evaluate various properties of water, cement and fertilizer

CO3: Analyse and evaluate various properties of sugar and milk

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2		1			1		1	3	1	1
CO2	2	3	2		1			1		1	3	1	1
CO3	2	3	2		1			1		1	3	1	1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH408 ORGANIC CHEMISTRY LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1. Criteria of purity of Solid and Liquid compounds determination of Melting point, Boiling point density, Refractive Index
2. Identification of organic compounds (Aliphatic or aromatic saturated / unsaturated Compounds
3. Characteristic reaction of functional groups in nitro compounds amino compounds and amides.
4. Identification of unknown organic compounds – Aldehydes
5. Identification of unknown organic compounds – Ketones
6. Identification of unknown organic compounds –Phenols
7. Identification of unknown organic compounds – Acids
8. Identification of unknown organic compounds – Esters
9. Identification of unknown organic compounds – Amines
10. Identification of unknown organic compounds – Alcohol
11. Organic preparation of benzoic acid from benzaldehyde.
12. Organic preparation of benzoic acid from acetanilide.
13. Organic preparation of dinitro Benzene from Nitrobenzene

* Minimum 10 experiments shall be offered.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: conduct simple experiments to identify the nature(aliphatic/aromatic), (Saturated/Unsaturated) of organic compounds

CO2: conduct simple experiments to identify the functional groups

CO3: prepare organic compounds like benzaldehyde, acetanilide and nitrobenzene

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3		3		1				2			
CO2	2	3		3		1				2			
CO3	2	3		3		1				2			
3 – Substantial, 2 – Moderate, 1 – Slight													

11MA502 PROBABILITY, STATISTICS AND LINEAR PROGRAMMING

3 1 0 4

MODULE – I **15**

Discrete distributions: Moment Generating Function – Properties - Binomial distribution - Poisson distribution Geometric distribution.

Continuous Distributions: Uniform distribution – Exponential distribution - Gamma distribution - Normal distribution and its properties .

MODULE – II **15**

Testing of Hypothesis: Small and large samples – Tests concerning single mean- Comparing means – Test for independence - Test for equality of variances- goodness of fit.

Design of Experiments: Analysis of variance- One way classification – Completely Randomized Design - Two way classification – Randomized Block Design – Latin Square Design.

MODULE – III **15**

Linear Programming Problem: Introduction– Basic Assumptions – Mathematical Formulation of Linear Programming Problem –Graphical Solution – Simplex Method to solve canonical form of Linear Programming Problem – Duality.

Transportation Model: Initial Basic Feasible Solution by Northwest Corner Rule, Least Cost Method, Vogel's Approximation method and optimal solution by MODI method – Assignment Model.

Lecture 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Ninth Edition Sultan Chand & Sons, New Delhi, 2011.
2. Taha H.A., "Operations Research - An Introduction", Seventh Edition, Pearson Edition, Asia, New Delhi, Reprint 2008.

REFERENCE BOOKS

1. Kandasamy P., Thilagavathi K. and Gunavathi K., "Probability Statistics and Queuing Theory", S. Chand & Co., New Delhi, 2010.
2. Veerarajan T., "Probability, Statistics and Random Processes", Tata McGraw-Hill, New Delhi, 2010.
3. Kanti Swarup, P K Gupta, and Man Mohan " Operations Research**",** Sultan Chand & Co,Reprint 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand different types of distributions and their uses

CO2: Apply the various methods of testing of hypothesis, analysis of variance and randomized block design and its applications in engineering

CO3: Design models and optimize their solution by using linear programming models

Mapping of COs with POs

COs/POs	a	B	c	d	e	f	g	h	i	j	k	l	m
CO1	2		2	1	3				1		1	1	
CO2	2		2	1	3				1		1	1	
CO3	2		2	1	3				1		2	1	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH501 MASS TRANSFER – I

3 0 0 3

MODULE – I **15**

Introduction to mass transfer operations and Diffusion: Molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions Diffusivity measurement and prediction, multicomponent diffusion, diffusion in solids and its applications.

Mass Transfer Coefficients and Theories of Mass Transfer & Analogies: Concept, local mass transfer co-efficient, mass transfer in laminar and turbulent flow. Film, Penetration, Surface renewal, combined film-surface renewal surface-stretch theories. Analogies: Reynolds, Chilton- Colburn and Taylor – Prandtl analogy.

MODULE – II **15**

Interphase Mass Transfer: Interphase phase mass transfer, individual mass transfer coefficients, over all mass transfer coefficients in binary and multicomponent systems. Relationship between individual and overall mass transfer co-efficient.Co-current and counter-current operations, Equilibrium and operating line concept. Operating characteristics of stage wise and differential contactors. Concepts of NTU, HTU.

Humidification: Basic concepts and terminologies, Adiabatic saturation process and theory of wet bulb temperature, psychrometric chart construction. Humidification and dehumidification operations. Cooling towers: Principle and design, types of equipment.

MODULE – III **15**

Drying: Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, various drying equipments and their applications.

Crystallization: Principles of crystallization, super saturation, theory of homogeneous and heterogeneous nucleation, law of crystal growth and growth coefficients. Calculations involving material and energy balances. Methods of crystallization based on supersaturation and industrial equipment. Introduction to population balance(Qualitative)

TOTAL : 45

TEXT BOOKS

1. Treybal, Robert E., "Mass Transfer Operations", Third Edition, McGraw-Hill Book Company, 1980.
2. McCabe, W.L., Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering", Seventh Edition, McGraw-Hill International Edition, New York, 2006.

REFERENCE BOOKS

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Volume-I, Pergamon Press, 1977.
2. Anantharaman N. and Meera Sheriffa Begum K.M., "Mass Transfer: Theory and Practice", Prentice-Hall of India, New Delhi, 2011.
3. Dutta, "Principles of Mass Transfer and Separation Processes", Prentice-Hall of India, New Delhi, 2007.
4. Alan S Foust, "Principles of Unit Operations", Second Edition, Wiley International Edition, 1960.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand diffusional operations and theories of mass transfer

CO2: Understand the concept of interphase mass transfer and gas- liquid mass transfer operations like humidification

CO3: Apply the knowledge gained in mass transfer to perform simple calculations in drying and crystallization

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	1			2			1			3	3	
CO2	3	2	2		2			1			3	3	2
CO3	3	2	2		2			1			3	3	2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH502 CHEMICAL REACTION ENGINEERING -I

3 1 0 4

MODULE – I **15**

Kinetics of Homogeneous reactions: Chemical Kinetics, Classification of chemical reaction, Rate equation, Rate constant, Reaction Mechanism, Order of the reaction, Kinetic models for non-elementary reaction, Testing kinetic model. Temperature dependent term of a rate equation: Arrhenius law, collision theory and transition theory and comparison of theories.

Analysis of Batch Reactor Data: Analysis of experimental reactor data, Integral and differential method, constant volume batch rector, varying volume batch reactor, Integral method analysis of rate data, Integral rate equation for different order reactions: constant and variable volume systems, Temperature and reaction rate

MODULE – II **15**

Ideal Reaction for a Single Reactor: Ideal reactors: Batch, Semi-batch, Steady state plug flow reactor, Steady state mixed flow reactor mass and Energy balances.

Design for Single Reactions: Size comparison of Single reactors, multiple reactor system, Recycle rector, Autocatalytic reactions

MODULE – III **15**

Design of Multiple Reactions: Reactions in Parallel, Reactions in Series, Yield and Selectivity, Qualitative treatment: Plug flow, Batch and Mixed flow reactor, Product distribution.

Temperature and Pressure Effects: Equilibrium conversion, Adiabatic operations, Non-adiabatic operations, Product distribution and Temperature.

Lecture:45,Tutorial:15,TOTAL:60

TEXT BOOKS

1. Levenspiel. O, "Chemical Reaction Engineering", Fourth Edition, Wiley India (P) Ltd, New Delhi, 2009
2. H. Scott Fogler., "Essentials of Chemical Reaction Engineering" First Edition, Prentice Hall, 2010.

REFERENCE BOOKS

1. Smith, J. M., "Chemical Engineering Kinetics", Third Edition, McGraw-Hill, New York,1981
2. Gavhane, A.K.., "Chemical Reaction Engineering –I" First Edition, Nirali Publications, Pune, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the principles of reaction kinetics, formulate rate equations and analyse the batch reactor data.

CO2: Analyze the experimental kinetic data to select a suitable reactor for a particular application and to workout conversion and space time for different types of reactors.

CO3: Evaluate selectivity, reactivity and yield for parallel and mixed reactions. Work out equilibrium constants and access the effect of physical variable on equilibrium.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3				3							3	
CO2	3				3							3	
CO3	3				3							3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH503 PROCESS DYNAMICS AND CONTROL

3 1 0 4

MODULE – I **15**

Open loop Control Systems: Review of Laplace transforms principles. Open loop systems-first order systems and their transient response for standard input functions.

First Order Systems in Series: linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

MODULE - II **15**

Controllers and Final Control Elements: Transfer function for controllers and final control element, Principles of pneumatic and electronic controllers, transportation lag, transient response of closed- loop control systems and their stability.

Closed Loop Control Systems: development of block diagram for feed-back control systems, servo and regulatory problems.

MODULE- III **15**

Frequency response techniques: Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Root Locus, Nyquist diagram.

Controller Tuning and Advance Control Systems: Tuning of controller settings – Ziegler Nichols and Cohen coon methods. Controller mechanism, Introduction to advanced control systems- cascade control, split-range control, feed forward control, ratio control

Lecture:45,Tutorial:15,TOTAL:60

TEXT BOOKS

1. Stephanopoulos. S.G "Chemical Process Control: An introduction to Theory and Practice", Prentice Hall of India, New Delhi, 2001.
2. Coughanowr. Donald R., "Process Systems Analysis and Control", Tata McGraw Hill, New Delhi, 1991.

REFERENCE BOOKS

1. Nagoor Kani. A., "Control Systems", RBA Publications, Chennai, 2002.
2. Patranabis. D., "Principles of Process Control", Tata McGraw-Hill, New Delhi, 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the prerequisites of control strategies and design different process control systems

CO2: Evaluate the suitable controllers for different chemical process.

CO3: Analyse and tune the control systems unto stability

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1				3						2	3	1
CO2	2				3						2	3	1
CO3	2				3						2	3	1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH504 CHEMICAL PROCESS PLANT SAFETY

3 0 0 3

MODULE – I **15**

Introduction to safety and ventilation design: Industrial safety principles. Site selection and plant layout. Legal Aspects. Design for ventilation.

Emergency response systems and codes for safety: Emergency response systems for hazardous goods basic rules and requirements which govern the chemical industries. Safety codes: NFPA & IS standards**.**

MODULE – II **15**

Hazards: Chemical hazards classification. Hazards due to fire, explosion and radiation. Reduction of process hazards by plant condition monitoring, Materials Safety Data sheets and National Fire protection agency's classifications

Diseases: Dangerous occupational diseases, poisoning, dust effect. The biomedical and engineering response to health hazards

MODULE – III **15**

Control of Hazards: Engineering control of plants instrumentation. Colour codes for pipe lines. Safety aspects of reactive chemicals.

Operation and Process Hazards: Safety in operations and processes. Runaway reactions, unstable products.

TOTAL : 45

TEXT BOOKS

1. Fawcett H. H. and Wood W. S., "Safety and Accident Prevention in Chemical Operation", Second Edition, Interscience, 1982.
2. "Loss Prevention and Safety Promotion in Chemical Process Industries", Vol. III, Published by Institution of Chemical Engineers U.K., 1983.

REFERENCE BOOKS

1. Yoshida T., "Safety of Reactive Chemicals", Vol. I, Elsevier, 1987.
2. Willium H. , "Industrial Safety Handbook", Second Edition, McGraw Hill, 1968.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Demonstrate the awareness of plant safety in selection and layout of chemical plants and the usage of safety codes.

CO2: Exhibit the skill in classifying chemical, fire, explosion hazards and to understand the occupational diseases

CO3: Analyze the bio medical and engineering response to health hazards and to implement the effective process control and instrumentation.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1		1		1	2		2	3	3	2		
CO2	2		1		1			2	3	3	2		
CO3	2		1		1			2	3	3	2		

3 – Substantial, 2 – Moderate, 1 – Slight

11CH505 CHEMICAL ENGINEERING THERMODYNAMICS - II

3 1 0 4

MODULE – I **15**

Properties of Pure fluids: Chemical potential. Fugacity – Fugacity coefficient - Effect of temperature and pressure on fugacity – Determination of fugacity. Activity – Effect of temperature and pressure on activity.

Properties of solutions: Partial molar properties, Fugacity coefficients in solutions. Henry's Law and dilute solutions. Activity in solutions. Activity coefficient and Gibbs Duhem equation. Heat effects of mixing. Excess properties of mixtures.

MODULE - II **15**

Phase Equilibria: Phase equilibrium and stability. equilibrium between phases in single/ multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope, composition, liquid-liquid equilibrium.

Activity coefficient models: Activity coefficient-composition based models, thermodynamic consistency of phase equilibria and application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation.

MODULE - III **15**

Chemical Reaction Equilibria: Criteria of Chemical reaction equilibrium standard state, standard free energy change and reaction equilibrium constant, effect of temperature and pressure on reaction equilibrium constant, factors affecting equilibrium conversion, prediction of free energy data, calculation of equilibrium compositions for homogeneous chemical reaction.

Refrigeration: Principles of refrigeration, methods of producing refrigeration, co-efficient of performance, choice of refrigerant, evaluation of the performance of various refrigeration cycles.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Narayanan K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India pvt ltd, New Delhi, 2007.
2. Smith, J M., Van Ness H C and Abbot, M M., "Introduction to Chemical Engineering Thermodynamics", McGraw-Hill, 7th Edition, 2005.

REFERENCE BOOKS

1. Rao, Y.V.C., "Chemical Engineering Thermodynamics", University Press (India) Ltd, Hyderabad (A.P), India, 1997.
2. Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles- Part II: Thermodynamics", John Wiley & Sons, New York, 1970.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand and evaluate thermal properties of pure fluids and solutions

CO2: Evaluate and analyse phase equilibrium data

CO3: Analyze chemical reaction rates and evaluate the performance of refrigeration cycles

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3				3						2	2	
CO2	3	3			3						2	1	
CO3	3				3			3			1	3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH506 MECHANICAL OPERATIONS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS*

01. Determination of the crushing law constants using Jaw crusher
02. Determination of the Reduction ratio using Crushing Rolls
03. Determination of the critical speed of Ball Mill
04. Determination of the average particle size using Size analysis and finding the Effectiveness of screen.
05. Determination of the particle size distribution and the average particle size using Beaker decantation
06. Determination of the specific cake resistance and Filter medium resistance using Filter press
07. Determination of the specific cake resistance and Filter medium resistance using Leaf filter
08. Determination of the separation efficiency of Cyclone separator
09. Carrying out the Batch sedimentation test and to design a thickener
10. Determination of the specific surface area of the given powder using Air Elutriator
11. Determination of the specific cake resistance and Filter medium resistance using Rotary Drum Filter
12. Determination of the mixing index using Liquid Mixing apparatus.
13. Determination of the specific cake resistance and Filter medium resistance using Basket Centrifuge
14. Determination of the specific cake resistance and Filter medium resistance using Froth flotation apparatus.

* Any ten experiments shall be offered.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Determine work index, average particle size through experiments by crushers, ball mill and conducting sieve analysis.

CO2: Design size separation equipments such as cyclone separator, sedimentation, Filters etc.

CO3: Determine specific surface area through air permeability apparatus

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3										3	1
CO2	2	3		2							1	3	2
CO3	2	3		2							1	3	2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH507 PROCESS HEAT TRANSFER LABORATORY

0 0 3 1

LIST OF EXPERIMENTS*

01. Estimation of individual and overall heat transfer coefficient for heat transfer in Packed Column
02. Determination of Stefan Boltzmann constant using Stefan Boltzmann Experiment
03. Estimation of unsteady state temperature values using Transient Heat Conduction experiment- Constant Flux and Constant Temperature
04. Estimation of individual heat transfer coefficient under forced convection heat transfer
05. Estimation of individual heat transfer coefficient under natural convection heat transfer
06. Studies on radiation heat transfer
07. Estimation of individual and overall heat transfer coefficient for heat transfer in Shell and Tube heat exchanger
08. Estimation of individual and overall heat transfer coefficient for heat transfer in Double pipe heat exchanger
09. Estimation of individual heat transfer coefficient and fin efficiency for heat transfer through extended surface.
10. Estimation of steam economy and efficiency of an evaporator
11. Heat transfer studies in Pool boiling
12. Estimation of individual heat transfer coefficient for heat transfer through horizontal and vertical Condenser
13. Estimation of individual and overall heat transfer coefficient for heat transfer in jacketed vessel
14. Estimation of thermal conductivity of a material

* Minimum 10 experiments shall be offered

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Determine thermal conductivity, Stefan Boltzmann constants through experiments.

CO2: Determine Heat transfer co-efficient and evaluate performance of different types of equipments including heat exchangers, horizontal / vertical condensers.

CO3: Determine heat transfer co-efficient and steam economy of evaporators.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2	2										3
CO2	2	3	2	2							1		3
CO3	2	3	2	2							1		3

3 – Substantial, 2 – Moderate, 1 – Slight

11EL501 LANGUAGE SKILLS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1.Language development through reading
Reading comprehension, Current affairs, Vocabulary building, Idioms and phrases,
Basic phonetics.

2.Speaking practice
Dialogue / Conversation, Type of conversations, Public Speaking, Debate,

3.Listening skills
Short Dialogues, TV News / Programmes, Speeches.

4.Telephone etiquette

5.Self Assessment
Identifying strength and weakness.

6.Personality development
Body Language, Non Verbal Skills, Leadership qualities, Emotional Quotient,
Effective Time Management, Surviving Stress, Overcoming failure.

7.Verbal communication
Social Exchange, Planned Speech, Extempore, Basics of attending and organizing meetings,
Informal Discussions.

Communication Software Package:

a. **Speaking Skills**
b. **Interview Skills**
c. **Meetings / Time Management**

- From Globarena Software

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Use English language effectively to communicate in real life and career related situations

CO2: Speak effectively, express opinions and ideas and argue using proper communicative strategies

CO3: Familiarize using modern communications to enhance listening, software and presentation skills

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1							3		2				
CO2							3		1				
CO3							3		1				

3 – Substantial, 2 – Moderate, 1 – Slight

11GE601 ECONOMICS AND MANAGEMENT FOR ENGINEERS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Economics – Basics Concepts and Principles – Demand and Supply – Law of demand – Determinants of demand, Law of supply – market Equilibrium – National Income – Circular Flow of Economic activities and Income –National Income and its measurement techniques – Inflation – Causes of Inflation – Controlling Inflation –Business Cycle .

MODULE – II **15**

Forms of business – Management Functions: Planning, Organizing, Staffing, Leading and Controlling- Managerial Skills - Levels of Management - Roles of manager.

Marketing – Core Concepts of Marketing, Four P's of Marketing, New product development, Product Life Cycle, Pricing Strategies and Decisions. Operations Management – Resources – Site selection, Plant Layout, Steps in Production Planning and Control – EOQ Determination

MODULE – III **15**

Accounting Principles – Financial Statements and its uses – Time value of Money – Depreciation methods — Break Even Analysis – Capital budgeting techniques – Introduction to FDI, FII, Mergers & Acquisition.

TOTAL : 45

TEXT BOOKS

1. Geetika, Plyali Ghosh, Purba Roy Choudhury, "Managerial Economics", 1st Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Jeff Madura, "Fundamentals of Business", Cengage Learning Inc, India, 2007.

REFERENCE BOOKS

1. Stanley L. Brue and Campbell R Mcconnell, "Essentials of Economics", Tata McGraw-Hill, New Delhi, 2007.
2. S.P.Jain, K.L.Narang, Simi Agrawal, "Accounting for Management", First Edition, Tata McGraw-Hill, New Delhi, 2009

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: estimate market equilibrium and interpret national income calculation and inflation issues

CO2: categorize the forms of business and analyse the functions of management

CO3: appraise marketing and operations management decisions

CO4: interpret financial and accounting statements

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1	1	2			3		2	2	2	3	2	
CO2		1	2			2	2	2	2	2	3	2	
CO3	1	2	1			2		2	2	2	3	2	
CO4	2	2				2		2	2	2	3	2	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH601 MASS TRANSFER – II

3 1 0 4

MODULE – I **15**

Absorption: Choice of solvent, Co-current and counter-current operations, Kresmer Equation for plate tower, overall volumetric mass transfer coefficients; Equipment for gas absorption: Mechanically agitated vessels, Packed column and plate columns.

Distillation: Vapour-liquid equilibria, Raoult's law and deviations from ideality. Methods of distillation: Batch distillation-calculations using Rayleigh equation, Flash vaporization, Continuous fractionation- Fenske equation; fractionation of binary system.

MODULE - II **15**

Fractionation Analysis and other Methods of Distillation: Design calculations by McCabe-Thiele and Ponchon-Savarit methods; continuous contact distillation tower (packed tower) design. Steam distillation, Principles of extractive and azeotropic distillation, low pressure distillation. Introduction of multicomponent distillation (Qualitative).

Adsorption: Characteristics and choice of adsorbents. Theories of adsorption of gases and liquids. Adsorption isotherms & breakthrough curve. Single and multiple cross current and counter current operation. Adsorption equipment for batch and continuous operation. Industrial applications.

MODULE - III **15**

Liquid Extraction: Equilibrium in ternary systems; Solvent selection criteria; Single stage operation, Multistage operation for partially miscible and immiscible systems. Extraction equipment - spray, packed and mechanically agitated contactors. Pulsed extractors, centrifugal extractors.

Leaching: Solid-liquid equilibria; calculations in single stage, multi stage crossflow and counter current leaching. Leaching equipment-batch and continuous.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Treybal, Robert E., "Mass Transfer Operations", Third Edition, McGraw-Hill Book Company, 1980.
2. McCabe, W.L. Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering", Seventh Edition, McGraw-Hill International Edition, New York, 2006.

REFERENCE BOOKS

1. Wankat, Philip.C., "Equilibrium Staged Operations", Prentice Hall of India, 1988.
2. Walas, Stanley M., "Chemical Process Equipment Selection and Design", Butterworth -Heinemann, Boston, 1990.
3. Coulson, J.M., and Richardson, J.F., "Chemical Engineering", Volume 1, Fifth Edition, J.M. Butterworth Heinemann, 2002.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand absorption and distillation operations and select methods of separation of mixtures based on mass transfer concepts

CO2: Design a distillation tower and to perform calculations in adsorption operation

CO3: Apply the ternary equilibrium diagram concepts to determine the number of stages required for separation of liquid-liquid and solid -liquid mixtures

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	1		2			1			3	3	2
CO2	3	2	2	1	2			1			3	3	2
CO3	3	2	1		2						3	3	2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH602 CHEMICAL REACTION ENGINEERING –II

3 1 0 4

MODULE – I **15**

Non-ideal flow: The residence time distribution as a factor performance; residence time functions and relationship between them in reactor.

Models for non-ideal flow: basic models for non-ideal flow; conversion in non-ideal reactors. Single and multi parameter model. Introduction to population balance.

MODULE - II **15**

Solid Catalysts and Rate Equation for Fluid-Solid Catalytic Reaction: Nature of catalysis, surface area and pore-volume distribution, catalyst preparation and characterization.

Adsorption isotherm: Adsorption isotherm and rates of adsorption desorption and surface reaction analysis of rate equation and rate controlling steps.

MODULE - III **15**

Diffusion and Reaction in Porous Catalysts: Diffusion within catalyst particle, effective thermal conductivity, mass and heat transfer within catalyst pellets; effectiveness factor, Thiele Modulus. Fixed, fluidized bed reactors**.**

Fluid-Solid non Catalytic Reactions: Models for explaining the kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidized and static reactors.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Smith, J. M., "Chemical Engineering Kinetics", Third Edition, McGraw-Hill, New York, 1981.
2. Levenspiel. O, "Chemical Reaction Engineering", Second Edition, John Wiley & Sons, New York, 1972.

REFERENCE BOOK

1. Fogler, H S., "Elements of Chemical Reaction Engineering", Fourth Edition, Prentice Hall of India, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Evaluate the performance of non-ideal reactors by "F" and" C" curves and to understand the models of non-ideal flow and calculate conversion.

CO2: Understand catalysis and preparation and characterization, Apply adsorption isotherms for analysis of development of rate equations and rate controlling steps.

CO3: Understand the mechanism of pore diffusion in catalyst to calculate effectiveness factors and to demonstrate the application of volume and surface models and to calculate conversion in non ideal flow reactor.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3				3							3	
CO2	3				3							3	
CO3	3				3							3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH603 CHEMICAL EQUIPMENT DESIGN –I

2 0 3 3

MODULE - I **15**

Design codes and systems :Introduction- Nature of Design- Codes and Standards- Design factor- Systems and units.
Design of Machine Elements: Basic design and drawing considerations of bolts, nuts welded joints, flanges and pipe fittings

MODULE - II **15**

Importance of Process Diagrams in Process Design: Introduction- Flow sheet presentation- Process simulation programs- Need for PFD & PID- Block diagram- Utility flow diagrams- Piping and Instrumentation Diagrams
Process Design of Piping and Fluid moving Devices: Introduction- Process Design of piping- Line sizing (single/two phase)- Process design of Fluid moving devices- Pumps (NPSH, Differential head, power, Drive)- Compressors

MODULE - III **15**

Heat Transfer Equipment: Introduction- Basic design procedure and theory- Overall HT Co-efficient- Fouling factors- Shell and Tube heat exchangers and Double pipe heat exchangers : Construction details- Mean temperature difference.
Design considerations: Tube side HT co-efficient and Pressure drop- Shell side HT co-efficient and Pressure drop- Condensers- Reboilers and evaporator

TOTAL : 45

TEXT BOOKS

1. Towler C Gavin and Sinnott Ray., "Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design", Elsevier, 2008.
2. Thakore, S.B and Bhatt, B I., "Introduction to Process Engineering and Design", Second reprint, Tata McGraw-Hill Publishing Company Limited, 2009.

REFERENCE BOOKS

1. Sinnot, R.K., "Chemical Equipment Design: Chemical Engineering Volume - 6, Elsevier-Butterworth, 2005.
2. Joshi, M.V and Mahajan V.V., "Process Equipment Design" Third Edition,Macmillan India Limited,1996.
   Perry's "Chemical Engineers' Handbook", Seventh Edition, McGraw-Hill Publications, 2004.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand different codes, standards, design factors and system of units used in design process and design of machine elements

CO2: understand the importance of process diagrams, design of piping and design of fluid moving devices like compressors and pumps

CO3: apply the skill in thermal design of heat transfer equipment like shell and tube, double pipe heat exchangers, evaporators, condensers and re-boilers and assessing thermal efficiency of the above equipment in practice

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		1										2
CO2	3		2		2							3	1
CO3	3		2		3							3	1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH604 PROCESS MODELLING AND SIMULATION

(Common to Chemical and EIE branches)

3 1 0 4

MODULE – I **15**

Introduction to Modelling: Physical Modelling, Mathematical Modelling, Chemical Systems Modelling - Principles of Formulation - Fundamental Laws used in Modelling, Representation of Model, Model Building, Types of Modelling Equations.

Mathematical Modelling: Classification based on – Independent and Dependent Variables and Parameters - Variation of Independent Variables - State of the Process - Types of the Process, Boundary Condition, Black Box Principles.

MODULE - II **15**

Modelling of Chemical Systems-I: Process Description and Mathematical Model Aspects of: Flow Through a Pipe, Cone Shaped Tank, Stirred Tank Heater, Two Stirred Tank Heater, Double Pipe Heat Exchanger, Triple Effect Evaporator, Flash Drum.

Modelling of Chemical Systems-II: Process Description and Mathematical Model Aspects of: Batch Reactor, CSTR and CSTR with Heat Removal, CSTR in series, Tubular Reactor, Compartmental and Ideal Binary Distillation Model.

MODULE - III **15**

Process Simulation: Introduction, Scope of process simulation, Formulation of problem, Simulation approach for steady state process – Modular Approaches to Process Simulation, Equation Solving Approach.

Process Simulator: Introduction, Structure of Process Simulator, Professional Simulation Packages: ASPEN and HYSYS - Selection of Proper Equation of State/Fluid packages - Available Unit Operation Models.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Babu B.V, "Process Plant Simulation", Oxford University Press, New Delhi, 2004.
2. Luyben W.L, "Process Modelling, Simulation and Control for Chemical Engineers", Second Edition, McGraw Hill Book Co., New York, 1990.

REFERENCE BOOKS

1. Gaikwad R.W and Dhirendra, "Process Modeling and Simulation", Second Edition, Denett & Co., Nagpur, 2006.
2. Amiya K. Jana, "Chemical Process Modelling and Computer Simulation", Prentice Hall of India, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the fundamentals of modelling and their applications to transport/energy equations, chemical and phase equilibria kinetics etc.

CO2: Create the mathematical models of stirred tank heaters, Heat exchangers, Evaporators, Reactors and distillation columns.

CO3: Analyze the simulation principles of steady state processes like gravity tank, CSTR in series and other process operations by utilizing software tools like ASPEN PLUS, HYSYS and can select proper equation of state for estimating component properties and process flow sheeting.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2				3				2			3	
CO2	2	2			3				2			3	
CO3	2	2			3				2		2	3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH605 MASS TRANSFER LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1. Determination of the activity coefficients & Van Laar constant for the given system by performing VLE experiments
2. Determination of the diffusivity of the given liquid to air
3. Conduction of batch drying test and estimation of the mass transfer coefficient and psychometric ratio
4. Determination of vaporization efficiency (E_v) and Thermal efficiency (E_t) of the given system using steam distillation apparatus
5. Conduction of liquid liquid extraction studies and plot binodal curve for the given ternary system / Conduction of Liquid-liquid extraction studies in Rotating Disc Contactor
6. Estimation of Height Equivalent to a Theoretical Plate and find out % recovery of the overhead and bottom products of given system under total reflux conditions
7. Studying the concept of Surface Evaporation and finding the constants of Himus Equation
8. Verifying adsorption isotherms by Batch Adsorption tests
9. Conduction of drying experiments using Vacuum Dryer
10. Estimation of Mass transfer co-efficient using Wetted wall column
11. Conduction of Simple /Co-current /Counter – current Leaching studies
12. Verifying the Raleigh's equation for the given system using simple distillation setup.
13. Mass transfer studies in Membrane Separations

* Any ten experiments shall be offered.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Determine diffusivity, mass transfer rate and mass transfer co-efficient of given system using fundamental principles.

CO2: Generate VLE data and evaluate the performance/ calculate the parameters in different distillation processes

CO3: Generate LLE data and evaluate the performance/ calculate the parameters in Leaching and drying operation

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2	1	1						3	2	1
CO2	2	3	2	1	2						3	2	2
CO3	2	3	2	1	2						3	2	2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH606 PROCESS DYNAMICS AND CONTROL LABORATORY

0 0 3 1

LIST OF EXPERIMENTS*

1. ON-OFF control of thermal, level, pressure and flow process
2. Servo problem with PI controller on thermal process
3. Performance comparison of P, PI, and PID controllers on flow control loop
4. Effect of P, PI, and PID controller on level process
5. Behavioral evaluation of P, PI and PID Controllers on pressure Control Loop
6. Estimation of optimum controller settings
7. Verifying the flow coefficient and inherent and installed characteristics of various control valves
8. Studying the response of Interacting and non-interacting level Systems
9. Simulation study on the characteristic behaviors of higher order systems and their servo and regulatory problems using MATLAB
10. Optimum controller tuning on level process station
11. Finding time constant of a dynamic CSTR
12. Dynamic characteristics of thermometer and manometer
13. Effect of feed forward / feed backward control loop in level system
14. Ratio control loop in pressure system
15. Monitoring of Level/Flow/Pressure using DCS(Demonstration)

* Any ten experiments shall be offered.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Demonstrating skill in the application of P, PI, PID controllers to temperature, level, pressure and flow control loops.

CO2: Physical familiarization with controllers' servo/regulatory responses, and tank systems in series.

CO3: Determine the characteristics of different control valves and the ability to apply the first and second order systems in practice, Simulation of PID controller using MAT LAB.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2	3	2						2	3	3
CO2	2	3	2	3	2						2	3	3
CO3	2	3	2	3	2						2	3	3

3 – Substantial, 2 – Moderate, 1 – Slight

11GE701 TOTAL QUALITY MANAGEMENT

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Quality Systems: Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs, Basic concepts of Total Quality Management, Historical Review. Need for ISO 9000 and Other Quality Systems, ISO 9000:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, Introduction to TS 16949, QS 9000, ISO 14000, ISO 18000, ISO 20000, ISO 22000.

MODULE – II **15**

TQM Principles: Principles of TQM, Leadership – Concepts, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation. Customer satisfaction – Customer Perception of Quality, Customer Complaints, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts.

MODULE – III **15**

TQM Tools: The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools, Poka Yoke. Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

TOTAL :45

TEXT BOOKS

1. Besterfield, Dale H. et al., "Total Quality Management", Third Edition, Pearson Education, 2008
2. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2007.

REFERENCE BOOKS

1. Feigenbaum. A.V, "Total Quality Management", Tata McGraw Hill, New Delhi, 1999.
2. Suganthi, L and Samuel A Anand., "Total Quality Management", PHI Learning, New Delhi.
3. Evans James R. and Lindsay William M., "The Management and Control of Quality", Seventh Edition, South-Western (Thomson Learning), 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: illustrate the evolution and basic concepts of TQM

CO2: interpret various ISO standards and their implementation procedures

CO3: apply the principles of TQM and its elements in real time scenario

CO4: adapt quality tools and techniques to implement TQM at the work place

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1						2	2	3	2	2	2	2	
CO2						3	3	3	3	2	2	2	
CO3					2	3	2	3	3	3	2	2	
CO4	3	2	2	2	2	1		2	2	2	3	3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH701 CHEMICAL PROCESS INDUSTRIES

3 0 0 3

MODULE – I **15**

Introduction: The role of a Chemical Engineers in process industries, importance of block diagrams and flow charts, unit operations, unit processes, process utilities and economics.

Inorganic Chemical Industries: Sodium chloride, Soda ash, Sodium bicarbonate, Chlorine and Caustic soda; Bleaching powders, Hydrochloric acid, Sulfuric acid, Phosphoric acid, Ammonia and Nitric acid industries

MODULE - II **15**

Fertilizer Industries: Growth elements and its functions. Manufacture of ammonium sulphate, ammonium nitrate, urea, single and triple super phosphate, ammonium phosphate, potassium chloride, potassium nitrate and phosphate. Compound fertilizers and bio-fertilizers.

Agrichemical Industries: Insecticides, pesticides, herbicides, plant nutrients and regulators

MODULE - III **15**

Starch, oil and detergent Industries: Wood Chemicals. Manufacture of pulp and paper. Raw and refined sugar. Starch, Cellulose and their derivatives.Oil, fats and their extraction methods. Hydrogenation of oils. Soaps and detergents.

Petroleum and its Derived Industries: Petroleum refining. Physical and chemical conversion products. Methane, olefins and aromatics. Different types of Polymerization processes and manufacture of Nylon 6 and 6, 6., ABS. Viscose Rayon production. Manufacture of films - cellulose Acetate, PVC, Polyesters. Natural rubber and Synthetic rubbers such as SBR, NBR, CR.

TOTAL : 45

TEXT BOOKS

1. Austin, G.T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984.
2. Dryden, C.E., "Outlines of Chemical Technology for 21st Century", Edited and Revised by Gopala Rao. M. and M.Sittig, Third edition, Affiliated East-West press, Reprint 2009.

REFERENCE BOOKS

1. Mark, W.V. and Bhatia, S.C. "Chemical Process Industries", Volume - I and II, Second Edition, CBS Publishers and Distributors, New Delhi, 2007.
2. Kent, J.A.(ed), "Riggel's Hand Book of Industrial Chemistry", Van Nostrant Reinhold, 1974.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the role of Chemical Engineers in process industries and manufacture of various acids and bases.

CO2: Understand manufacturing processes and applications of agrichemicals and fertilizers.

CO3: Understand the manufacturing processes of starch, cellulose, oils, fats, soaps and detergents, petroleum products, natural and synthetic rubbers.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3			1	3	1		2	1	2	3	1	1
CO2	2			1	3	1		2	1	2	3	1	1
CO3	3			1	3	1		2	1	2	3	1	1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH702 TRANSPORT PHENOMENA

3 1 0 4

MODULE – I **15**

Philosophy and Fundamentals of Transport Phenomena: Importance of Transport Phenomena; Analogous nature of transfer process; Basic concepts, Conservation laws; Continuous concept, field, reference frames, substantial derivative and boundary conditions; Methods of analysis-differential, integral and experimental methods. Phenomenological laws of transport properties- Newtonian and Non-Newtonian fluids; Rheological models; Theories of transport properties of gases and liquids; Effect of pressure and temperature.

One Dimensional Transport in Laminar Flow: General method of shell balance approach to transfer problems; Most common boundary conditions. Momentum flux and velocity distribution for flow of Newtonian and Non-Newtonian fluids in pipes, planes, slits and annulus. Heat flux and temperature distribution for heat sources such as electrical, nuclear, viscous and chemical; forced and free convection. Mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

MODULE - II **15**

Equations of Change and their Applications: Conservation laws and equations of change; Development of equations of continuity, motion and energy in single and multi component systems in rectangular co-ordinates and the forms in curvilinear co-ordinates; simplified forms of equations for special cases, solutions of momentum, mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up

MODULE - III **15**

Transport in Turbulent and Boundary Layer Flow: Turbulent phenomena; phenomenological relations for transfer fluxes; Time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics; thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface.

Lecture:45,Tutotial:15,TOTAL : 60

TEXT BOOKS

1. Bird R.B., Stewart W.E. and Lighfoot E.W., "Transport Phenomena", Second Edition, John Wiley, 2002.
2. Brodkey, Robert S. and Hershey, Harry C., "Transport Phenomena", McGraw-Hill International Edition, 1988.

REFERENCE BOOKS

1. Sissom, L. S and Pitts, D.R., "Elements of Transport Phenomena", McGraw-Hill, New York, 1972.
2. Fahien, R.W., "Elementary Transport Phenomena", McGraw-Hill, New York, 1983.
3. Welty J.R., Wilson R.W. and Wicks C.W., "Fundamentals of Momentum Heat and Mass Transfer", Second Edition, John Wiley, New York, 1973.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the principles of momentum, heat and mass transport by developing mathematical models to determine respective fluxes and velocity, temperature and concentration distribution for flow channels, heat sources and systems involving diffusion and reactions.

CO2: Apply the equation of change and scale factors for different coordinate systems and solve of momentum, mass and heat transport problems.

CO3: Analyze the analogy between the transports and understand the turbulence and boundary layer concept in heat and mass transport.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3				3				2			3	
CO2	3	2			3				2			3	
CO3	3	2			3				2			3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH703 CHEMICAL EQUPIMENT DESIGN -II

2 0 3 3

MODULE - I **15**

Mechanical Design of Process Equipment: Introduction- Storage and Pressure vessel codes and standards- Fundamental principles and equations

Process vessel design: General design considerations of pressure vessels- Design of thin walled vessels under internal pressure/external pressure/combined loading- vessel supports types- Pressure relief devices.

MODULE - II **15**

Equipment Selection, Specification and Design: Introduction- Separation processes- Liquid-Solid separators- Liquid/Liquid separation- Gas/Solid separation- Gas/Liquid separators.

Separation Columns: Introduction- Continuous distillation- Design variables in distillation- Design methods for binary systems- Column sizing- Plate hydraulic design- Absorption column.

MODULE - III **15**

Design of driers: Batch and Rotary drier - Introduction to fluid bed dryer.

Design of extractors and cyclone separators: Basic design and drawing of extraction equipment, Basic design and drawing of cyclone separator.

TOTAL : 45

TEXT BOOKS

1. Ludwig. E.E "Applied Process Design for Chemical and Petrochemical Plant", Volume. I, II, & III, Gulf publications, 2001.
2. Joshi, M.V and Mahajan V.V., "Process Equipment Design" Third Edition, Macmillan India Limited, 1996.

REFERENCE BOOKS

1. Kister H.Z "Distillation Design", McGraw Hill Publications, 2001.
2. Perry's "Chemical Engineers Handbook", Seventh Edition, Mc-Graw Hill Publications, 2004
3. Wales, S.M "Chemical Process Equipment: Selection and Design", Elsevier- Butterworth publication, 1990.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the skills in mechanical design of process equipment, design considerations of pressure vessels and pressure relief devices

CO2: apply the concepts involved in phase separation and design of distillation and absorption columns

CO3: demonstrate the skills in basic design and drawing of different dryers, extraction equipments and cyclone separators

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		2		2						1		1
CO2	3		2		3						2		1
CO3	3		2		3						2		1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH704 MATERIAL TECHNOLOGY FOR PROCESS INDUSTRIES

(Common to Chemical Engineering and Food Technology branches)

3 0 0 3

MODULE – I **15**

Nature of Materials and Processing of Metals and Alloys: Micro and macro structures, properties and definitions: mechanical, thermal, chemical, electrical and magnetic properties. Casting- hot and cold rolling- extrusion- forging- deep drawing- plastic deformation of metal, single crystal and poly crystalline metals- recovery and recrystallization of plastically deformed metals.

Ferrous Metals: Pure iron, cast iron, mild steel, special steels and alloys, high temperature steels, iron carbide phase diagram, heat treatment of plain carbon steels-Manufacture, properties and application in chemical industries.

MODULE - II **15**

Polymeric Materials: Polymerization reactions-Industrial polymerization methods-Crystallinity and stero-isomerism in thermoplastics – thermosetting elastomers- creep and fracture of polymeric materials.

Composite and Ceramic Materials: Fiber-reinforced plastic composite materials- manufacturing methods-asphalt and asphalt mixtures- wood-sandwich structures. Ceramic crystal and silicate structures, Properties-glasses, porcelain, enamels and their application to chemical process industries.

MODULE - III **15**

Corrosion and Protective Coatings: Definitions and scope, basic theories and mechanism of corrosion, types of corrosion, application of corrosion, theories in equipment design and fabrication- anti-corrosion methods. Organic paints and coatings, metal coatings, linings

Material Selection: General criteria for selection of materials of construction for process industries.

Stainless steel, Alloys of Nickel, Copper, Chromium, Tin, Zinc, Magnesium, Aluminium, Lead and their application to different chemical process equipment and industries.

TOTAL : 45

TEXT BOOKS

1. Khanna O. P., "A text book of Material Science and Metallurgy", Second Edition, Dhanpat Rai Publications, New Delhi, 1998.
2. Hajra Choudhury, S K and Hajra Choudhury, A K., "Materials Science and Processes", Media Promotors & Publishers, Bombay, 1995.

REFERENCE BOOKS

1. Carl. A and Keyser.C.E. "Material Science in Engineering", McGraw-Hill, 1968.
2. Clauster Henry R., "Industrial and Engineering Materials", McGraw-Hill, 1975.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand how the different methods of processing of metals and alloys like casting, rolling, extrusion, forging etc.,

CO2: Understand engineering plastics, composites and ceramic materials and their application to Chemical process industries.

CO3: Understand different mechanisms of corrosions and its control and enable selection of material for different applications in chemical industries.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3			3									1
CO2	3			3								2	2
CO3	3			3									2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH705 PROCESS SIMULATION LABORATORY

1 0 3 2

LIST OF EXPERIMENTS /EXERCISES*

1. Analysis of physical properties and generation of T-x-y and P-x-y diagram for different systems
2. Estimation of physical property for a non data bank component
3. Calculation of bubble point and dew point temperature/pressure
4. Simulation of mixer and flash separator
5. Simulation of heat exchanger
6. Simulation of distillation column
7. Simulation of batch and flow reactors
8. Simulation and analysis of absorption/extraction column
9. Sensitivity analysis and optimization of parameters
10. Simulation and analysis of simple flow sheets problems
11. Design of shell and tube heat exchanger
12. Design of plate and frame exchanger
13. Design of air cooler
14. Simulation of drying of solids

* Any 10 of the above experiments shall be offered

REFERENCES / MANUALS/SOFTWARE:

1. Aspen Plus Software, Aspen Technology Inc., Burlington, USA, 2008

.2. HTRI Software, Heat Transfer Research Inc., Texas, USA, 2011.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Analyse and estimate the physical properties of data bank and non-data bank components; calculate bubble and dew points and generate T-x-y and P-x-y diagram by simulating flash drum using ASPEN PLUS Process simulator

CO2: Create and analyse the simulation of heat exchangers, distillation column, absorbers and simple flow sheets

CO3: Understand the thermal design of heat exchangers using HTRI software and can analyse and evaluate the results to get the best design

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	3		3				2		3	3	
CO2	1	3	3		3				2		3	3	
CO3	2	3	3		3				2		3	3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH706 CHEMICAL REACTION ENGINEERING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS *

1. Kinetic Studies in a batch reactor
2. Kinetic Studies in a plug flow reactor
3. Kinetic studies in a mixed flow reactor
4. Kinetic Studies in a PFR followed by CSTR
5. Kinetic studies in an adiabatic reactor
6. Determination of conversion in semi batch reactor
7. Determination of effect of temperature on reaction rate constant
8. RTD studies in a plug flow Reactor
9. RTD studies in a mixed flow Reactor
10. RTD Studies in CSTR in Series

10.RTD studies in a packed bed reactor

11.RTD studies in a fluidized bed reactor

12. BET method

* Any ten experiments shall be offered.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand rate equation for different types of reactors.

CO2: Design experiments in kinetics to determine conversion and effect of temperature on rate constant.

CO3: Assess the performance of Plug flow Mixed flow, Packed bed and fluidized bed reactors by studying the residence time distribution.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1	3			1						2		
CO2	2	3			2						2		
CO3	2	3			1						1		

3 – Substantial, 2 – Moderate, 1 – Slight

11GE801 PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Introduction to Human Values and Engineering Ethics: Understanding: Morals- Values-Ethics– Honesty – Integrity – Work Ethic – Service Learning – Civic Virtue –caring – Sharing– Courage – Valuing Time – Co-operation – Commitment – Empathy –Self-Confidence – Character – Spirituality- Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –customs and religion- uses of ethical theories.

MODULE - II **15**

Safety, Responsibilities and Rights: Meaning of Engineering experimentation - engineers as responsible experimenters - codes of ethics for engineers - a balanced outlook on law - the challenger case study. Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights – discrimination- Intellectual Property Rights (IPR)

MODULE - III **15**

Global Ethical Issues and Codes : Multinational corporations - Environmental ethics - computer ethics – weapons development-engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers(IETE),India. etc.

TOTAL: 45

TEXT BOOKS

1. Martin Mike and Schinzinger Roland., “Ethics in Engineering”, Tata McGraw-Hill, New Delhi,2003.
2. Govindarajan M, Natarajan S, and Senthil Kumar V. S., “Engineering Ethics”, Prentice HallofIndia, NewDelhi, 2004.

REFERENCE BOOKS

1. Fleddermann, Charles D., “Engineering Ethics”, Pearson Education/Prentice Hall, New Jersey, 2004.
2. Harris, Charles E., Protchard, Michael S. and Rabins,Michael J., “Engineering Ethics: Concepts and Cases”, Wadsworth Thompson Learning, United States, 2000.
3. Seebauer Edmund G and Barry Robert L., “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: examine the various aspects of human values

CO2: develop as responsible experimenters particularly with reference to safety

CO3: apply appropriate code of ethics to evaluate the probable consequences of actions

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1						3		3		2		3	
CO2	1	2	2	2		2	2	3	3	2		3	
CO3				1		2	1	3	3			3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH801 ENERGY TECHNOLOGY

3 0 0 3

MODULE - I **15**

Conventional Energy Sources: Coal-types-Exploration –Conversion technologies, oil-Transportation-refining, natural gas, nuclear energy-Nuclear fission-nuclear reactor power plant.

Biomass energy-Resources-conversion; depletion of energy resources; co-generation; need for conservation; uncertainties; national and international issues.

MODULE - II **15**

Non-conventional Energy Sources: Hydro electricity-Resources, Hydro-Electric power plant-classification, wind energy-wind turbine, solar energy-solar thermal collectors, Solar pond.

Geothermal energy-Origin-Resources-Geothermal power plant, fuel cells- types, ocean wave power-Resources, ocean thermal energy-open cycle-closed cycle, tidal power-Conversion-power plant.

MODULE - III **15**

Energy management: Introduction to energy monitoring, targeting and waste avoidance; need for energy recovery; energy recovery in recuperative and regenerative heat exchangers

Introduction to energy audit; energy forecasting and planning; optimization of heat exchanger train; input – output analysis.

TOTAL: 45

TEXT BOOKS

1. Twidell, John and Weir, Tony., "Renewable Energy Sources", Second Edition, Taylor & Francis, New York, 2006.
2. Fay, James A. and Golomb, Dan S., "Energy and the Environment", Oxford University Press, Inc., New York, 2002.

REFERENCE BOOK

1. Beggs, Clive., "Energy: Management Supply and Conservation", Butterworth-Heinemann, Oxford, 2002.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the importance of conserving energy and understand the sources and use of different renewable energy

CO2: Understand Non conventional Energy sources and develop design parameters for equipment to be used in Chemical process industries

CO3: Understand energy audit in process industries and know the optimization of heat exchangers and conduct input output analysis

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1						3		3	2			3	
CO2						3		3				3	2
CO3				1		3		3				3	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH011 OIL AND NATURAL GAS ENGINEERING

3 0 0 3

MODULE – I **15**

Production of Petroleum: Origin, Exploration and production of petroleum, Availability vs Demands, Future outlook.
Crudes- types and characterization : Types of crudes, Composition, characteristics, products pattern and characteristics, indigenous and imported crudes

MODULE – II **15**

Production of Natural Gas: Availability of natural gas, Properties and composition, Exploration and control of gas output
Application, storage and transport of Natural Gas : Natural gas application in Chemical Process and transportation industry LNG technology, Natural gas storage and transport

MODULE – III **15**

Correlations for fluid flow: General Hydrodynamic equations for flow of fluids through porous media, two dimensional flow problems and potential theory methods, gravity flow systems.
Multiphase flow correlations : Use of multiphase flow correlations to determine flow ratio and pressure traverse in flowing oil wells, gas condensate wells, PVT properties for oil gas systems

TOTAL: 45

TEXT BOOKS

1. Katz Donald L. and Lee Robert L., "Natural Gas Engineering", Mc Graw – Hill Publishing Company, NY, 1990.
2. Lyons William C., "Standard Handbook of Oil and Natural Gas Engineering", Gulf Professional Publishing – an imprint of Butterworth - Heinmann, Vol. 1 & 2, 1996.

REFERENCE BOOKS

1. Nelson, W.L "Petroleum Refinery Engineering" McGraw Hill Publishing Company Limited, 1985.
2. Econonides M.J. and Daniel A. "Petroleum Production Systems", Prentice Hall Petroleum Engineering series, 1999.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the origin, exploration, composition, characteristics and production of crude petroleum and to work out the future outlook of indigenous and imported crude based and the availability and demand pattern.

CO2: Understand the availability, properties and composition and to gain knowledge in the applications of natural g as in Chemical process and transport industry.

CO3: Understand and evaluate the flow properties and to study the correlation of multiphase flow in the oil and gas reserves

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3					2	3	2	3		
CO2	3		3	2	2				3	2	3	2	
CO3	3	2	3					2	3		3	2	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH012 POLYMER SCIENCE AND ENGINEERING

3 0 0 3

MODULE - I **15**

Introduction to Polymerization: Monomer; functionality and degree of polymerizations; polymers and their classification; Types of polymerization and mechanisms: addition; condensation and copolymerization.

Methods of Polymerizations: bulk, solution, emulsion and suspension polymerizations; Structure of polymers: linear, branched and cross linked; Characterization of polymers: molecular weight, crystallinity, glass transition and mechanical properties

MODULE - II **15**

Polymer Stability and Plastics: Introduction; Types: Thermal; Mechanical; Ultrasonic waves; Photodegradation, High energy radiation, Oxidative and hydrolytic; Anti-oxidants and stabilizers;

Thermally stable polymers: Introduction to plastics: polymer additives; fillers, plasticizers; colorants. Moulding methods: Injection; compression transfer and Blow moulding, Processing techniques: Calendaring; casting; extrusion; thermoforming; foaming.

MODULE - III **15**

Characterization Techniques: Chemical analysis of polymer; X-ray diffraction, Microscopic technique: Light scattering, SEM; Spectroscopic methods: IR, NMR. Thermal analysis: DSC, DTA and TGA

Preparation, Properties and Industrial uses of Polymers: polyethylene; poly propylene; polystyrene, polymethylmethacrylate; polyvinyl chloride; polytetrafluoroethylene; polyacrylate; nylon 6, nylon 6,6 and polyesters; Phenol formaldehyde, urea formaldehyde, and melamine formaldehyde; epoxy; urethanes and silicones, ion exchange polymers.

TOTAL : 45

TEXT BOOKS

1. Gowarikar, V.R., Viswanathan, N.V. and Jayadev Sreedhar., "Polymer Science", New Age International (p) Limited, India, Ninth reprint, 1996.
2. Rodriguez.F., Cohen, C., Ober, C, Archer, L.A., "Principles of Polymer Systems" Taylor and Francis, Great Britain, London, Fifth Edition, 2003.

REFERENCE BOOKS

1. Williams, D. J.; "Polymer Science and Engineering", Prentice Hall, New York, 1971.
2. Arora, M.G., and Singh, M., "Polymer Chemistry", Anmol Publications (p) Limited, India, Reprint 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the mechanism and effectiveness of polymerization in designing reactor systems.

CO2: Understand the knowledge of polymer stability for developing new formulations, products and elementary moulding methods

CO3: Acquire knowledge on different analytical instruments for characterization of polymer for applications in R & D work; understand the manufacture and properties of industrial polymers.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2		2	1	2		1			1	2		3
CO2	2		2	1	2		1			1			3
CO3	2		2	1	2		1				2		3

3 – Substantial, 2 – Moderate, 1 – Slight

11CH013 PROCESS OPTIMIZATION

3 0 0 3

MODULE – I **15**

Developing Models for Optimization: Scope and hierarchy of optimization, Essential features of Optimization problems, Classification of Models, Building a model, Factorial experimental designs, Degree of freedom

Basic Concepts: Formation of objective function, continuity of functions, NLP problem statement, convexity and applications, Interpretation of objective function based on its Quadratic approximation

MODULE - II **15**

Optimization of Unconstrained functions: Methods for one dimensional search, Newton's method and Quasi – Newton methods for uni dimensional search. Polynomial approximation methods

Unconstrained Multivariable Optimization: Methods using function value only, methods using first derivative, Newton's method, Quasi – Newton methods. .

MODULE - III **15**

Linear Programming: Simplex method, Barrier method, sensitivity analysis, Linear mixed integer programs, Examples

Nonlinear Programming with Constrains: Direct substitution, Quadratic programming, Penalty, Barrier and Augmented Lagrangian Methods. Optimization of Chemical Processes: Case studies and examples

TOTAL : 45

TEXT BOOKS

1. Edgar, T.F., Himmelblau, D.M., and Ladson, L.S., "Optimization of Chemical Practice", Second Edition, McGraw Hill International, New York, 2003.
2. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall India, New Delhi, 2005.

REFERENCE BOOKS

1. Joshi, M.C., and Kannan M. Moudgalya, "Optimization, Theory and Practice", Narsoa Publication, New Delhi, 2004.
2. Urmila M. Diwaker, "Introduction to Applied optimization", Kluwer Academic Publication, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Design experiments and formulate models of chemical processes/equipment

CO2: Understand different search methods and linear programming methods for solution of chemical process problems like optimization of process variables to get maximum yield/conversion, product mix pattern product distribution etc

CO3: Understand the non-linear programming methods for application in R & D work.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2							1		3	2	
CO2	3	2		2	2				1			3	
CO3	3		2								3	3	2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH014 COMPUTATIONAL FLUID DYNAMICS IN CHEMICAL ENGINEERING

3 0 0 3

MODULE – I **15**

Introduction to CFD: Conservation laws of fluid motion and boundary conditions: governing equations of fluid flow and heat transfer, equations of state, Navier-Stokes equations for Newtonian fluid, conservative form of governing equations of flow, differential and integral forms of general transport equations, classification of physical behaviour, the role of characteristics in hyperbolic equations.

Classification method for simple partial differential equations, classification of fluid flow equations auxiliary conditions for viscous fluid flow equations; Turbulence and its modelling: transition from laminar to turbulent flow, effect of turbulence on time-averaged Navier-Stokes equations, characteristics of simple turbulent flows, turbulence models.

MODULE – II **15**

Introduction to methods of discretisation; Finite volume method for diffusion problems: finite volume method for one-dimensional, two-dimensional and three-dimensional steady state diffusion; Finite volume method for convective-diffusion problems: steady one-dimensional convection and diffusion, the central differencing scheme.

Properties of discretisation schemes, assessment of the central differencing scheme for convection-diffusion problems, the upwind differencing scheme, the hybrid differencing scheme, the power-law scheme, higher order differencing schemes for convection-diffusion problems.

MODULE – III **15**

Solution algorithms for pressure-velocity coupling in steady flows: staged grid, momentum equations, SIMPLE algorithm, assembly of a complete method, SIMPLER, SIMPLEC, and PISO algorithms; Solution of discretised equations: tri-diagonal matrix algorithm, application TDMA to two-dimensional and three-dimensional problems.

Finite volume method for unsteady flows: one-dimensional unsteady heat conduction, implicit method for two-and three-dimensional problems, discretisation of transient convection-diffusion equation, transient convection-diffusion using QUICK differencing, solution procedures for unsteady flow calculations, steady state calculations using pseudo-transient approach.

TOTAL : 45

TEXT BOOKS

1. Versteeg H.K. and Malalasekara W., "An Introduction to Computational Fluid Dynamics:The Finit Volume Method", Addsion Wesley Longman Limited, 1996.
2. Anderson John D., "Computational Fluid Dynamics- The Basics with Applications", McGraw-Hill, Inc., 1995.

REFERENCE BOOK

1. Muralidhar K. and Sundarajan T., "Computational Fluid Flow and Heat Transfer", Second Edition, Narosa Publishing House, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand C.F.D techniques in developing fluid flow models.

CO2: Apply finite volume method for solution of steady state diffusion and convection diffusion problems.

CO3: Demonstrate the application of SIMPLER, SIMPLEC and PISO algorithms for solution of industrial and R & D problems; solve unsteady flow heat conduction and convection diffusion processes.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	1	1	2	3						1	1	
CO2	3		2		3						1	2	
CO3	1	2	3	1	3						3	2	1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH015 MODERN SEPARATION PROCESSES

3 0 0 3

MODULE – I **15**

Separation Process Fundamentals: Role of separation processes in industry. Concept of separating agents and separation factor. Characteristics of Separation process. Mechanism of separation. Selection of feasible separation processes.

Filtration Processes: Process concept, Theory and equipment used in cross flow filtration, cross flow electrofiltration, dual functional filter and Sirofloc filter

MODULE - II **15**

Membrane Separation Processes: Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fiber membrane reactors and their relative merits. Process concept, equipment and applications of Dialysis, Reverse Osmosis, Nanofiltration, Ultrafiltration and Microfiltration

Ionic separation: Electrophoresis, Dielectrophoresis and Electrodialysis

MODULE - III **15**

Pervaporation and permeation: Pervaporation and permeation techniques for solids, liquids and gases.

Other Separation Process: Lyophilisation, Zone melting, Adductive crystallization, Foam separation, Thermal diffusion, Supercritical fluid extraction.

TOTAL : 45

TEXT BOOKS

1. Scott, K. and Hughe, R. , " Industrial Membrane Separation Technology", Blackie academic and Professional Publications, 1996
2. Schoen, H.M., "New Chemical Engineering Separation Techniques", Interscience Publishers, 1972.

REFERENCE BOOKS

1. Roussel Ronald W., "Handbook of Separation Process Technology", John Wiley, New York, 1987.
2. Osadar, Varid Nakagawal, "Membrane Science and Technology", Marcel Dekkar, 1992.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Create the understanding of separation processes for selecting optimal process for new and innovative applications. Ability to exhibit the skill to develop membrane processes and reactors

CO2: Apply the latest concepts like super critical fluid extraction in chemical process industries

CO3: Understand novel techniques of controlling and managing oil spills

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3			3									
CO2	3		1	3							2		1
CO3	3			3	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH016 DRUGS AND PHARMACEUTICALS TECHNOLOGY

3 0 0 3

MODULE – I **15**

Drug Metabolism and Unit Processes: Development of drugs and pharmaceutical industry; organic therapeutic agent's uses and economics. Drug metabolism; physico chemical principles; radio activity; pharma kinetics-action of drugs on human bodies.

Chemical conversion processes : alkylation; carboxylation; condensation and cyclisation; dehydration, esterification, halogenation, oxidation, sulfonation; complex chemical conversions fermentation.

MODULE – II **15**

Manufacturing methods: Compressed tablets; wet granulation; dry granulation or slugging; direct compression, tablet presses formulation; coating pills; capsules sustained action dosage forms; parential solutions, oral liquids; injections; ointments; standard of hygiene and manufacturing practice.

Analytical Methods: Analytical methods and tests for various drugs and pharmaceuticals.Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives; external antiseptics; antacids and others.

MODULE – III **15**

Quality Assurance: Concept of quality control, quality assurance & total quality controls. Sources of variation, Quality control of raw materials & pharmaceutical process & finished products.

Documentation: concepts of statistical quality control. Validation of pharmaceutical process (at least one case study of a process & analytical method.)

TOTAL : 45

TEXT BOOKS

1. Yalkonsky, S.H., and Swarbick. J. "Drug and Pharamaceutical Sciences", Vol. I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.
2. John E. (editor), "Remingtons Pharmaceutical Sciences", Hoover Binding: Hardcover Mack Publishing Co., 1975.

REFERENCE BOOKS

1. Rawbins, E.A. "Bentleys Text book of Pharmaceutics", Third Edition, Bailliere Tindall, London, 1977.
2. Quality Assurance Guide; By Organization of Pharmaceutical producers of India

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the Drug Metabolism and pharmaco–kinetics principles

CO2: Apply knowledge of unit processes and analytical methods to develop new processes and product formulations

CO3: Demonstrate statistical quality control procedure and quality assurance programmes in various stages of pharmaceutical process

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2			3						1	1	
CO2	3	3			3						2	1	
CO3	3				3		2		2		2	1	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH017 BIOCHEMICAL ENGINEERING

3 0 0 3

MODULE – I **15**

Microbes and Microbial Kinetics: Classification of Microbes**;** Typical growth characteristics of microbial cells; immobilization techniques; Factors affecting growth; Monod model; Immobilized whole cells and their characteristics.

Enzymes and Enzyme Kinetics: Classification of Enzymes; Mechanism of enzymatic reactions; Michaelis-Menten kinetics; Enzyme Inhibition; Industrial Applications of Enzymes

MODULE – II **15**

Transport in Microbial Systems: Theories of Diffusional Mass Transfer; Mass Transfer by Convection Measurement of K_La; Oxygen Transfer Methodology; Factors affecting Oxygen Transfer Rate.

Fermentation and Sterilization: Requirements of fermentation process; Aerobic and Anaerobic fermentation Processes; Solid state and Submerged fermentation; Batch and Continuous Sterilization; Sterilization of Air; Effect of Sterilization on Quality of Nutrients.

MODULE – III **15**

Bioreactors: Classification based on feeding Mechanism- batch, continuous, fed batch reactors; Fluidized bed reactor, Immobilized cell rector, Air-Lift reactor.

Downstream Processes: Suspended solids removal; Filtration; Sedimentation; Centrifugation; Cell disruption; Extraction; Membrane Separation; Chromatography; Crystallization and Drying

TOTAL : 45

TEXT BOOKS

1. Bailey, J.E., and Ollis, D.F., "Biochemical Engineering Fundamentals", Second Edition, McGraw-Hill, International Edition, New York, 1986.
2. Blanch Harvey W., and Clark Douglas S., "Biochemical Engineering", First Edition, Marcel Dekker, Inc. New York, 1997.

REFERENCE BOOKS

1. Aiba, S., Humphrey, A.E., and Millis, N.F., "Biochemical Engineering", Second Edition, Academic Press, 1973.
2. Lee James M., "Biochemical Engineering", Prentice Hall, 1992
3. Rao, D. G., "Introduction to Biochemical Engineering", Tata McGraw-Hill, New Delhi, 2006.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the knowledge of micro organisms and enzymes to study different biochemical reactions and rate equations

CO2: Understand transport mechanisms and sterilization concepts to design and analyze bioreactors

CO3: Understand the downstream processing and industrial bioreactors

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	2		1			1				1	
CO2	3	2			2			1				2	
CO3	3				2			1				2	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH018 PETROLEUM REFINING ENGINEERING

3 0 0 3

MODULE – I **15**

Formation and composition of Petroleum: Origin and formation of petroleum; composition; petroleum reserves in India an in world; types classification, composition.

Treatment Techniques: Evaluation of petroleum crude; physical properties and testing methods of crude and petroleum products; fractionation of petroleum: dehydration and desalination of crudes, distillation of petroleum.

MODULE - II **15**

Thermal and Catalytic processes: Thermal and catalytic cracking processes; thermal and catalytic refining processes; solvent extraction; hydro treatment processes; polymerization; isomerisation; finishing and purification processes.

Manufacture of petroleum products: Manufacture of LPG, petrol, diesel, kerosene, naphtha, wax, sulphur, tar.

MODULE - III **15**

Design of petroleum refining equipment: Design of tube still heaters, heat exchangers, coolers, condensers, and reboilers.

Material and Energy balances: Refinery energy and material balances; controlling hydrocarbon losses in refinery; application of pollution control techniques.

TOTAL: 45

TEXT BOOKS

1. Nelson, W.L, "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited, 1985.
2. Watkins, R.N, "Petroleum Refinery Distillation", Second Edition, Gulf Publishing Company, Texas, 1981.

REFERENCE BOOK

1. Hobson, G.D., "Modern Petroleum Refining Technology", Fourth Edition, Institute of Petroleum U.K, 1973

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand the classification, composition and testing methods of crude petroleum / product to develop innovative refining process and develop quality control and assurance techniques.

CO2: Apply the knowledge of treatment processes to develop the manufacture of petroleum products.

CO3: Perform material and energy balances to facilitate the design of tube still heaters, heat exchangers, coolers, condensers and reboilers.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3								2		2	1	
CO2	3				2				2				1
CO3	3										1	2	1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH019 PROCESS INSTRUMENTATION

3 0 0 3

MODULE - I **15**

Principles of Measurements: Analysis: Measurement force, strain, and torque-use of strain gauges. Transducers-relative, capacitive, inductive and piezoelectric pickups. Static and dynamic response of instruments

Temperature Measurement: Liquid filled, gas filled and vapours pressure thermometers. Bimetallic and resistance thermometers. Thermocouples and thermistors. Optical and radiation pyrometers. Infrared thermometry.

MODULE - II **15**

Pressure Measurements: Manometers, bourdon gauge and bellows gauge used in pressure measurement, measurement of pressure and vacuum. Use of transducers.

Flow and Level Measurements: Variable head flow meters. Variable area flow meters. Positive displacement meters. Pressure probes. Level measurements-direct and inertial types. Mass flow meter, coreolis meter.

MODULE - III **15**

Miscellaneous Measurements: Measurement of density and specific gravity. Instruments for weighing and feeding.

Analysis of gas mixtures: Thermal conductivity, viscosity and electrical conductivity.Introduction to DCS, PLC.

TOTAL : 45

TEXT BOOKS

1. Eckmen, D.P., "Industrial instrumentation", Wiley Eastern, New Delhi, 2004.
2. Patranabis, D., "Principles of Industrial Instrumentation", Tata-McGraw Hill, New Delhi, 2009.

REFERENCE BOOK

1. Perry, R.H. and Green, D.W. (Editors), "Perry's Chemical Engineers' Hand Book", McGraw Hill, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the knowledge in selection of right temperature measuring devices

CO2: Exhibit a good grasp of instruments for pressure, level and flow.

CO3: Understand the working principles of conductivity meter, viscometer, pH meter, gas analysis instruments and etc

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3			2	2					1	2		1
CO2	3			2	2					1	2		1
CO3	3			2	2					1	2		1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH020 CHEMICAL PROCESS UTILITIES

3 0 0 3

MODULE - I **15**

Water: Source of water, their characteristics, raw water storage and treatment of water for boiler use, soft water and DM water, cooling water systems.

Steam: Properties of steam, steam generation by utilizing process waste heat using thermic fluid. Regeneration and re-evaporates of steam in plant, efficient use of steam, condensate utilization. Application of steam trap-classification, selection and applications

MODULE - II **15**

Air: Compressed air from blower and compressor. Air drying system for instant and plant air. Humidification and dehumidification of air. Production of oxygen and nitrogen by PSA systems.

Refrigeration: Principles of refrigeration, refrigeration system like compression refrigeration absorption refrigeration and chilled water system. Types of refrigerants, eco friendly refrigerants.

MODULE – III **15**

Vacuum System: Selection of vacuum system, operation of various process equipment under vacuum distillation, reactor and evaporators.

Insulation and Inert Gas: Importance of insulation. Insulation materials and their use. Insulation for high, intermediate, low and very low temperatures. Properties of inert gases and their uses

TOTAL: 45

TEXT BOOKS

1. Jack Broughton, "Process utility System- Introduction to design operation and maintenance", Institution of Chemical Engineers, UK, 1994.
2. Lyle., O., "Efficient use of steam", HMSO Publishers, 2000.

REFERENCE BOOK

1. Wangham., D.A., "Theory and practice of Heat engine", ELBS Cambridge University Press, 1970.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Comprehend the principles of water treatment, and methods of treating cooling water; understand the principles of efficient steam generation and utilisation

CO2: Understand methods of compression of air, air drying system and different types refrigeration and humidification systems used in process industries; simple calculations of compressors

CO3: Understand the principles of selection up vacuum system, vacuum process

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3			1	3			2		2	2		2
CO2	3		2	1	3					1	2		2
CO3	3		2	1	3					1	2		2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH021 PIPING ENGINEERNG

3 0 0 3

MODULE - I **15**

Fluid Flow: Types of pipes –metallic and Non-metallic pipe. Piping and pipeline codes. Fluid properties. Pressure drop due to friction, minor losses-values, fittings , enlargement, reduction, entrance and exit loss.

Single phase incompressible flow of Newtonian and Non-Newtonian liquids-veloctiy, flow equation. Complex piping system -pipe in series and parallel. Pipe network.Single phase compressible flow-flow analysis for ideal and non-ideal gas. Work, energy and power required for compression of gas.

MODULE - II **15**

Piping Design: Economic diameter, equivalent length estimation. Fitting number and types. Gravity flow, Sizing economics. Steam line –optimum diameter, temperature (low and high) considerations, and vacuum considerations. Pressure design calculation for plant piping, slurry piping and plastic piping

Pipeline design –waste water system, compressed air system, oil piping system, slurry system and Non-Newtonian fluid system

MODULE - III **15**

Pipeline Operation and Maintenance: Friction reduction, cleaning, coating, war, freezing prevention of by bleeding, leak detection, leak detection using SCADA.

Pipeline failure- outside force damage, internal pressure, subsidence strains, Rupture. Pipeline economics and cost. Piping insulations and repair techniques

TOTAL :45

TEXT BOOKS

1. John J.Mcketta, “Piping Design Handbook”, Marcel Dekker Publication, 1992.
2. Henry Liu, “Pipeline Engineering”, Lewis Publishers, 2003.

REFERENCE BOOK

1. George A. Antaki, “Piping and Pipeline Engineering: Design, Construction, Maintenance, Integrity and Repair”, Marcel Dekker Publication,2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: To know about various types and compositions of crude

CO2: To know steps and considerations in the exploration of natural gas

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2	3	2	3			2			1	1	
CO2	2	2	3	2	3			2			1	1	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH022 FOOD TECHNOLOGY

3 0 0 3

MODULE – I **15**

Fruit and Vegetable Processing Technology: Classification structural, composition & nutritional aspects of fruits and vegetables. Physiological Development - Deterioration factors. Different methods of preservation - heat, sugar, chemicals & fermentation. Processing of Juice, pulps, concentrates syrups, squash, cordial and nectars. Preparation of jam, jellies, marmalades. Sauerkraut, pickle and vinegar production. Processing of tomato, mango, tapioca, potato. Drying and dehydration of fruits and vegetables. Fruit powders. Canning of fruits and vegetables - filling, closing and sterilization operation. Precautions in canning operations

MODULE - II **15**

Dairy Technology: Sources, composition and properties of milk - Platform tests. Storage and distribution of milk. Processing of market milk, Standardization. Classification, homogenizer, cream separation. Pasteurizers, Different type of sterilizers, toning of milk. Principles and working of different types of bottle filters and capping machine, pouch filling machine. Description, working and maintenance of can washers, bottle washers. Factors affecting washing operations. CIP cleaning. Whole and skimmed milk powder and other dairy products. **Bakery and Confectionery Technology:** Raw materials required for bread making and their functional properties. Major ingredients and Minor ingredients. Production of Bread - bread making methods - advantages and disadvantages of various methods of bread making. Bread characters - defects/faults**,** spoilage, remedies. Cake making: Ingredients and their function. Bakery Equipment - Dough Kneaders, Dividing, rounding, sheeting, and laminating, Fermentation enclosures, Oven and Slicer, Packaging materials and equipment. Confectionery Products-Definition, importance of sugar confectionery and flour confectionery. Types of confectionery products-chocolate boiled sweets caramels toffees, fondants.

MODULE - III **15**

Introduction, Types and characteristics of poultry products. Unit operation poultry processing of poultry meat. Structure, composition, nutritive value, calculation of nutritive value and functional properties of eggs, Factor affecting egg quality and measures of egg quality. Egg powder processing. **Meat Processing:** Types of Meat and its sources, composition, structure, of meat and meat products. Ante mortem handling, slaughtering of animals, Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat. Color, flavors, microbiology and spoilage factors of meat and meat products. Factors affecting post-mortem changes, properties and shelf-life of meat. Meat tenderization and Meat quality evaluation. Modern abattoirs, slaughter house and its features. Preservation of meat- aging, pickling, smoking. Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Sausages **Fish Processing:** Types of fish, composition, structure, and spoilage factors of fish. Post-mortem changes in fish. Handling and transportation of fish. Freezing and Individual quick freezing, Canning and smoking operations, Salting and drying of fish, pickling

TOTAL : 45

TEXT BOOKS

1. S.Ranganna, "Handbook of Analysis and Quality Control for Fruit and Vegetable", Tata McGraw-Hill, 1986.
2. Lal, G., Siddappa, G. and Tondon G.L., "Preservation of Fruits and Vegetables", Indian Council of Agricultural Research, New Delhi, 1986.

REFERENCE BOOKS

1. Sukumar De. R.,"Outlines of Dairy Technology", Royal, Oxford University, Press, Delhi, 1983.
2. Tufail Ahmed, "Dairy Plant Engineering and Management", CBS Publishers and Distributors, New Delhi, 2001.
3. Matz, Samuel A., "Bakery Technology and Engineering", Third Edition, Chapman & Hall, London,
4. Cauvain, Stanley P, and Young, Linda S., "Technology of Bread Making", Second Edition, Aspen publication, Maryland, 1999.
5. Matz, Samuel A., "Bakery Technology and Engineering", Third Edition, Chapman & Hall, London,
6. Cauvain, Stanley P, and Young, Linda S., "Technology of Bread Making", Second Edition Aspen publication. Maryland, 1999.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Demonstrate the application of chemical engineering principles in the design, operation and maintenance of food processes equipment

CO2: Understand fruits and vegetable processing, dairy, and bakery technology to develop cleaner and energy efficient processes

CO3: Apply the principles of poultry and fish processing to the industries

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2		1	3						2	2		1
CO2	2			3						2	2		1
CO3	2			3						2	2		1

3 – Substantial, 2 – Moderate, 1 – Slight

11GE011 ENTREPRENEURSHIP DEVELOPMENT

(Common to all Engineering and Technology branches except Civil Engg.)

3 0 0 3

MODULE – I **15**

Entrepreneurship Concepts: Meaning and Concepts of Entrepreneurship – Definition and Characteristics of an Entrepreneur – Entrepreneurial Process – The scope of Entrepreneurship in India. Entrepreneurial Motivation – Factors creating Entrepreneurship – Classification of Entrepreneurs – Intrapreneurship - Barriers to Entrepreneurship – Creativity, Innovation & Entrepreneurship - Role of Entrepreneurship in Economic Development.

MODULE – II **15**

Business Plan: Business Planning Process – Idea generation, Environmental Scanning, Feasibility Analysis, Drawing Functional Plan - Marketing Plan – Production/Operations Plan –Organizational Plan – Financial Plan – Human Resource Plan – Project Report Preparation , Evaluation, Control and Review.

MODULE – III **15**

Managing a Small Business: Sources of Finance - Institutions Supporting Entrepreneurs - EDPs. Small Scale Industry – The Strengths and Weaknesses of Small Business - Growth strategies – Sickness - Evaluation, Symptoms, Causes and Assessment – Rehabilitation of Sick Industries.

TOTAL :45

TEXT BOOKS

1. Madhurima Lall and Shikha Sahai, " Entrepreneurship", Excel Books, New Delhi, 2006
2. S.S.Khanka, " Entrepreneurial Development", S.Chand & Company Ltd, 2005

REFERENCE BOOKS

1. Robert D Hisrich, Michael P Peters and Dean A Shepherd, "Entrepreneurship", Sixth Edition, Tata McGraw Hill, New Delhi, 2009.
2. Mary Coulter, "Entrepreneurship in Action", Second Edition, Prentice Hall of India, New Delhi, 2005.
3. Jain P.C., "Handbook for New Entrepreneurs", Oxford University Press, Oxford, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate knowledge of entrepreneurship concepts
CO2: plan various aspects of business activities
CO3: manage to start and run small business.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1			1		3	3	3		3			3
CO2	1			1		3	3	3		3			3
CO3	1			1		3	3	3		3			3

3 – Substantial, 2 – Moderate, 1 – Slight

11CH023 ENZYME ENGINEERING

3 0 0 3

MODULE- I **15**

Types of Microorganism: Structure and function of microbial cells. Fundamentals of microbial growth, batch and continuous culture. Isolation and purification of enzymes from cells. Cell and Enzyme Immobilization.

Fermentation – Types of mechanisms, Continuous fermentation – aeration and agitation,kinetics of fermentation – Processes

MODULE-II **15**

Introduction of Bioreactor design: Continuously stirred aerated tank bioreactors. Mixing power correlation. Determination of volumetric mass transfer rate of oxygen from air bubbles and effect of mechanical mixing and aeration on oxygen transfer rate, heat transfer and power.

Enzyme and Enzyme Kinetics Introduction to Biochemistry, Function and applications. Nature and function of enzyme.Coenzyme / Cofactor. Classification of enzymes.

MODULE – III **15**

Assay methods and units. Examples of applications of enzymes in industry, analytical technique medicine and Pharmaceuticals.

Industrial Bioreactors utilizing Isolated enzymes and biosensors development and applications. Designs of reactor, Batch and continue type; analysis for immobilized enzyme reactors. Sterile and non sterile operations; reactors in series with and without recycle.

TOTAL: 45

TEXT BOOKS

1. Technological Applications of Bio-catalysts, BIOTOL series, Butter worth, 1995.
2. Cornish. A -Bowden, Analysis of Enzyme Kinetic Data, Oxford University Press, 1996.

REFERENCE BOOKS

1 Wiseman A (Ed.), Topics in enzyme and fermentation Bio-technology, Ellis and Harwood, U.K. Vol-5.

2 Wiseman. A and Blakeborough N and Dunnill P, Enzymic and nonenzymic catalysis,Ex. Vol.5 Ellis and Harwood, U.K. (1981).

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Design effective fermentation systems by optimization of input resources using mass transfer concepts

CO2: Select enzyme/coenzyme for different applications in chemical and pharmaceutical industries

CO3: Understand the immobilization technique to develop design for immobilized enzyme reactors

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2			3						2		2	
CO2	2			3						2		1	
CO3	2			3						2		1	

3 – Substantial, 2 – Moderate, 1 – Slight

11CH024 AIR POLLUTION AND CONTROL

3 0 0 3

MODULE- I **15**

Air Pollution Regulatory Framework History – Air Pollution Regulatory Framework -Regulatory System – Laws and Regulations – Clean air Act – Provisions for Recent Developments.

Measurement fundamentals – chemicals and physical properties – Phase Equilibrium consecoation laws – Incinerators.

MODULE-II **15**

Design and Performance – Operation and Maintainance - Absorbers – Design operation and improving performances Absorbers.

Particle Collection mechanisms – Fluid particle Dynamics – Particle size Distribution –Efficiency – Gravity Settling chambers Cyclones – Electrostatic precipitators Bag houses

MODULE – III **15**

Hybrid System :Heat electrostatic precipitation – Genizing Heat Scrubbers – Dry Scrubbers –Electrostatically Augmented Fabric Filtration

Air Pollution Control Equipment: Introduction – Installation – Cost Model.

TOTAL: 45

TEXT BOOKS

1. Louis Theodore., "Air Pollution Control Equipment", Burley Intuscence , 2008.
2. CD Cooper and FC.Alley "Air Pollution Control" , Wairland Press, III Edition 2002.

REFERENCE BOOKS

1. Noel de nevey ., "Air Pollution Control", Engg,– McGraw Hill.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Design Air Pollution Control equipment like settling chamber, Electrostatic Precipitator, Bag houses, absorbers, Desorbers etc.,

CO2: Apply the knowledge of basic principles to design Scrubbers, Incinerators

CO3: Design and apply the knowledge of Air Pollution Control laws to properly operating and maintaining Air Pollution Control equipments

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2			2		2		2	2	1			
CO2	2			2		2		2	2				
CO3	2			2		2		2					

3 – Substantial, 2 – Moderate, 1 – Slight

11CH025 WASTE WATER TREATMENT

3 0 0 3

MODULE- I **15**

Waste Water Treatment - Overview: Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents.

Process Analysis And Selection: Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis.

MODULE-II **15**

Modelling of Reactors: Modelling of ideal and non ideal flow in Reactors –Process Selection.

Chemical Unit Processes: Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization –Chemical Storage.

MODULE – III **15**

Biological Treatment : Overview of biological Treatment – Microbial metabolism – Bacterial growth and energatus – Aerobic biological oxidation – Anaerobic fermentation and oxidation –
Trickling filters – Rotating biological contractors – Combined aerobic processes –Activated sludge film packing.

Advanced Waste Water Treatment: Technologies used in advanced treatment – Classification of technologies -Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration, Absorption – Ion Exchange – Advanced oxidation process.

TOTAL: 45

TEXT BOOKS

1. G. Tchobanoglous, FI Biston, "Waste water Engineering Treatment and Reuse", McGraw Hill, 2002.
2. Industrial Wastewater Management, Treatment, and Disposal - MOP FD-3, Ed3, McGraw Hill. 2008.

REFERENCE BOOKS

1. Eckenfelder, W.W., Industrial Water Pollution Control, McGraw-Hill, 1999.
2. Arceivala, S.J., Wastewater Treatment for Pollution Control, McGraw-Hill, 1998.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Familiarize with sources, constituents and environmental concerns of waste water and overview of waste water treatment method

CO2: Demonstrate various chemical treatment processes and reactor modelling

CO3: Demonstrate various biological treatment process and Demonstrate various advanced treatment process.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	3	1	3	1		2	1	2	3	1	1
CO2	3	2	3	1	3	1		2	1	2	3	1	1
CO3	3	2	3	1	3	1		2	1	2	3	1	1

3 – Substantial, 2 – Moderate, 1 – Slight

11CH026 PULP AND PAPER TECHNOLOGY

3 0 0 3

MODULE- I **15**

Introduction: Basic pulp and paper technology – Wood haves dry – Wood as a raw material.

Woodyard Operation: Woodyard operation - Mechanical pulping – Chemical pulping – Secondary fibre pulp processing.

MODULE-II **15**

Paper Machine: Paper Machine wet and addition paper machine dry and operation – Paper machine Wet and operation

Paper And Paperboard: Paper and paperboard frames and products – Surface treatments. Finishing operation – End uses.

MODULE – III **15**

Properties of Pulp And Paper: Properties of pulp and paper, Process control.

Testing of Pulp And Paper: Testing of pulp and paper– Quality assurance – Water and air pollution control.

TOTAL: 45

TEXT BOOKS

1. Monica ER Monica, Goran Gellerstcdt Gunnar Hennksson De Gneyter "Pulp and paper chemistry and Technology", 2009.
2. Austin, G.T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984.

REFERENCE BOOKS

1. Dryden, C.E., "Outlines of Chemical Technology for 21st Century", Edited and Revised by Gopala Rao. M. and M.Sittig, Third edition, Affiliated East-West press, Reprint 2009.
2. Kent, J.A.(ed), "Riggel's Hand Book of Industrial Chemistry", Van Nostrant Reinhold, 1974.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand of raw materials, characteristics to economical/environmentally safe method of preparation.

CO2: Knowledge to Safely operate paper machine and optimize its energy consumption.

CO3: Knowledge to characterize the different varieties of paper/paper products, find its new applications for the same.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1		1					1	1	1			
CO2	1		1					1	1	1			
CO3	1		1					1	1	1			

3 – Substantial, 2 – Moderate, 1 – Slight

11CH027 FUNDAMENTALS OF NANOSCIENCE

3 0 0 3

MODULE- I **15**

Introduction: Nanoscale- Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

Preparation Methods : Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation,
Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

MODULE-II **15**

Patterning and Lithography for Nanoscale Devices: Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography.

Preparation Environments: Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required.

MODULE – III **15**

Working practices, sample cleaning, Chemical purification, chemical and biological Contamination, Safety issues, flammable and toxic hazards, biohazards.

Characterisation Techniques :X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

TOTAL: 45

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale characterization of surfaces & Interfaces", 2nd edition,Weinheim Cambridge, Wiley-VCH, 2000

REFERENCE BOOKS

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modelling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand fundamental concepts of nanoscience and technology, properties and preparation methods of nanoparticles

CO2: Develop knowledge on nanoscale devices and its preparation environments

CO3: Learn about working practices and various characterization techniques

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		2					2			3	2	
CO2	2		2					1			2	3	2
CO3	3	2	1					2			3	3	2

3 – Substantial, 2 – Moderate, 1 – Slight

11CH028 ECOLOGICAL AND ECO SYSTEMS ENGINEERING

3 0 0 3

MODULE- I **15**

Development and evolution of ecosystems – Principles and concepts – Energy flow and material cycling – productivity – Classification of ecotechnology – ecological engineering.

Classification of systems – Structural and functional interactions of environmental systems –Mechanisms of steady-state maintenance in open and closed systems.

MODULE-II **15**

Modelling and ecotechnology – Classification of ecological models – Applications-Ecological economics- Self-organizing design and processes – Multi seeded microcosms.

Interface coupling in ecological systems – Concept of energy – Determination of sustainable loading of ecosystems.

MODULE – III **15**

Ecosanitation – soil infiltration systems – Wetlands and ponds – Source separation systems.

Aqua cultural systems – Agro ecosystems – Detritus based treatment for solid wastes –marine systems- Case studies.

TOTAL: 45

TEXT BOOKS

1. Kangas, P.C. and Kangas, P., Ecological Engineering: Principles and Practice, Lewis Publishers, New York, 2003.
2. Etnier, C. and Guterstam, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers, New York, 1997.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Knowledge of the structural and functional interaction of ecological systems to locate specific principle of chemical process industries

CO2: Apply the modelling techniques to couple ecological systems and reduce, recycle energy

CO3: Understand the **a**pplication of eco-sanitation systems to protect the environment in and around chemical process industries

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2			2		2		2	2				
CO2	2			2		2		2					
CO3	2			2		2		1	2	1			

3 – Substantial, 2 – Moderate, 1 – Slight

11CH029 ENVIRONMENTAL BIOTECHNOLOGY

3 0 0 3

MODULE- I **15**

Environmental Biotechnology -Principles and concepts - usefulness to mankind.
Degradation of high concentrated toxic pollutants- halogenated, non halogenated, petroleum hydrocarbons, metals.

MODULE-II **15**

Mechanisms of detoxification – oxidation - dehalogenation -biotransformation of metals - biodegradation of solid wastes. Biotechnological remedies for environmental pollution - decontamination of groundwater –bioremediation - Production of proteins – bio fertilizers - Physical, chemical and microbiological factors of composting – health risk – pathogens – door management –Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biogas technology.

MODULE – III **15**

Concept of rDNA technology – expression vectors – cloning of DNA – mutation –construction of microbial strains - radioactive probes - protoplast fusion technology –applications.
Environmental effects and ethics of microbial technology – genetically engineered organisms- Microbial containment-Risk assessment.

TOTAL: 45

TEXT BOOKS

1. Chaudhury, G.R., Biological degradation and Bioremediation of toxic chemicals, Dioscorides Press, Oregon, 1994
2. Martin.A.M, Biological degradation of wastes, Elsevier Applied Science, London, 1991.

REFERENCE BOOK

1. Blaine Metting.F (Jr.,) Soil Microbiology Ecology, Marcel Dekker Inc., 1999.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the basic principles of Microbial cell/enzyme technology to develop effective biogas production systems.

CO2: Understand apply the concepts of DNA technology to develop new strains of microbes for pollution abatement problems

CO3: Demonstrate the application of microbial technology to select and develop products using genetic engineering

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2			2		2		2	2				
CO2	2			2		2		2					
CO3	2			2		2		1	2	1			

3 – Substantial, 2 – Moderate, 1 – Slight