SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

B.TECH (Full Time) - CHEMICAL ENGINEERING
Curriculum & Syllabus
2013 – 2014

Volume – I
(all courses except open electives)

FACULTY OF ENGINEERING AND TECHNOLOGY
SRM UNIVERSITY
SRM NAGAR, KATTANKULATHUR – 603 203

STUDENT OUTCOMES

The curriculum and syllabus for B.Tech programs (2013) conform to outcome based teaching learning process. In general, **ELEVEN STUDENT OUTCOMES** (a-k) have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meets one or more of these outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Further each course in the program spells out clear instructional objectives which are mapped to the student outcomes.

The student outcomes are:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

SCHOOL OF BIOENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING
B.TECH. CHEMICAL ENGINEERING
CURRICULUM – 2013
(Applicable for Students Admitted From the Academic Year 2013-14 Onwards)

SEMESTER I						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1001	G	SOFT SKILLS I	1	0	1	1
MA1001	B	CALCULUS AND SOLID GEOMETRY	3	2	0	4
PY1001	B	PHYSICS	3	0	0	3
PY1002	B	PHYSICS LAB	0	0	2	1
CY1001	B	CHEMISTRY	3	0	0	3
CY1002	B	CHEMISTRY LAB	0	0	2	1
LE1002	G	VALUE EDUCATION	1	0	0	1
CE1001	E	BASIC CIVIL ENGINEERING	2	0	0	2
Courses from Table I						
Student shall register for minimum 20 credits in I semester and minimum 20 credits in II semester. However student shall have registered for all the courses enlisted under Semester I and II as well the courses in Table I by the time the registration process is complete in II semester. Keeping this in mind student shall register for the courses in I and II semesters.						
NC1001 NS1001/ SP1001/ YG1001	G	*NCC/NSS/NSO/YOGA	0	0	1	1

Legend:

L - Number of lecture hours per week
T - Number of tutorial hours per week
P - Number of practical hours per week
C - Number of credits for the course

Category of courses:
G - General
B - Basic Sciences
E - Engineering Sciences and Technical Arts
P - Professional Subjects

SEMESTER II						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1002	G	SOFT SKILLS II	1	0	1	1
MA1002	B	ADVANCED CALCULUS AND COMPLEX ANALYSIS	3	2	0	4
PY1003	B	MATERIAL SCIENCE	2	0	2	3
CY1003	B	PRINCIPLES OF ENVIRONMENTAL SCIENCE	2	0	0	2
CY1004	P	MATERIAL TECHNOLOGY	3	1	0	3
LE1001	G	ENGLISH	1	2	0	2
Courses from Table I						
Student shall register for minimum 20 credits in I semester and minimum 20 credits in II semester. However student shall have registered for all the courses enlisted under Semester I and II as well the courses in Table I by the time the registration process is complete in II semester. Keeping this in mind student shall register for the courses in I and II semesters.						

TABLE I
COURSES WHICH CAN BE REGISTERED FOR EITHER IN I OR II SEMESTER

SEMESTER I / II						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
CS1001	G	PROGRAMMING USING MATLAB	0	1	2	2
BT1001	B	BIOLOGY FOR ENGINEERS	2	0	0	2
ME1001	E	BASIC MECHANICAL ENGINEERING	2	0	0	2
EE1001	E	BASIC ELECTRICAL ENGINEERING	2	0	0	2
EC1001	E	BASIC ELECTRONICS ENGINEERING	2	0	0	2
ME1004	E	WORKSHOP	0	0	3	2
ME1005	E	ENGINEERING GRAPHICS	0	1	4	3

*NCC-National Cadet Corps
NSS-National Service Scheme
NSO-National Sports Organization (India)

SEMESTER III						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
LE1003/ LE1004/ LE1005/ LE1006/ LE1007	G	GERMAN LANGUAGE PHASE I / FRENCH LANGUAGE PHASE I/ JAPANESE LANGUAGE PHASE I/ KOREAN LANGUAGE PHASE I/ CHINESE LANGUAGE PHASE I	2	0	0	2
PD1003	G	APTITUDE I	1	0	1	1
MA1013	B	FOURIER SERIES, PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS	4	0	0	4
CH1001	P	ORGANIC CHEMISTRY	3	0	0	3
CH1002	P	CHEMICAL PROCESS CALCULATION	4	0	0	4
CH1003	P	MOMENTUM TRANSFER	4	0	0	4
CH1004	P	MECHANICAL OPERATIONS	3	0	0	3
CH1005	P	MOMENTUM TRANSFER LABORATORY	0	0	3	1
CH1006	P	MECHANICAL OPERATIONS LABORATORY	0	0	3	1
TOTAL			**21**	**0**	**7**	**23**
Total Contact Hours			**28**			

SEMESTER IV						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
LE1008/ LE1009/ LE1010/ LE1011/ LE1012	G	GERMAN LANGUAGE PHASE II / FRENCH LANGUAGE PHASE II/ JAPANESE LANGUAGE PHASE II/ KOREAN LANGUAGE PHASE II / CHINESE LANGUAGE PHASE II	2	0	0	2
PD1004	G	APTITUDE II	1	0	1	1
MA1004	B	NUMERICAL METHODS	4	0	0	4
CH1007	P	PHYSICAL CHEMISTRY	3	0	0	3
CH1008	P	MASS TRANSFER – I	3	0	0	3
CH1009	P	CHEMICAL ENGINEERING THERMODYNAMICS – I	3	0	0	3
CH1010	P	HEAT TRANSFER	4	0	0	4
CH1011	P	PHYSICAL CHEMISTRY LABORATORY	0	0	3	1

CH1012	P	HEAT TRANSFER LABORATORY	0	0	3	1
	P	DEP. ELECTIVE I	3	0	0	3
TOTAL			**23**	**0**	**7**	**25**
Total Contact Hours			**30**			

SEMESTER V						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1005	G	APTITUDE III	1	0	1	1
CH1013	B	COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING	3	0	0	3
CH1014	P	CHEMICAL ENGINEERING THERMODYNAMICS - II	3	0	0	3
CH1015	P	MASS TRANSFER – II	3	0	0	3
CH1016	P	CHEMICAL REACTION ENGINEERING – I	3	0	0	3
CH1017	P	CLASSICAL AND INSTRUMENTAL METHODS OF ANALYSIS LABORATORY	0	1	3	2
CH1018	P	COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING LABORATORY	0	0	4	2
CH1047	P	INDUSTRIAL TRAINING I (Training to be undergone after IV semester)	0	0	1	1
	P	DEP. ELECTIVE -II	3	0	0	3
	P	OPEN ELECTIVE I	3	0	0	3
TOTAL			**19**	**1**	**9**	**24**
Total Contact Hours			**29**			

SEMESTER VI						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1006	G	APTITUDE IV	1	0	1	1
CH1019	P	CHEMICAL PROCESS TECHNOLOGY	4	0	0	4
CH1020	P	CHEMICAL REACTION ENGINEERING-II	3	0	0	3
CH1021	P	PROCESS CONTROL AND INSTRUMENTATION	4	0	0	4
CH1022	P	CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING LABORATORY - I	0	1	3	2

CH1023	P	MASS TRANSFER LABORATORY	0	0	4	2
CH1049	P	MINOR PROJECT	0	0	2	1
	P	DEP. ELECTIVE III	3	0	0	3
		OPEN ELECTIVE II	3	0	0	3
		OPEN ELECTIVE III	3	0	0	3
TOTAL			**21**	**1**	**10**	**26**
Total Contact Hours			**32**			

SEMESTER VII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
CH1024	P	TRANSPORT PHENOMENA FUNDAMENTALS	4	0	0	4
CH1025	P	PROCESS MODELING & SIMULATION	3	0	0	3
CH1026	P	PROCESS ENGINEERING ECONOMICS	3	0	0	3
CH1027	P	CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING LABORATORY- II	0	1	3	2
CH1028	P	CHEMICAL REACTION ENGINEERING & PROCESS CONTROL LABORATORY	0	0	4	2
CH1029	P	PROCESS MODELING AND SIMULATION LABORATORY	0	0	4	2
CH1048	P	INDUSTRIAL TRAINING II (Training to be undergone after VI semester)	0	0	1	1
	P	DEP. ELECTIVE IV	3	0	0	3
	P	DEP. ELECTIVE V	3	0	0	3
TOTAL			**16**	**1**	**12**	**23**
Total Contact Hours			**29**			

SEMESTER VIII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
CH1050	P	MAJOR PROJECT / PRACTICE SCHOOL	0	0	24	12
Total			**0**	**0**	**24**	**12**
Total contact hours			**24**			

DEPARTMENTAL ELECTIVES						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
CH1101	P	ENERGY TECHNOLOGY AND MANAGEMENT	3	0	0	3
CH1102	P	RENEWABLE ENERGY ENGINEERING	3	0	0	3
CH1103	P	ENERGY ENGINEERING AND TECHNOLOGY	3	0	0	3
CH1104	P	INDUSTRIAL POLLUTION PREVENTION	3	0	0	3
CH1105	P	INDUSTRIAL POLLUTION CONTROL	3	0	0	3
CH1106	P	INTRODUCTION TO BIOCHEMICAL PRINCIPLES	3	0	0	3
CH1107	P	BIOCHEMICAL PROCESS DESIGN	3	0	0	3
CH1108	P	ENZYME ENGINEEING AND TECHNOLOGY	3	0	0	3
CH1109	P	BIOREACTOR ANALYSIS	3	0	0	3
CH1110	P	BIOREACTOR DESIGN	3	0	0	3
CH1111	P	FERTILIZER TECHNOLOGY	3	0	0	3
CH1112	P	PETROLEUM REFINING TECHNOLOGY	3	0	0	3
CH1113	P	POLYMER TECHNOLOGY	3	0	0	3
CH1114	P	DRUG AND PHARMACEUTICAL TECHNOLOGY	3	0	0	3
CH1115	P	PULP AND PAPER TECHNOLOGY	3	0	0	3
CH1116	P	PETROCHEMICAL TECHNOLOGY	3	0	0	3
CH1117	P	FOOD TECHNOLOGY	3	0	0	3
CH1118	P	CHEMICAL PLANT SAFETY AND OCCUPATIONAL HAZARD	3	0	0	3
CH1119	P	ELECTROCHEMICAL ENGINEERING	3	0	0	3
CH1120	P	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3
CH1121	P	INTRODUCTION TO STATISTICAL THERMODYNAMICS	3	0	0	3
CH1122	P	EQUILIBRIUM STAGE OPERATIONS	3	0	0	3
CH1123	P	CHEMICAL PLANT UTILITIES	3	0	0	3
CH1124	P	CHEMICAL PROCESS OPTIMIZATION	3	0	0	3

Summary of Credits

Semester	I	II	III	IV	V	VI	VII	VIII	Total	%
Credits	**23**	**24**	**23**	**25**	**24**	**26**	**23**	**12**	**180**	**100.0**
G	4	4	3	3	1	1	0	0	**16**	**8.9**
B	12	11	4	4	3	0	0	0	**34**	**18.9**
E	7	6	0	0	0	0	0	0	**13**	**7.2**
P	0	3	16	18	20	25	23	12	**117**	**65**
MINIMUM CREDITS TO BE EARNED FOR THE AWARD OF DEGREE: 180										

***Number of departmental / open electives may vary depending upon the number of credits each of them is assigned to. But total credits for dept. electives shall be 15 and that for the open electives shall be 9.**

Category: GENERAL

SEMESTER I						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1001	G	SOFT SKILLS I	1	0	1	1
LE1002	G	VALUE EDUCATION	1	0	0	1
NC1001/NS1001 SP1001/YG1001	G	NCC/NSS/NSO/YOGA	0	0	1	1

SEMESTER II						
PD1002	G	SOFT SKILLS II	1	0	1	1
LE1001	G	ENGLISH	1	2	0	2

SEMESTER I / II						
CS1001	G	PROGRAMMINGUSING MATLAB	1	0	2	2

SEMESTER III						
LE1003/LE1004/ LE1005/LE1006/ LE1007	G	GERMAN LANGUAGE PHASE I / FRENCH LANGUAGE PHASE I/ JAPANESE LANGUAGE PHASE I/ KOREAN LANGUAGE PHASE I / CHINESE LANGUAGE PHASE I	2	0	0	2
PD1003	G	APTITUDE I	1	0	1	1

SEMESTER IV						
LE1008/LE1009/ LE1010/LE1011/ LE1012	G	GERMAN LANGUAGE PHASE II / FRENCH LANGUAGE PHASE II/ JAPANESE LANGUAGE PHASE II /KOREAN LANGUAGE PHASE II /CHINESE LANGUAGE PHASE II	2	0	0	2
PD1004	G	APTITUDE II	1	0	1	1

SEMESTER V						
PD1005	G	APTITUDE III	1	0	1	1

SEMESTER VI						
PD1006	G	APTITUDE IV	1	0	1	1

SEMESTER-I

PD1001	**SOFT SKILLS-I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	To develop inter personal skills and be an effective goal oriented team player.
2.	To develop professionals with idealistic, practical and moral values.
3.	To develop communication and problem solving skills.
4.	To re-engineer attitude and understand its influence on behavior.

UNIT I - SELF ANALYSIS **(4 hours)**

SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem

UNIT II - ATTITUDE **(4 hours)**

Factors influencing Attitude, Challenges and lessons from Attitude.

Change Management

Exploring Challenges, Risking Comfort Zone, Managing Change

UNIT III - MOTIVATION **(6 hours)**

Factors of motivation, Self talk, Intrinsic & Extrinsic Motivators.

UNIT IV - GOAL SETTING **(6 hours)**

Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals.

Time Management

Value of time, Diagnosing Time Management, Weekly Planner To do list, Prioritizing work.

UNIT V - CREATIVITY **(10 hours)**

Out of box thinking, Lateral Thinking

Presentation

ASSESSMENT

1. A practical and activity oriented course which has continuous assessment for 75 marks based on class room interaction, activities etc.
2. Presentation – 25 marks

TEXT BOOK

INSIGHT, 2012, Career Development Centre, SRM Publications.

REFERENCES

1. Covey Sean, "*Seven Habits of Highly Effective Teens"*, New York, Fireside Publishers, 1998.
2. Carnegie Dale, "*How to win Friends and Influence People"*, New York: Simon & Schuster, 1998.
3. Thomas A Harris, "*I am ok, You are ok"* , New York-Harper and Row, 1972.
4. Daniel Coleman, "*Emotional Intelligence"*, Bantam Book, 2006.

PD1001 - SOFT SKILLS-I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	J	k
					x		x	x		x		
2.	Mapping of instructional objectives with student outcome				1		2	3		4		
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1002	**VALUE EDUCATION**	**L**	**T**	**P**	**C**
	Total Contact Hours- 15	**1**	**0**	**0**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide guiding principles and tools for the development of the whole person recognizing that the individual is comprised of Physical, Intellectual, Emotional and Spiritual dimensions.

INSTRUCTIONAL OBJECTIVES

1.	To help individuals think about and reflect on different values.
2.	To deepen understanding, motivation and responsibility with regard to making personal and social choices and the practical implications of expressing them in relation to themselves, others, the community and the world at large
3.	To inspire individuals to choose their own personal, social, moral and spiritual values and be aware of practical methods for developing and deepening

UNIT I - INTRODUCTION **(3 hours)**

Definition, Relevance, Types of values, changing concepts of values

UNIT II - INDIVIDUAL AND GROUP BEHAVIOUR **(3 hours)**

Personal values – Self – Strengths (self-confidence, self-assessment, self-reliance, self-discipline, determination, self-restraint, contentment, humility, sympathy and compassion, gratitude, forgiveness) Weaknesses (Influences -- Peer pressure, familial and societal expectations, media)

UNIT III - SOCIETIES IN PROGRESS **(3 hours)**

Definition of society; Units of society; Communities – ancient and modern – Agents of change – Sense of survival, security, desire for comfort and ease sense of belonging, social consciousness and responsibility

UNIT IV - ENGINEERING ETHICS **(3 hours)**

Definition - Societies for engineers – Code of Ethics – Ethical Issues involved in cross border research -- Ethical and Unethical practices – case studies – situational decision making

UNIT V - SPIRITUAL VALUES **(3 hours)**

What is religion? -- Role of religion – Misinterpretation of religion – moral policing – Consequences -- Religion as spiritual quest – Aesthetics and religion

TEXT BOOK

Department of English and Foreign Languages SRM University, "*Rhythm of Life",* SRM Publications, 2013.

REFERENCE

Values (Collection of Essays). Published by : Sri Ramakrishna Math, Chennai-4. 1996.

LE1002 VALUE EDUCATION												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	J	k
							x			x		
2.	Mapping of instructional objectives with student outcome						1-3			1-3		
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

NC1001/ NS1001/ SP1001/ YG1001	NATIONAL CADET CORPS (NCC)/ NATIONAL SERVICE SCHEME (NSS)/ NATIONAL SPORTS ORGANIZATION (NSO) / YOGA	L	T	P	C
	Total Contact Hours – 15 (minimum, but may vary depending on the course)	0	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To imbibe in the minds of students the concepts and benefits of NCC/NSS/NSO/YOGA and make them practice the same

INSTRUCTIONAL OBJECTIVES

1. To enable the students to gain knowledge about NCC/NSS/NSO/YOGA and put the same into practice

NATIONAL CADET CORPS (NCC)

Any student enrolling as a member of National Cadet Core (NCC) will have to attend sixteen parades out of twenty parades each of four periods over a span of academic year.

Attending eight parades in first semester will qualify a student to earn the credits specified in the curriculum. Grading shall be done based on punctuality, regularity in attending the parades and the extent of active involvement.

NATIONAL SERVICE SCHEME (NSS)

A student enrolling as member of NSS will have to complete 60 hours of training/ social service to be eligible to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

NATIONAL SPORTS ORGANIZATION (NSO)

Each student must select one of the following games/sports events and practice for one hour per week. An attendance of 75% is compulsory to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

List of games/sports: Basket Ball, Football, Volley Ball, Ball Badminton, Cricket, Throw-ball, Track events. Field events or any other game with the approval of faculty member.

YOGA

Benefits of Agnai Meditation -Meditation - Agnai, Asanas, Kiriyas, Bandas, Muthras Benefits of santhi Meditation - Meditation Santhi Physical Exercises (I&II) Lecture & Practice - Kayakalpa Yoga Asanas, Kiriyas, Bandas, Muthras Analysis of Thought - Meditation Santhi Physical Exercises III & IV Benefits of Thuriyam - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras Attitude - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras Importance of Arutkappy & Blessings - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras Benefits of Blessings - Meditation Santhi Kayakalpa Asanas, Kiriyas, Bandas, Muthras.

Assessment

An attendance of 75% is compulsory to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

TEXT BOOKS

1. Yogiraj Vethathiri Maharishi, "*Yoga for Modern Age*", Vethathiri Publishers, 1989.
2. Vethathiri Maharishi. T, "*Simplified Physical Exercises*", Vethathiri Publishers, 1987.

NC1001/ NS1001/ SP1001/ YG1001		**NATIONAL CADET CORPS (NCC)/ NATIONAL SERVICE SCHEME (NSS)/ NATIONAL SPORTS ORGANIZATION (NSO)/YOGA**										
Course Designed by		**NCC/ NSS/ NSO/YOGA UNITS**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	J	k
					x					x		
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER II

PD1002	**SOFT SKILLS-II**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE	
To enhance holistic development of students and improve their employability skills.	
INSTRUCTIONAL OBJECTIVES	
1.	To develop inter personal skills and be an effective goal oriented team player.
2.	To develop professionals with idealistic, practical and moral values.
3.	To develop communication and problem solving skills.
4.	To re-engineer attitude and understand its influence on behavior.

UNIT I - INTERPERSONAL SKILLS (6 hours)

Understanding the relationship between Leadership Networking & Team work, Realizing Ones Skills in Leadership, Networking & Team Work, and Assessing Interpersonal Skills Situation description of Interpersonal Skill.

Team Work

Necessity of Team Work Personally, Socially and Educationally

UNIT II - LEADERSHIP (4 hours)

Skills for a good Leader, Assessment of Leadership Skills

Change Management

Exploring Challenges, Risking Comfort Zone, Managing Change

UNIT III - STRESS MANAGEMENT (6 hours)

Causes of Stress and its impact, how to manage & distress, Understanding the circle of control, Stress Busters.

Emotional Intelligence

What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales. Managing Emotions.

UNIT IV - CONFLICT RESOLUTION (4 hours)

Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

UNIT V - DECISION MAKING **(10 hours)**

Importance and necessity of Decision Making, process of Decision Making, Practical way of Decision Making, Weighing Positives & Negatives.

Presentation

ASSESSMENT

1. A practical and activity oriented course which has a continuous assessment for 75 marks based on class room interaction, activities etc.,
2. Presentation - 25 marks

TEXT BOOK

INSIGHT, 2009. Career Development Centre, SRM Publications.

REFERENCE

1. Covey Sean, "*Seven Habit of Highly Effective Teens"*, New York, Fireside Publishers, 1998.
2. Carnegie Dale," *How to win Friends and Influence People"*, New York: Simon & Schuster, 1998.
3. Thomas. A, Harris," *I am ok, You are ok"* , New York-Harper and Row, 1972.
4. Daniel Coleman," *Emotional Intelligence"*, Bantam Book, 2006.

PD1002 - SOFT SKILLS-II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	J	k
					x		x	x		x		
2.	Mapping of instructional objectives with student outcome				1		2	3		4		
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

	ENGLISH	L	T	P	C
LE1001	Total Contact Hours-45	**1**	**2**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

To help students achieve proficiency in English and develop their professional communication skills to meet the demand in the field of global communication to enable them to acquire placement anywhere with ease and confidence.

INSTRUCTIONAL OBJECTIVES	
1.	To enable students improve their lexical, grammatical and communicative competence.
2.	To enhance their communicative skills in real life situations.
3	To assist students understand the role of thinking in all forms of communication.
4.	To equip students with oral and appropriate written communication skills.
5.	To assist students with employability and job search skills.

UNIT I - INVENTIONS **(9 hours)**

1. Grammar and Vocabulary – Tense and Concord:
2. Listening and Speaking – Common errors in Pronunciation (Individual sounds); Process description (Describing the working of a machine, and the manufacturing process)
3. Writing – Interpretation of data (Flow chart, Bar chart)
4. Reading -- (Reading Comprehension -- Answering questions)

UNIT II - ECOLOGY **(9 hours)**

1. Grammar and Vocabulary – Error Analysis – Synonyms and Antonyms, Parallelisms
2. Listening and Speaking - Conducting Meetings
3. Writing – Notice, Agenda, Minutes , letters to the editor via email : Email etiquette
4. D Reading Comprehension – Summarizing and Note-making

UNIT III - SPACE **(9 hours)**

1. Grammar and Vocabulary – tense and concord; word formation
2. Listening and Speaking – Distinction between native and Indian English (Speeches by TED and Kalam) – accent, use of vocabulary and rendering;
3. Writing – Definitions and Essay writing
4. Reading Comprehension – Predicting the content

UNIT IV - CAREERS **(9 hours)**

1. Grammar and Vocabulary –Homonyms and Homophones
2. Listening and Speaking – – Group Discussion
3. Writing Applying for job, cover letter and resume
4. Reading, etymology (roots ; idioms and phrases), Appreciation of creative writing.

UNIT V – RESEARCH **(9 hours)**

1. Grammar and Vocabulary – Using technical terms, Analogies
2. Listening and Speaking -- Presentation techniques (Speech by the learner)
3. Writing – Project Proposal
4. Reading Comprehension -- Referencing Skills for Academic Report Writing (Research Methodology – Various methods of collecting data) Writing a report based on MLA Handbook

TEXTBOOK

1. Department of English and Foreign Languages. "*English for Engineers*", SRM University Publications, 2013.

REFERENCES

1. Dhanavel. S.P, "*English and Communication Skills for Students of Science and Engineering*"**,** Orient Blackswan Ltd., 2009.
2. Meenakshi Raman and Sangeetha Sharma**.** "*Technical Communication-Principles and Practice*", Oxford University Press, 2009.
3. Day. R A, Scientific English: "*A Guide for Scientists and Other Professionals*", 2nd ed. Hyderabad: Universities Press, 2000.

LE1001 ENGLISH												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	J	k
					x		x	x		x		
2.	Mapping of instructional objectives with student outcome				1-5		1-5	1-5		1-5		
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER I/II

CS1001	PROGRAMMING USING MATLAB	L	T	P	C
	Total Contact Hours – 45	0	1	2	2
	Prerequisite				
	Nil				

PURPOSE

This Lab Course will enable the students to understand the fundamentals and programming knowledge in MATLAB.

INSTRUCTIONAL OBJECTIVES

1.	To learn the MATLAB environment and its programming fundamentals
2.	Ability to write Programs using commands and functions
3.	Able to handle polynomials, and use 2D Graphic commands

LIST OF EXPERIMENTS

1. Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files.
2. Data types, Constants and Variables, Character constants, operators, Assignment statements.
3. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements.
4. Input-Output functions, Reading and Storing Data.
5. Vectors and Matrices, commands to operate on vectors and matrices, matrix Manipulations.
6. Arithmetic operations on Matrices, Relational operations on Matrices, Logical operations on Matrices.
7. Polynomial Evaluation, Roots of Polynomial, Arithmetic operations on Polynomials.
8. Graphics: 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart.

TEXT BOOK

1. Bansal. A.K, Goel. M.K, Sharma, "*MATLAB and its Applications in Engineering*", Pearson Education, 2012.

REFERENCES

1. Amos Gilat, *"MATLAB-An Introduction with Applications"*, Wiley India, 2009.
2. Stephen.J.Chapman, *"Programming in MATLAB for Engineers"*, Cengage Learning, 2011.

CS1001 PROGRAMMING USING MATLAB												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objectives with student outcome	2,3	1-3									1
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)					Professional Subjects (P)	
		x		--		--					--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER III

LE1003	GERMAN LANGUAGE PHASE I	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

Germany offers infinite opportunities for students of engineering for higher studies, research and employment in Germany. B.Tech Students are offered German Language during their second year. Knowledge of the language will be helpful for the students to adjust themselves when they go for higher studies.

INSTRUCTIONAL OBJECTIVES

1.	To introduce the language, phonetics and the special characters in German language
2.	To introduce German culture & traditions to the students.
3.	By the end of Phase – I, the students will be able to introduce themselves and initiate a conversation..
4.	We endeavor to develop the ability among the students to read and understand small texts written in German
5.	To enable the students to elementary conversational skills.

UNIT I (**6 hours)**

Wichtige Sprachhandlungen: Phonetics – Sich begrüßen - Sich und andere vorstellen formell / informell - Zahlen von 1 bis 1 Milliarde - verstehen & sprechen **Grammatik:** regelmäßige Verben im Präsens - "sein" und haben im Präsens - Personalpronomen im Nominativ

UNIT II **(6 hours)**

Wichtige Sprachhandlungen Telefon Nummern verstehen und sprechen Uhrzeiten verstehen und sagen Verneinung "nicht und kein" (formell und informell) **Grammatik** : Wortstellung – Aussagesatz – W-Frage und Satzfrage (Ja/Nein Frage) Nomen buchstabieren und notieren bestimmter und unbestimmter Artikel und Negativartikel im Nom. & Akkusativ

UNIT III **(6 hours)**

Wichtige Sprachhandlungen Tageszeiten verstehen und über Termine sprechen -Verabredungen verstehen - Aufgaben im Haushalt verstehen **Grammatik** Personalpronomen im Akkusativ und Dativ - W-Fragen "wie, wer, wohin,wo, was usw.- Genitiv bei Personennamen - Modalverben im Präsens "können, müssen, möchten"

UNIT IV **(6 hours)**

Wichtige Sprachhandlungen Sich austauschen, was man kann, muss – Bezeichnungen Lebensmittel – Mengenangaben verstehen – Preise verstehen und Einkaufzettel schreiben

Grammatik Wortstellung in Sätzen mit Modalverben – Konnektor "und" – "noch"-kein-------mehr – "wie viel, wie viele, wie alt, wie lange" –Possessivartikel im Nominativ.

UNIT V **(6 hours)**

Wichtige Sprachhandlungen Freizeitanzeigen verstehen – Hobbys und Sportarten Anzeigen für Freizeitpartner schreiben bzw. darauf antworten – Vorlieben und Abneigungen ausdrucken

Grammatik Verben mit Vokalwechsel im Präsens – Modalverben im Präsens " dürfen, wollen und mögen - "haben und sein" im Präteritum – regelmäßige Verben im Perfekt – Konnektoren "denn, oder, aber

TEXT BOOK

Studio d A1. Deutsch als Fremdsprache with CD.(Kursbuch und Sprach training).

REFERENCES

German for Dummies
Schulz Griesbach

LE1003 GERMAN LANGUAGE PHASE I												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-5				
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)					Professional Subjects (P)	
		x		--		--					--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1004	FRENCH LANGUAGE PHASE I	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To enable the student learners acquire a basic knowledge of the French language and concepts of general French for everyday interactions and technical French at the beginner's level and also to get to know the culture of France.

INSTRUCTIONAL OBJECTIVES	
1.	To enable students improve their grammatical competence.
2.	To enhance their listening skills.
3	To assist students in reading and speaking the language.
4.	To enhance their lexical and technical competence.
5.	To help the students introduce themselves and focus on their communication skills.

UNIT I **(6 hours)**

1. Grammar and Vocabulary: Usage of the French verb "se presenter", a verb of self- introduction and how to greet a person- "saluer"
2. Listening and Speaking – The authentic sounds of the letters of the French alphabet and the accents that play a vital role in the pronunciation of the words.
3. Writing – correct spellings of French scientific and technical vocabulary.
4. Reading -- Reading of the text and comprehension – answering questions.

UNIT II **(6 hours)**

1. Grammar and Vocabulary – Definite articles , "prepositions de lieu" subject pron ouns
2. Listening and Speaking – pronunciation of words like Isabelle, presentez and la liaison – vous etes, vous appelez and role play of introducing each other – group activity
3. Writing – particulars in filling an enrollment / registration form
4. Reading Comprehension – reading a text of a famous scientist and answering questions.

UNIT III **(6 hours)**

1. Grammar and Vocabulary – verb of possession "avoir' and 1st group verbs "er", possessive adjectives and pronouns of insistence- moi, lui..and numbers from 0 to 20
2. Listening and Speaking –nasal sounds of the words like feminine, ceinture , parfum and how to ask simple questions on one's name, age, nationality, address mail id and telephone number.
3. Writing –conjugations of first group verbs and paragraph writing on self – introduction and introducing a third person.
4. Reading Comprehension – reading a text that speaks of one's profile and answering questions

UNIT IV **(6 hours)**

1. Grammar and Vocabulary –negative sentences, numbers from 20 to 69, verb "aimer"and seasons of the year and leisure activities.
2. Listening and Speaking – To express one's likes and dislikes and to talk of one's pastime activities (sports activities), je fais du ping-pong and nasal sounds of words – janvier, champagne
3. Writing- conjugations of the irregular verbs – faire and savoir and their usage. Paragraph writing on one's leisure activity- (passé temps favori)
4. Reading- a text on seasons and leisure activities – answering questions.

UNIT V **(6 hours)**

1. Grammar and Vocabulary – les verbes de direction- to ask one's way and to give directions, verbes- pouvoir and vouloir and 2nd group verbs , a droite, la premiere a gauche and vocabulary relating to accommodation.
2. Listening and Speaking – to read and understand the metro map and hence to give one directions – dialogue between two people.
3. Writing –paragraph writing describing the accommodation using the different prepositions like en face de, derriere- to locate .
4. Reading Comprehension -- a text / a dialogue between two on location and directions- ou est la poste/ la pharmacie, la bibliotheque?.....

TEXT BOOK

Tech French

REFERENCES

1. French for Dummies.
2. French made easy-Goyal publishers
3. Panorama

LE1004 FRENCH LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-5				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE 1005	JAPANESE LANGUAGE PHASE I	L	T	P	C
	Total contact hours- 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on Japan, Japanese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the Japanese scripts viz. hiragana and a few basic kanji.
2.	To make the students acquire basic conversational skill.
3.	To enable students to know about Japan and Japanese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Japan.

UNIT I

Introduction to Japanese language. Hiragana Chart 1 - vowels and consonants and related vocabulary.
Self introduction
Grammar – usage of particles wa, no, mo and ka and exercises
Numbers (1-100)
Kanji – introduction and basic kanjis – naka, ue, shita, kawa and yama Greetings, seasons, days of the week and months of the year Conversation – audio
Japan – Land and culture

UNIT II

Hiragana Chart 1 (contd.) and related vocabulary
Grammar – usage of kore, sore, are, kono, sono, ano, arimasu and imasu. Particles – ni (location) and ga. Donata and dare.
Numbers (up to 99,999)
Kanji – numbers (1-10, 100, 1000, 10,000 and yen)
Family relationships and colours.
Conversation – audio
Festivals of Japan

UNIT III

Hiragana Charts 2&3, double consonants, vowel elongation and related vocabulary
Lesson 3
Grammar - particles ni (time), kara, made and ne. Koko, soko, asoko and doko.
Time expressions (today, tomorrow, yesterday, day before, day after)
Kanji – person, man, woman, child, tree and book
Directions – north, south, east and west

UNIT IV

Grammar - directions,-kochira, sochira, achira and dochira. Associated vocabulary (mae, ushiro, ue, shita, tonari, soba, etc.)

Conversation – audio

Japanese art and culture like ikebana, origami, etc.

UNIT V

Kanji – hidari, migi, kuchi

Japanese sports and martial arts

REFERENCES

1. First lessons in Japanese, ALC Japan
2. Japanese for dummies. Wiley publishing co. Inc., USA.
3. Kana workbook, Japan foundation

LE1005 JAPANESE LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)					Professional Subjects (P)	
		x		--		--					--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1006	**KOREAN LANGUAGE PHASE I**	**L**	**T**	**P**	**C**
	Total contact hours-30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on Korea, Korean language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the scripts.
2.	To make the students acquire basic conversational skill.
3.	To enable students to know about Korean culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Korea.

UNIT I

Lesson 1 < Introduction to Korean Language >, Lesson2 < Consonants and Vowels >, <Basic Conversation, Vocabularies and Listening >

UNIT II

Lesson 3 < Usage of "To be" >, Lesson 4 < Informal form of "to be" >, Lesson 5 <Informal interrogative form of "to be" >, Lesson 6 < To be, to have, to stay >, < Basic Conversation, Vocabularies and Listening >

UNIT III

Lesson 7 < Interrogative practice and Negation >, < Basic Conversation, Vocabularies and Listening >

UNIT IV

Lesson 8 < Korean Culture and Business Etiquette >, < Basic Conversation, Vocabularies and Listening

REFERENCES

1. Korean Through English 1 (Basic Korean Grammar and Conversation)
2. Bharati Korean (Intermediate Korean Grammar)
3. Hand-outs
4. Various visual mediums such Movie CD, Audio CD
5. Collection of vocabularies for engineering field.

LE1006 KOREAN LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1007	**CHINESE LANGUAGE PHASE I**	**L**	**T**	**P**	**C**
	Total contact hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	NIL				

PURPOSE

To enable students achieve a basic exposure on China, Chinese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES	
1.	To help students learn the Chinese scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about China and Chinese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with china.

UNIT I

Introduction of Chinese Language

UNIT II

Phonetics and Notes on pronunciation

a) 21 Initials:

b p m f d t n l g k h j q x z c s zh ch sh r

b) 37 Finals:

a	o	e	I	u	ü
ai	ou	ei	ia	ua	üe
an	ong	en	ian	uai	üan
ang	eng	iang	uan	ün	
ao	er	iao	uang		
			ie	uei(ui)	
			in	uen(un)	
			ing	ueng	
			iong	uo	
			iou(iu)		

c) The combination of Initials and Finals - Pinyin

UNIT III

Introduction of Syllables and tones

a) syllable=initial+final+tone

b) There are four tones in Chinese: the high-and-level tone, the rising tone, the falling-and-rising tone, and the falling tone. And the markers of the different tones.

UNIT IV

A. Tones practice

B. the Strokes of Characters

1. Introduction of Chinese Characters
2. The eight basic strokes of characters

UNIT V

1. **Learn to read and write the Characters:**
   八(eight) 不(not) 马(horse) 米(rice) 木(wood).
2. **classes are organized according to several Mini-dialogues.**

TEXT BOOK

A New Chinese Course 1- Beijing Language and Culture University Press.

REFERENCES

1. New Practical Chinese Reader Textbook (1) – Beijing Language and Culture University Press.
2. 40 Lessons For Basic Chinese Course I – Shanghai Translation Press.
3. My Chinese Classroom - East China Normal University Press.

LE1007 CHINESE LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

PD1003	**APTITUDE-I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				
PURPOSE					
To enhance holistic development of students and improve their employability skills.					
INSTRUCTIONAL OBJECTIVES					
1.	To improve aptitude, problem solving skills and reasoning ability of the student.				
2.	To collectively solve problems in teams & group.				

UNITI - NUMBERS(6 hours)

Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

UNITII - ARITHMETIC–I (6 hours)

Percentages, Profit & Loss, Simple Interest & Compound Interest, , Clocks & calendars

UNITIII - ALGEBRA-I **(6 hours)**

Logarithms, Problems on ages

UNITIV - MODERNMATHEMATICS-I **(6 hours)**

Permutations, Combinations, Probability

UNIT V - REASONING **(6 hours)**

Logical Reasoning, Analytical Reasoning

ASSESSMENT

Objective type – Paper based / Online – Time based test

REFERENCE

1. Agarwal. R.S – *"Quantitative Aptitude for Competitive Examinations,"* S.Chand Limited 2011.
2. Abhijit Guha*, "Quantitative Aptitude for Competitive Examinations",* Tata McGraw Hill, 3rd Edition*,* 2011.
3. Edgar Thrope, *"Test Of Reasoning for Competitive Examinations",* Tata McGraw Hill, 4th Edition, 2012.
4. *"Other material related to quantitative aptitude"*

PD1003 – APTITUDE-I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcome	1			2							
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER IV

LE1008	**GERMAN LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1003-German Language Phase I				

PURPOSE

Familiarity in German language will be helpful for the students in preparing their resumes in German. Proficiency in the language will be an added asset for the students to have an edge in the present day highly competitive and global job market.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to speak and understand about most of the activities in the day to day life.
2.	The students will be able to narrate their experiences in Past Tense.
3.	The students will be able to understand and communicate even with German Nationals.
4.	By the end of Phase – II the students will have a reasonable level of conversational skills.

UNIT - I **(6 hours)**

Wichtige Sprachhandlungen: Zimmersuche, Möbel

Grammatik: Verben mit trennbaren Vorsilben im Präsens und Perfekt. Verben mit trennbaren Vorsilben und Modalverben imPräsens. Verben mit untrennbaren Vorsilben im Perfekt. Unregelmäßige und gemischte Verben im Perfekt.

UNIT - II **(6 hours)**

Wichtige Sprachhandlungen: Kleidung ,Farben , Materialien.

Grammatik : formelle Imperativsätze mit “Sie” informelle Imperativsätze Vorschläge mit “wir” – “sollen/wollen wir”—Soll ich? Modalpartikeln “doch” “mal” “doch mal.

UNIT - III **(6 hours)**

Wichtige Sprachhandlungen : Sehenswürdigkeite (Prater, Brandenburger Tör,Kolossium, Eifeltürm)

Grammatik : Ortsangaben mit Akk. und Dativ “alle”,”man” Indefinitepronomen “etwas”, “nichts”,

UNIT - IV **(6 hours)**

Wichtige Sprachhandlungen : Wegbeschreibung/ Einladung interkulturelle Erfahrung. Grammatik : Verwendung von Präsens für zukünftigen Zeitpunkt.

UNIT - V **(6 hours)**

Wichtige Sprachhandlungen: Essen und Trinken im Restaurant , Partyvorbereitung und Feier

Grammatik: Nomen aus Adjektiven nach "etwas"und "nichts" Nomen aus dem Infinitiv von Verben, zusammegesetzte Nomen und ihre Artikel. Adjektive im Nom. und Akk. nach unbestimmten Artikel, Negativartikel und Possessivartikel.

TEXT BOOK

Studio d A1. Deutsch als Fremdsprache with CD.(Kursbuch und Sprachtraining).

REFERENCES

German for Dummies
Schulz Griesbach

LE01008 GERMAN LANGUAGE PHASE II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1009	**FRENCH LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1004- French Language Phase I				

PURPOSE	
To enable the students communicate effectively with any French speaker and have a competitive edge in the international market.	
INSTRUCTIONAL OBJECTIVES	
1.	To enable students access information on the internet
2.	To receive and send e mails
3	To assist students in gaining a certain level of proficiency to enable them to give the level 1 exam conducted by Alliance Française de Madras.
4.	To enhance their lexical and technical competence.

UNIT – I **(6 hours)**

1. Grammar and Vocabulary: The second group verbs: Finir, rougir, grossir, grandir . “Les preposition de temps”: à, en, le, de 7h à 8h, jusqu’ à, vers.
2. Listening and Speaking – the semi- vowels: Voilà, pollutant. Writing –the days of the week. Months, technical subjects, time, “les spécialités scientifiques et l’ année universitaire, paragraph writing about time table.
3. Reading -- Reading of the text and comprehension – answering questions

UNIT – II **(6 hours)**

Grammar and Vocabulary – The adjectives, the nationality, feminine & masculine noun forms “les métiers scientifiques”.
Listening and Speaking – Vowels: soirée, année, près de, très.
Writing – Countries name, nationality, “les métiers scientifiques”, numbers from: 69 to infitive and some measures of unit.
Reading Comprehension – reading a text.

UNIT – III **(6 hours)**

Grammar and Vocabulary – near future, The demonstrative adjectives, Express the aim by using the verb, Listening and Speaking –“La liaison interdite – en haut”. Writing – some scientific terms, French expressions to accept an invitation. Sentence framing. Reading Comprehension – reading a text.

UNIT – IV **(6 hours)**

Grammar and Vocabulary –the verbs: manger, boire , the partitive articles
Listening and Speaking – “le ‘e’ caduc Writing- the food, the ingredients, fruits, vegetables, expression of quantity, paragraph writing about food habits. Reading – reading a text.

UNIT – V **(6 hours)**

Grammar and Vocabulary – “ les prepositions de lieu”: au à la, à l’, chez, the reflexives verbs, verbs to nouns. Listening and Speaking – “le ‘e’ sans accents ne se prononce pas. C’est un “e” caduc. Ex: quatre, octobre. “ les sons (s) et (z)- salut , besoin. Writing –paragraph writing about one’s everyday life, French culture. Reading Comprehension -- reading a text or a song.....

TEXT BOOK

Tech French

REFERENCES

1. French for Dummies
2. French made easy: Goyal publishers
3. Panorama

LE1009 FRENCH LANGUAGE PHASE II												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE 1010	JAPANESE LANGUAGE PHASE II	L	T	P	C
	Total Contact Hours- 30	2	0	0	2
	Prerequisite				
	LE1005- Japanese Language Phase I				

PURPOSE

To enable students to learn a little advanced grammar in order to improve their conversational ability in Japanese.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn Katakana script (used to write foreign words)
2.	To improve their conversational skill.
3	To enable students to know about Japan and Japanese culture.
4.	To improve their employability by companies who are associated with Japan.

UNIT – I **(8 hours)**

Introduction to Verbs; Ikimasu, okimasu, nemasu, tabemasu etc.
Grammar – usage of particles de, o, to, ga(but) and exercises
Common daily expressions and profession.
Katakana script and related vocabulary.
Religious beliefs, Japanese housing and living style.
Conversation – audio

UNIT – II **(8 hours)**

Grammar :Verbs –Past tense, negative - ~mashita, ~masen deshita..
i-ending and na-ending adjectives - introduction
Food and transport (vocabulary)
Japanese food, transport and Japanese tea ceremony.
Kanji Seven elements of nature (Days of the week)
Conversation – audio

UNIT – III **(6 hours)**

Grammar - ~masen ka, mashou
Adjectives (present/past – affirmative and negative)
Conversation – audio

UNIT – IV **(4 hours)**

Grammar – ~te form
Kanji – 4 directions
Parts of the body
Japanese political system and economy
Conversation – audio

UNIT – V **(4 hours)**

Stationery, fruits and vegetables
Counters – general, people, floor and pairs

TEXT BOOK

First lessons in Japanese, ALC Japan

REFERENCES

1. Japanese for dummies. Wiley publishing co. Inc., USA.
2. Kana workbook, Japan foundation

LE1010 JAPANESE LANGUAGE PHASE II												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1011	KOREAN LANGUAGE PHASE II	L	T	P	C
	Total Contact Hours-30	2	0	0	2
	Prerequisite				
	LE1006-Korean Language Phase I				

PURPOSE

To enable students achieve a basic exposure on Korea, Korean language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES	
1.	To help students learn the scripts.
2.	To make the students acquire basic conversational skill.
3.	To enable students to know about Korean culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Korea.

UNIT - I (**9 hours)**

Lesson 1 <Review of Vowels and Consonants>, Lesson2 < Various Usages of "To be">, Lesson3 < Informal form of "to be"> <Basic Conversation, Vocabularies and Listening>

UNIT - II (**9 hours)**

Lesson 4 < Informal interrogative form of "to be">, Lesson 5 < To be, to have, to stay>, Lesson 5 < Advanced Interrogative practice>, Lesson 6 < Types of Negation>, <Basic Conversation, Vocabularies and Listening>

UNIT - III (**9 hours)**

Lesson 7 < Honorific forms of noun and verb2>, Lesson8 < Formal Declarative2>, Lesson 9 < Korean Business Etiquette>, <Basic Conversation, Vocabularies and Listening>

UNIT - IV (**3 hours)**

Lesson 10 <Field Korean as an Engineer1>, <Field Korean as an Engineer2> <Basic Conversation, Vocabularies and Listening>

TEXT BOOK

Korean through English 2 (Basic Korean Grammar and Conversation)

REFERENCES

1. Bharati Korean (Intermediate Korean Grammar)
2. Hand-outs
3. Various visual media such Movie CD, Audio CD, and music
4. Collection of vocabularies for engineering field.

LE1011 KOREAN LANGUAGE PHASE II												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)	Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		x	--			--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1012	CHINESE LANGUAGE PHASE II	L	T	P	C
	Total Contact Hours-30	2	0	0	2
	Prerequisite				
	LE1007-Chinese Language Phase I				

PURPOSE

To enable students achieve a basic exposure on China, Chinese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1. To help students learn the Chinese scripts.
2. To make the students acquire basic conversational skill.
3. To enable students to know about China and Chinese culture.
4. To create an advantageous situation for the students to have better opportunity for employability by companies who have association with china.

UNIT - I

A) Greetings
Questions and answers about names
Introducing oneself
Receiving a guest
Making corrections

New words: 你ˆyouˇ 好ˆgood 'wellˇ
工作ˆwork 'jobˇ人员ˆpersonnel 'staff memberˇ请问ˆMay I ask…ˇ
贵ˆexpensive 'valuableˇ 姓ˆone's family name isˇ

B) Questions and answers about the number of people in a family
Expressing affirmation/negation
Questions and answers about the identity of a person same or not.

New words: 家ˆfamily 'homeˇ 有ˆhaveˇ 几ˆseveralˇ
爸爸 (fatherˇ 妈妈 (mother) 哥哥 (elderly brotherˇ

UNIT - II

A. About places
B. About numbers
C. if one knows a certain person
D. Expressing apology
E. Expressing affirmation/negation
F. Expressing thanks.

New Words:

客人﹀guest,visitor﹀这儿﹀here﹀中文﹀Chinese﹀ 对﹀right, correct﹀ 学生﹀student﹀ 多﹀many, a lot﹀

Grammar: Sentences with a verbal predicate

UNIT - III

Introducing people to each other

A. Exchanging amenities
B. Making/Negating conjectures
C. Questions and answers about nationality

Grammar: Sentences with an adjectival predicate

UNIT - IV

A) About places to go
Indicating where to go and what to do
Referring to hearsay.
Saying good-bye

B) Making a request
Questions and answers about postcodes and telephone numbers
Reading dates postcodes and telephone numbers
Counting Renmibi

Grammar: Sentences with a subject-verb construction as its predicate
Sentences with a nominal predicate

UNIT - V

A. Asking and answering if someone is free at a particular time
B. Making proposals
C. Questions about answers about time
D. Making an appointment
E. Telling the time
F. Making estimations

TEXT BOOK

A New Chinese Course 1- Beijing Language and Culture University Press

REFERENCES

1. New Practical Chinese Reader Textbook (1) – Beijing Language and Culture University Press
2. 40 Lessons For Basic Chinese Course I – Shanghai Translation Press
3. My Chinese Classroom - East China Normal University Press

LE1012 CHINESE LANGUAGE PHASE II												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)	Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		x	--			--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

PD1004	APTITUDE-II	L	T	P	C
	Total Contact Hours – 30	1	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	To improve verbal aptitude, vocabulary enhancement and reasoning ability of the student.

UNIT - I **(6 hours)**

Critical Reasoning – Essay Writing

UNIT - II **(6 hours)**

Synonyms – Antonyms - Odd Word - Idioms & Phrases

UNIT - III **(6 hours)**

Word Analogy - Sentence Completion

UNIT - IV **(6 hours)**

Spotting Errors - Error Correction - Sentence Correction

UNIT - V **(6 hours)**

Sentence Anagram - Paragraph Anagram - Reading Comprehension

ASSESSMENT

Objective type – Paper based /Online – Time based test

TEXT BOOK:

Personality Development -Verbal Work Book, Career Development Centre, SRM Publications

REFERENCE

1. Green Sharon Weiner.M.A, & Wolf Ira K.*Barron's New GRE*, *19th Edition*. Barron's Educational Series, Inc, 2011.
2. Lewis Norman, *Word Power Made Easy*, Published by W.R.Goyal Pub, 2011.
3. Thorpe Edgar and Thorpe Showich, *Objective English.* Pearson Education 2012.
4. Murphy Raymond, *Intermediate English Grammar*, (Second Edition), Cambridge University Press, 2012.

PD1004 - APTITUDE-II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER V

PD1005	APTITUDE-III	L	T	P	C
	Total Contact Hours – 30	1	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	Understand the importance of effective communication in the workplace.
2.	Enhance presentation skills – Technical or general in nature.
3.	Improve employability scope through Mock GD, Interview

UNIT - I **(6 hours)**

Video Profile

UNIT - II **(6 hours)**

Tech Talk / Area of Interest / Extempore / Company Profile

UNIT - III **(6 hours)**

Curriculum Vitae

UNIT- IV **(6 hours)**

Mock Interview

UNIT - V **(6 hours)**

Group Discussion / Case Study

ASSESSMENT

1. Objective type – Paper based / Online – Time based test
2. 50% marks based on test, 50 % based on Continuous Communication assessment

REFERENCE

1. Bovee Courtland and Throill John, *Business Communication Essentials: A skills-Based Approach to Vital Business English*. Pearson Education Inc., 2011.
2. Dhanavel. S.P, *English & Communication Skills for Students of Science and Engineering*. Orient Black Swan, 2009.
3. Rizvi. M, Ashraf *Effective Technical Communication*, Tata McGraw-Hill Publishing Company Limited, 2006.

PD1005 – APTITUDE-III												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								X		X	X	
2.	Mapping of instructional objectives with student outcome							1,2,3		1,2		2,3
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER VI

	APTITUDE-IV	L	T	P	C
PD1006	Total Contact Hours – 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	To improve aptitude, problem solving skills and reasoning ability of the student.
2.	To collectively solve problems in teams & group.

UNIT I - ARITHMETIC - II **(6 hours)**

Ratios & Proportions, Averages, Mixtures & Solutions

UNIT II - ARITHMETIC – III **(6 hours)**

Time, Speed & Distance, Time & Work

UNIT III - ALGEBRA – II **(6 hours)**

Quadratic Equations, Linear equations & inequalities

UNIT IV - GEOMETRY **(6 hours)**

2D Geometry, Trigonometry, Mensuration

UNIT V – MODERN MATHEMATICS – II **(6 hours)**

Sets & Functions, Sequences & Series, Data Interpretation, Data Sufficiency

ASSESSMENT

Objective type – Paper based / Online – Time based test

REFERENCE

1. Agarwal,R.S – *"Quantitative Aptitude for Competitive Examination"s,* S Chand Limited 2011.
2. Abhijit Guha*, "Quantitative Aptitude for Competitive Examinations",* Tata Mcgraw Hill, 3rd Edition
3. Edgar Thrope*, "Test Of Reasoning For Competitive Examinations",* Tata Mcgraw Hill, 4th Edition
4. *"Other material related to quantitative aptitude"*

PD1006 - APTITUDE-IV												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcome	1			2							
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

CATEGORY: BASIC SCIENCES

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	C
SEMESTER I						
MA1001	B	CALCULUS AND SOLID GEOMETRY	3	2	0	4
PY1001	B	PHYSICS	3	0	0	3
PY1002	B	PHYSICS LAB	0	0	2	1
CY1001	B	CHEMISTRY	3	0	0	3
CY1002	B	CHEMISTRY LAB	0	0	2	1
SEMESTER II			**L**	**T**	**P**	**C**
MA1002	B	ADVANCED CALCULUS AND COMPLEX ANALYSIS	3	2	0	4
PY1003	B	MATERIAL SCIENCE	2	0	2	3
CY1003	B	PRINCIPLES OF ENVIRONMENTAL SCIENCE	2	0	0	2
SEMESTER I / II			**L**	**T**	**P**	**C**
BT1001	B	BIOLOGY FOR ENGINEERS	2	0	0	2
SEMESTER III			**L**	**T**	**P**	**C**
MA1013	B	FOURIER SERIES, PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS	4	0	0	4
SEMESTER IV			**L**	**T**	**P**	**C**
MA1004	B	NUMERICAL METHODS	4	0	0	4
SEMESTER V			**L**	**T**	**P**	**C**
CH1013	B	COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING	3	0	0	3

SEMESTER I

MA1001	**CALCULUS AND SOLID GEOMETRY**	**L**	**T**	**P**	**C**
	Total Contact Hours-75	3	2	0	4
	(Common to all Branches of Engineering except Bio group)				

PURPOSE

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To apply advanced matrix knowledge to Engineering problems.
2.	To equip themselves familiar with the functions of several variables.
3.	To familiarize with the applications of differential equations.
4.	To improve their ability in solving geometrical applications of differential calculus problems
5.	To expose to the concept of three dimensional analytical geometry.

UNIT I - MATRICES (15 hours)

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley – Hamilton theorem orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformations.

UNIT II - FUNCTIONS OF SEVERAL VARIABLES (15 hours)

Function of two variables – Partial derivatives – Total differential – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrangian Multiplier method – Jacobians – Euler's theorem for homogeneous function.

UNIT III - ORDINARY DIFFERENTIAL EQUATIONS (15 hours)

Linear equations of second order with constant and variable coefficients – Homogeneous equation of Euler type – Equations reducible to homogeneous form – Variation of parameter – Simultaneous first order with constant co-efficient.

UNIT IV - GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS (15 hours)

Curvature – Cartesian and polar coordinates – Circle of curvature – Involutes and Evolutes – Envelopes – Properties of envelopes.

UNIT V - THREE DIMENSIONAL ANALYTICAL GEOMETRY (15 hours)

Equation of a sphere – Plane section of a sphere – Tangent Plane – Orthogonal Sphere - Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

TEXT BOOKS

1. Kreyszig. E, "*Advanced Engineering Mathematics*", John Wiley & Sons. Singapore, 10th edition, 2012.
2. Ganesan. K Sundarammal Kesavan, K.S.Ganapathy Subramanian & Srinivasan. V "*Engineering Mathematics*",Gamma publications, Revised Edition, 2013.

REFERENCES

1. Grewal. B.S, Higher "*Engineering Mathematics"*, Khanna Publications, 42nd Edition,2012.
2. Veerajan. T, "*Engineering Mathematics I*", Tata McGraw Hill Publishing Co, New Delhi, 5th edition, 2006.
3. Kandasamy. P etal. "*Engineering Mathematics*", Vol.I (4th revised edition), S.Chand &Co., New Delhi, 2000.
4. Narayanan. S, Manicavachagom Pillay T.K., Ramanaiah G., "*Advanced Mathematics for Engineering students*", Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
5. Venkataraman. M.K, "*Engineering Mathematics*" – First Year (2nd edition), National Publishing Co., Chennai, 2000.

MA1001 CALCULUS AND SOLID GEOMETRY												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1-5				1-5						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

PY1001	PHYSICS	L	T	P	C
	Total Contact Hours-45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of physical concepts and underlying various engineering and technological applications. In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.

INSTRUCTIONAL OBJECTIVES

1.	To understand the general scientific concepts required for technology
2.	To apply the Physics concepts in solving engineering problems
3.	To educate scientifically the new developments in engineering and technology
4.	To emphasize the significance of Green technology through Physics principles

UNIT I – MECHANICAL PROPERTIES OF SOLIDS AND ACOUSTICS (9 hours)

Mechanical properties of solids: Stress-strain relationship – Hooke's law – Torsional Pendulum – Young's modulus by cantilever – Uniform and non-uniform bending — Stress-strain diagram for various engineering materials – Ductile and brittle materials – Mechanical properties of Engineering materials (Tensile strength, Hardness, Fatigue, Impact strength, Creep) – Fracture – Types of fracture (Elementary ideas).

Acoustics: Intensity – Loudness – Absorption coefficient and its determination – Reverberation – Reverberation time – Factors affecting acoustics of buildings and their remedies – Sources and impacts of noise – Sound level meter – Strategies on controlling noise pollution – Ultrasonic waves and properties – Methods of Ultrasonic production (Magnetostriction and Piezoelectric) – Applications of Ultrasonics in Engineering and medicine.

UNIT II – ELECTROMAGNETIC WAVES, CIRCUITS AND APPLICATIONS(9 hours)

Del operator – grad, div, curl and their physical significances - displacement current –Maxwell's equations (derivation) – Wave equation for electromagnetic waves – Propagation in free space – Poynting theorem – Characteristic of Transverse electric and magnetic waves – Skin depth – Rectangular and circular waveguides – High powered vacuum-based cavity magnetrons – Applications including radars, microwave oven and lighting systems.

UNIT I II - LASERS AND FIBER OPTICS (9 hours)

Lasers: Characteristics of Lasers – Einstein's coefficients and their relations – Lasing action – Working principle and components of CO_2 Laser, Nd-YAG Laser, Semiconductor diode Laser, Excimer Laser and Free electron Laser – Applications in Remote sensing, holography and optical switching – Mechanism of Laser cooling and trapping.

Fiber Optics: Principle of Optical fiber – Acceptance angle and acceptance cone – Numerical aperture – V-number – Types of optical fibers (Material, Refractive index and mode) – Photonic crystal fibers – Fiber optic communication – Fiber optic sensors.

UNIT IV – QUANTUM MECHANICS AND CRYSTAL PHYSICS (9 hours)

Quantum mechanics: Inadequacies of Classical Mechanics – Duality nature of electromagnetic radiation – De Broglie hypothesis for matter waves – Heisenberg's uncertainty principle –Schrödinger's wave equation – Particle confinement in 1D box (Infinite Square well potential). **Crystal Physics:** Crystal directions – Planes and Miller indices – Symmetry elements – Quasi crystals – Diamond and HCP crystal structure – Packing factor – Reciprocal lattice – Diffraction of X-rays by crystal planes – Laue method and powder method – Imperfections in crystals.

UNIT V – GREEN ENERGY PHYSICS (9 hours)

Introduction to Green energy – **Solar energy:** Energy conversion by photovoltaic principle – Solar cells – **Wind energy:** Basic components and principle of wind energy conversion systems – **Ocean energy:** Wave energy – Wave energy conversion devices – Tidal energy – single and double basin tidal power plants – Ocean Thermal Electric Conversion (OTEC) – **Geothermal energy:** Geothermal sources (hydrothermal, geo-pressurized hot dry rocks, magma) – **Biomass:** Biomass and bio-fuels – bio-energies from wastages – **Fuel cells**: H_2O_2 – **Futuristic Energy:** Hydrogen – Methane Hydrates – Carbon capture and storage (CCS).

* One problem sheet consisting of 10 to 15 problems is to be prepared for each unit and discussed in the class.
* Few problems based on design considerations related to appropriate branches of engineering can be incorporated in each problem sheet.

TEXT BOOKS

1. Thiruvadigal,..J. D, Ponnusamy,S..Sudha.D and Krishnamohan M, *"Physics for Technologists"*, Vibrant Publication, Chennai, 2013.
2. Dattu Joshi. R. "Engineering Physics",Tata McGraw- Hill,New Delih,2010.

REFERENCES

1. Wole Soboyejo, "*Mechanical Properties of Engineered Materials*", Marcel Dekker Inc., 2003.
2. Frank Fahy, "*Foundations of Engineering Acoustics*", Elsevier Academic Press, 2005.
3. Alberto Sona, "*Lasers and their applications*", Gordon and Breach Science Publishers Ltd., 1976.
4. David. J, Griffiths, "*Introduction to electrodynamics*", 3rd ed., Prentice Hall, 1999.
5. Leonard. I, Schiff, "*Quantum Mechanics"*, Third Edition, Tata McGraw Hill, 2010.
6. Charles Kittel, "*Introduction to Solid State Physics*", Wiley India Pvt. Ltd, 7th ed., 2007.
7. Godfrey Boyle, "*Renewable Energy: Power sustainable future*", 2nd edition, Oxford University Press, UK, 2004.

PY1001 PHYSICS												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x		x		x						x
2.	Mapping of instructional objectives with student outcome	1		4		2						3
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		--		x		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

PY1002	**PHYSICS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to develop scientific temper in experimental techniques and to reinforce the physics concepts among the engineering students

INSTRUCTIONAL OBJECTIVES

1.	To gain knowledge in the scientific methods and learn the process of measuring different Physical variables
2.	Develop the skills in arranging and handling different measuring instruments
3.	Get familiarized with experimental errors in various physical measurements and to plan / suggest on how the contributions could be made of the same order, so as to minimize the errors.

LIST OF EXPERIMENTS

1. Determination of Young's modulus of a given material – Uniform / Non-uniform bending methods.
2. Determination of Rigidity modulus of a given material – Torsion pendulum
3. Determination of dispersive power of a prism – Spectrometer
4. Determination of laser parameters – divergence and wavelength for a given laser source –laser grating/ Particle size determination using laser
5. Study of attenuation and propagation characteristics of optical fiber cable
6. Calibration of voltmeter / ammeter using potentiometer
7. Construction and study of IC regulation properties of a given power supply
8. Study of electrical characteristics of a solar cell
9. Mini Project – Concept based Demonstration

TEXT BOOKS

1. Thiruvadigal. J. D, Ponnusamy. S, Sudha. D and Krishnamohan .M, "*Physics for Technologists"*, Vibrant Publication, Chennai, 2013
2. Shukla. R.K and Anchal Srivastava, "*Practical Physics*", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

REFERENCES

1. Souires, "*Practical Physics:*", 4th Edition, Cambridge University, UK, 2001.
2. Chattopadhyay. D Rakshit. P. C and Saha. B "*An Advanced Course in Practical Physics*", 2nd ed., Books & Allied Ltd., Calcutta, 1990.

PY1002 PHYSICS LABORATORY												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x			x						
2.	Mapping of instructional objectives with student outcome	1	3			2						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

CY1001	**CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To enable the students to acquire knowledge in the principles of chemistry for engineering applications

INSTRUCTIONAL OBJECTIVES	
1.	The quality of water and its treatment methods for domestic and industrial applications.
2.	The classification of polymers, different types of polymerizations, preparation, properties and applications of important polymers and FRPs.
3.	The phase rule and its application to one and two component systems.
4.	The principle, types and mechanism of corrosion and protective coatings.
5.	The classification and selection of lubricants and their applications.
6.	The basic principles, instrumentation and applications of analytical techniques

UNIT I - WATER TREATMENT (9 hours)

Water quality parameters: Physical, Chemical & Biological significance - Hardness of water - estimation of hardness (EDTA method) - Dissolved oxygen – determination (Winkler's method), Alkalinity - determination - disadvantages of using hard water in boilers: Scale, sludge formation - disadvantages - prevention - treatment: Internal conditioning - phosphate, carbon and carbonate conditioning methods - External: Zeolite, ion exchange methods - desalination - reverse osmosis and electrodialysis - domestic water treatment.

UNIT II - POLYMERS AND REINFORCED PLASTICS (9 hours)

Classification of polymers - types of polymerization reactions - mechanism of addition polymerization: free radical, ionic and Ziegler - Natta - effect of structure on the properties of polymers - strength, plastic deformation, elasticity and crystallinity -Preparation and properties of important resins: Polyethylene, PVC, PMMA, Polyester, Teflon, Bakelite and Epoxy resins - compounding of plastics - moulding methods - injection, extrusion, compression and calendaring - reinforced plastics - FRP – Carbon and Glass- applications.

UNIT III - PHASE EQUILIBRIA, LUBRICANTS AND ADHESIVES (9 hours)

Phase rule: Statement - explanation of the terms involved - one component system (water system only). Condensed phase rule - thermal analysis - two component systems: simple eutectic, Pb-Ag; compound formation, Zn-Mg.

Lubricants: Classification –solid, semi solid, liquid, emulsion- properties – selection of lubricants for different purposes, Adhesives: classification-natural, synthetic, inorganic- Adhesive action - applications.

UNIT IV - CORROSION AND ITS CONTROL (9 hours)

Corrosion: Basic concepts - mechanism of chemical, electrochemical corrosion - Pilling Bedworth rule – Types of Electrochemical corrosion - galvanic corrosion - differential aeration corrosion - pitting corrosion - stress corrosion – Measurement of corrosion (wt. loss method only) - factors influencing corrosion. Corrosion control: Cathodic protection - sacrificial anodic method - corrosion

inhibitors. Protective coatings: surface preparation for metallic coatings - electro plating (copper plating) and electroless plating (Nickel plating) - chemical conversion coatings - anodizing, phosphating & chromate coating.

UNIT V - INSTRUMENTAL METHODS OF ANALYSIS (9 hours)

Basic principles, instrumentation and applications of potentiometry, UV - visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy and flame photometry .

TEXT BOOKS

1. Kamaraj. P & Arthanareeswari. M, "*Applied Chemistry", 9th Edition*, Sudhandhira Publications, 2012.
2. Dara. S.S a Text book of Engineering Chemistry, 10th Edition, S.Chand & Company Ltd., New Delhi, 2003.

REFERENCES

1. Jain.P.C and Monika Jain, "*Engineering Chemistry*", Danpat Rai publishing company (P) Ltd, New Delhi, 2010.
2. Helen P Kavitha, "*Engineering Chemistry – I", Scitech* Publications, 2nd edition, 2008.

CY1001 CHEMISTRY												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x		x						x
2.	Mapping of instructional objectives with student outcome	1-6	1,5	3		2						4
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

CY1002	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To apply the concepts of chemistry and develop analytical skills for applications in engineering.

INSTRUCTIONAL OBJECTIVES

To enable the students to understand the basic concepts involved in the analyses.

LIST OF EXPERIMENTS

1. Preparation of standard solutions
2. Estimation of total, permanent and temporary hardness by EDTA method
3. Conductometric titration - determination of strength of an acid
4. Estimation of iron by potentiometry.
5. Determination of molecular weight of polymer by viscosity average method
6. Determination of dissolved oxygen in a water sample by Winkler's method
7. Determination of Na / K in water sample by Flame photometry (Demonstration)
8. Estimation of Copper in ore
9. Estimation of nickel in steel
10. Determination of total alkalinity and acidity of a water sample
11. Determination of rate of corrosion by weight loss method.

REFERENCES

1. Kamaraj & Arthanareeswari, Sudhandhira Publications "*Practical Chemistry*" (work book) , 2011.
2. Helen Kavitha. P "*Chemistry Laboratory Manual*" , Scitech Publications, 2008.

CY1002 CHEMISTRY LABORATORY												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objectives with student outcome	1	1									1
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER II

	ADVANCED CALCULUS AND COMPLEX ANALYSIS	L	T	P	C
MA1002	Total Contact Hours -75	3	2	0	4
	Common to all Branches of Engineering except Bio group)				

PURPOSE

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To have knowledge in multiple calculus
2.	To improve their ability in Vector calculus
3.	To equip themselves familiar with Laplace transform
4.	To expose to the concept of Analytical function
5.	To familiarize with Complex integration

UNIT I - MULTIPLE INTEGRALS (**12 hours)**

Double integration in Cartesian and polar coordinates – Change of order of integration – Area as a double integral – Triple integration in Cartesian coordinates – Conversion from Cartesian to polar – Volume as a Triple Integral.

UNIT II - VECTOR CALCULUS (12 hours)

Gradient, divergence, curl – Solenoidal and irrotational fields – Vector identities (without proof) – Directional derivatives – Line, surface and volume integrals – Green's, Gauss divergence and Stoke's theorems (without proof) – Verification and applications to cubes and parallelopipeds only.

UNIT III - LAPLACE TRANSFORMS (12 hours)

Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – periodic functions – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only.

UNIT IV - ANALYTIC FUNCTIONS (12hours)

Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions - Determination of harmonic conjugate – Milne-Thomson's method – Conformal mappings: 1/z, az, az+b and bilinear transformation.

UNIT V - COMPLEX INTEGRATION (12 hours)

Line integral – Cauchy's integral theorem (without proof) – Cauchy's integral formulae and its applications – Taylor's and Laurent's expansions (statements only) – Singularities – Poles and Residues – Cauchy's residue theorem – Contour integration – Unit circle and semi circular contour.

TEXT BOOKS

1. Kreyszig. E, "*Advanced Engineering Mathematics*", 10th edition, John Wiley & Sons. Singapore, 2012.
2. Ganesan. K, Sundarammal Kesavan, Ganapathy. K.S, Subramanian & V.Srinivasan, "*Engineering Mathematics*", Gamma publications, Revised Edition, 2013.

REFERENCES

1. Grewal. B.S, "*Higher Engg Maths*", Khanna Publications, 42nd Edition, 2012.
2. Veerajan. T, "*Engineering Mathematics I*", Tata McGraw Hill Publishing Co., New Delhi, 5th edition, 2006.
3. Kandasamy. P, etal. "*Engineering Mathematics*", Vol.I (4th revised edition), Chand &Co., New Delhi, 2000.
4. Narayanan. S, Manicavachagom Pillay. T.K, Ramanaiah. G, "*Advanced Mathematics*" for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
5. Venkataraman. M.K, "*Engineering Mathematics*" – First Year (2nd edition), National Publishing Co., Chennai, 2000.

MA1002 ADVANCED CALCULUS AND COMPLEX ANALYSIS												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1-5				1-5						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

PY1003	MATERIALS SCIENCE	L	T	P	C
	Total Contact Hours - 60	2	0	2	3
	Prerequisite				
	Nil				

PURPOSE

The course introduces several advanced concepts and topics in the rapidly evolving field of material science. Students are expected to develop comprehension of the subject and to gain scientific understanding regarding the choice and manipulation of materials for desired engineering applications.

INSTRUCTIONAL OBJECTIVES

1.	To acquire basic understanding of advanced materials, their functions and properties for technological applications
2.	To emphasize the significance of materials selection in the design process
3.	To understand the principal classes of bio-materials and their functionalities in modern medical science
4.	To get familiarize with the new concepts of Nano Science and Technology
5.	To educate the students in the basics of instrumentation, measurement, data acquisition, interpretation and analysis

UNIT I – ELECTRONIC AND PHOTONIC MATERIALS (6 hours)

Electronic Materials: Fermi energy and Fermi–Dirac distribution function – Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors – Hall effect – Dilute Magnetic Semiconductors (DMS) and their applications

Superconducting Materials: Normal and High temperature superconductivity – Applications.

Photonic Materials: LED – LCD – Photo conducting materials – Photo detectors – Photonic crystals and applications – Elementary ideas of Non-linear optical materials and their applications.

UNIT II – MAGNETIC AND DIELECTRIC MATERIALS (6 hours)

Magnetic Materials: Classification of magnetic materials based on spin – Hard and soft magnetic materials – Ferrites, garnets and magnetoplumbites – Magnetic bubbles and their applications – Magnetic thin films – Spintronics and devices (Giant magneto resistance, Tunnel magneto resistance and Colossal magneto resistance).

Dielectric Materials: Polarization mechanisms in dielectrics – Frequency and temperature dependence of polarization mechanism – Dielectric loss – Dielectric waveguide and dielectric resonator antenna – Piezoelectric, pyroelectric and ferroelectric materials and their applications.

UNIT III – MODERN ENGINEERING AND BIOMATERIALS (6 hours)

Modern Engineering Materials: Smart materials – Shape memory alloys – Chromic materials (Thermo, Photo and Electro) – Rheological fluids – Metallic glasses – Advanced ceramics – Composites.

Bio-materials: Classification of bio-materials (based on tissue response) – Comparison of properties of some common biomaterials – Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels) – Tissue replacement implants – Soft and hard tissue replacements – Skin implants – Tissue engineering – Biomaterials for organ replacement (Bone substitutes) – Biosensor.

UNIT IV – INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOG (6 hours)

Basic concepts of Nanoscience and Nanotechnology – Quantum wire – Quantum well – Quantum dot – fullerenes – Graphene – Carbon nanotubes – Material processing by chemical vapor deposition and physical vapor deposition – Principle of SEM, TEM, AFM, Scanning near-field optical microscopy (SNOM) – Scanning ion-conducting microscopy (SCIM) – Potential uses of nanomaterials in electronics, robotics, computers, sensors, sports equipment, mobile electronic devices, vehicles and transportation – Medical applications of nanomaterials.

UNIT V – MATERIALS CHARACTERIZATION (6 hours)

X-ray diffraction, Neutron diffraction and Electron diffraction– X-ray fluorescence spectroscopy – Fourier transform Infrared spectroscopy (FTIR) – Ultraviolet and visible spectroscopy (UV-Vis) – Thermogravimetric Analysis (TGA) – Differential Thermal Analysis (DTA) – Differential Scanning Calorimetry (DSC).

PRACTICAL EXPERIMENTS (30 hours)

1. Determination of resistivity and band gap for a semiconductor material – Four probe method / Post-office box
2. Determination of Hall coefficient for a semiconducting material
3. To study V-I characteristics of a light dependent resistor (LDR)
4. Determination of energy loss in a magnetic material – B-H curve
5. Determination of paramagnetic susceptibility – Quincke's method
6. Determination of dielectric constant for a given material
7. Calculation of lattice cell parameters – X-ray diffraction
8. Measurement of glucose concentration – Electrochemical sensor
9. Visit to Advanced Material Characterization Laboratory (Optional)

TEXT BOOKS

1. Thiruvadigal. J. D, Ponnusamy. , .Sudha..D, and Krishnamohan. M, "*Materials Sciences"*, Vibrant Publication, Chennai, 2013.
2. Rajendran. V, "*Materials Science*",Tata McGraw- Hill,New Delhi,2011

REFERENCES

1. Rolf . E,Hummel, "*Electronic Properties of Materials"*, 4th ed., Springer, New York, 2011.
2. Dennis. W, Prather, "*Photonic Crystals: Theory, Applications, and Fabrication"*, John Wiley & Sons, Hoboken, 2009.
3. James. R, Janesick, "*Scientific Charge-Coupled Devices",* Published by SPIE - The International Society for Optical Engineering, Bellingham, Washington, 2001.
4. David M. Pozar, "*Microwave Engineering*", 3rd ed., John Wiley & Sons, 2005.
5. Silver. F and Dillion. C "*Biocompatibility: Interactions of Biological and Implantable Materials*", VCH Publishers, New York, 1989.
6. Severial Dumitriu, "*Polymeric Biomaterials*" Marcel Dekker Inc, CRC Press, Canada 2001.
7. Cao.G, "*Nanostructures and Nanomaterials: Synthesis, Properties and Applications*", Imperial College Press, 2004.
8. Pradeep. T "*A Text Book of Nanoscience and Nanotechnology*", Tata McGraw Hill, New Delhi, 2012.
9. Sam Zhang, "*Materials Characterization Techniques*", CRC Press, 2008.

PY1003 MATERIALS SCIENCE												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x		x	x						x
2.	Mapping of instructional objectives with student outcome	1	5		4	2						3
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		--		x		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

CY1003	PRINCIPLES OF ENVIRONMENTAL SCIENCE	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

The course provides a comprehensive knowledge in environmental science, environmental issues and the management.

INSTRUCTIONAL OBJECTIVES

To enable the students

1. To gain knowledge on the importance of environmental education and ecosystem.
2. To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.
3. To understand the treatment of wastewater and solid waste management.
4. To acquire knowledge with respect to biodiversity, its threats and its conservation and appreciate the concept of interdependence.
5. To be aware of the national and international concern for environment for protecting the environment

UNIT I - ENVIRONMENTAL EDUCATION AND ECOSYSTEMS (6 hours)

Environmental education: Definition and objective. Structure and function of an ecosystem – ecological succession –primary and secondary succession - ecological pyramids – pyramid of number, pyramid of energy and pyramid of biomass.

UNIT II - ENVIRONMENTAL POLLUTION (6 hours)

Environmental segments – structure and composition of atmosphere - Pollution – Air, water, soil , thermal and radiation – Effects – acid rain, ozone layer depletion and green house effect – control measures – determination of BOD, COD, TDS and trace metals.

UNIT III - WASTE MANAGEMENT (6 hours)

Waste water treatment (general) – primary, secondary and tertiary stages.
Solid waste management: sources and effects of municipal waste, bio medical waste - process of waste management.

UNIT IV - BIODIVERSITY AND ITS CONSERVATION (6 hours)

Introduction: definition - genetic, species and ecosystem diversity – bio diversity hot spots - values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife – endangered and endemic species of India, Conservation of biodiversity: in-situ and ex-situ conservations.

UNIT V - ENVIRONMENTAL PROTECTION (6 hours)

National concern for environment: Important environmental protection acts in India – water, air (prevention and control of pollution) act, wild life conservation and forest act – functions of central and state pollution control boards - international effort – key initiatives of Rio declaration, Vienna convention, Kyoto protocol and Johannesburg summit.

TEXT BOOKS

1. Kamaraj. P & Arthanareeswari .M, "*Environmental Science – Challenges and Changes"*, 4th Edition, Sudhandhira Publications, 2010.
2. Sharma. B.K. and Kaur, "*Environmental Chemistry",* Goel Publishing House, Meerut, 1994.

REFERENCES

1. De. A.K., "*Environmental Chemistry"*, New Age International, New Delhi, 1996.
2. Helen Kavitha. P "*Principles of Environmental Science*", Sci tech Publications, 2nd Edition, 2008.

CY1003 – PRINCIPLES OF ENVIRONMENTAL SCIENCE												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
				x		x	x		x	x	x	
2.	Mapping of instructional objectives with student outcome			5		2	4		1,3	3	2, 5	
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		--		x		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER I/II

BT1001	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide a basic understanding of biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize the students with the basic organization of organisms and subsequent building to a living being
2.	To impart an understanding about the machinery of the cell functions that is ultimately responsible for various daily activities.
3.	To provide knowledge about biological problems that require engineering expertise to solve them

UNIT I - BASIC CELL BIOLOGY (6hours)

Introduction: Methods of Science-Living Organisms: Cells and Cell theory Cell Structure and Function, Genetic information, protein synthesis, and protein structure, Cell metabolism-Homoeostasis- Cell growth, reproduction, and differentiation.

UNIT II - BIOCHEMISTRY AND MOLECULAR ASPECTS OF LIFE (5 hours)

Biological Diversity --Chemistry of life: chemical bonds--Biochemistry and Human biology--Protein synthesis—Stem cells and Tissue engineering.

UNIT III - ENZYMES AND INDUSTRIAL APPLICATIONS (5 hours)

Enzymes: Biological catalysts, Proteases, Carbonic anhydrase, Restriction enzymes, and Nucleoside monophosphate kinases—Photosynthesis

UNIT IV - MECHANOCHEMISTRY (7 hours)

Molecular Machines/Motors—Cytoskeleton—Bioremediation—Biosensors

UNIT V - NERVOUS SYSTEM, IMMUNE SYSTEM, AND CELL SIGNALI (7 hours)

Nervous system--Immune system- General principles of cell signaling

TEXT BOOK

1. ThyagaRajan. S, Selvamurugan. N Rajesh. M. P. Nazeer. R. A. Richard .W Thilagaraj. S, Barathi, and. Jaganathan. M. K "*Biology for Engineers*," Tata McGraw-Hill, New Delhi, 2012.

REFERENCES

1. Jeremy. M, Berg, John Tymoczko. L and Lubert Stryer, "*Biochemistry*," Freeman. W.H, and Co. Ltd., 6th Ed., 2006.
2. Robert Weaver, "*Molecular Biology*," MCGraw-Hill, 5th Edition, 2012.
3. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Books**, 2**004.
4. Martin Alexander, "*Biodegradation and Bioremediation,"* Academic Press, 1994.
5. Kenneth Murphy, "*Janeway's Immunobiology*," Garland Science; 8th edition, 2011.
6. Eric Kandel. R James. H, Schwartz, Thomas. M, Jessell, "Principles of Neural Science, McGraw-Hill, 5th Edition, 2012.

BT1001 BIOLOGY FOR ENGINEERS												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x			X						x	
2.	Mapping of instructional objectives with student outcome	1			2						3	
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER III

		L	T	P	C
MA 1013	**FOURIER SERIES, PARTIAL DIFFERENTIAL EQUATIONS & ITS APPLICATIONS**	**4**	**0**	**0**	**4**
	Total contact hours = 60 hours				
	(Common to Auto, Aero, Mech, Nano, Civil & Chemical)				

PURPOSE:

To inculcate the problem solving ability in the minds of students so as to apply the theoretical knowledge to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES:

1.	To know to formulate and solve partial differential equations
2.	To have thorough knowledge in Fourier series
3.	To learn to solve boundary value problems
4.	To be familiar with applications of PDE in two dimensional heat equation
5.	To gain good knowledge in the application of Fourier transform

UNIT I - PARTIAL DIFFERENTIAL EQUATIONS (12 hours)

Formation - Solution of standard types of first order equations - Lagrange's equation - Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT II - FOURIER SERIES (12 hours)

Dirichlet's conditions - General Fourier series - Half range sine and cosine series- Parseval's identity - Harmonic analysis.

UNIT III - BOUNDARY VALUE PROBLEMS (12 hours)

Classification of second order linear partial differential equations - Solutions of one-dimensional wave equation - one-dimensional heat equation

UNIT IV - TWO DIMENSIONAL HEAT EQUATION (12 hours)

Steady state solution of two-dimensional heat equation - Fourier series solutions in Cartesian coordinates & Polar coordinates.

UNIT V - FOURIER TRANSFORMS (12 hours)

Statement of Fourier integral theorem (without proof) - Fourier transform pairs - Fourier Sine and Cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

TEXT BOOKS

1. Kreyszig .E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons. Singapore,2012.
2. Grewal. B, S., Higher Engineering Mathematics, 42nd edition, Khanna Publishers, New Delhi, 2012.

REFERENCES

1. Sivaramakrishna Das P. and Vijayakumari.C, A text book of Engineering Mathematics-III,Viji's Academy,2010
2. Kandasamy. P., etal., Engineering Mathematics, Vol. II & Vol. III (4th revised edition), S.Chand & Co., New Delhi, 2000
3. Narayanan. S, Manickavachagom Pillay. T,. and Ramanaiah,G., Advanced Mathematics for Engineering students, Volume II & III (2nd edition), S,Viswanathan Printers and Publishers, 1992
4. Venkataraman,.M, K. Engineering Mathematics - Vol.III - A & B (13th edition), National Publishing Co., Chennai, 1998.
5. Sankara Rao, "Introduction to Partial Differential Equations", 2nd Edition, PHI Learning Pvt. Ltd., 2006.

MA 1013 - FOURIER SERIES, PDE & ITS APPLICATIONS												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1-5				1-5						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER IV

	NUMERICAL METHODS	L	T	P	C
MA1004	Total Contact Hours - 60	4	0	0	4
	(Common to Auto, Aero, Mech, Mechatronics, EEE, Civil , Chemical, ICE & EIE)				

PURPOSE

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To familiarise with numerical solution of equations
2.	To get exposed to finite differences and interpolation
3.	To be thorough with the numerical Differentiation and integration
4.	To find numerical solutions of ordinary differential equations
5.	To find numerical solutions of partial differential equations

UNIT I - CURVE FITTING AND NUMERICAL SOLUTION OF EQUATIONS (12 hours)

Method of Least Squares – Fitting a straight line – Fitting a parabola – Fitting an exponential curve – Fitting a curve of the form $y = ax^b$ – Calculation of the sum of the squares of the residuals.- Newton-Raphson method – Gauss Elimination method – Gauss Jacobi method – Gauss Seidel method.

UNIT II - FINITE DIFFERENCES AND INTERPOLATION (12 hours)

First and Higher order differences – Forward differences and backward differences and Central Differences – Differences of a polynomial – Properties of operators – Factorial polynomials – Shifting operator E – Relations between the operators. Interpolation – Newton-Gregory Forward and Backward Interpolation formulae - Divided differences – Newton's Divided difference formula – Lagrange's Interpolation formula – Inverse interpolation

UNIT III - NUMERICAL DIFFERENTIATION AND INTEGRATION (12 hours)

Newton's forward and backward differences formulae to compute first and higher order derivatives – The Trapezoidal rule – Simpson's one third rule and three eighth rule.

UNIT IV - NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS (12 hours)

Solution by Taylor's series – Euler's method – Improved and modified Euler method – Runge-Kutta methods of fourth order (No proof) – Milne's Method - Adam's Bashforth method.

UNIT V - NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

(12 hours)

Classification of Partial differential equations of the second order - Difference quotients – Laplace's equation and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of Parabolic and Hyperbolic equations.

TEXT BOOKS

1. Grewal. B.S, "*Numerical Methods in engineering and science"*, Khanna Publishers, 42nd edition, 2012.
2. Sastry. S.S., "*Introductory Methods of Numerical Analysis",* 4th edition, 2005.

REFERENCES:

1. Dr.. Venkataraman. M.K *"Numerical Methods in Science and Engineering"*, National Publishing Co., 2005.
2. Balagurusamy. E. "*Computer Oriented Statistical and Numerical Methods"* – Tata McGraw Hill., 2000.
3. .Jain. M.K Iyengar. SRK and .Jain. R.L "*Numerical Methods for Scientific and Engineering Computation"*, Wiley Eastern Ltd., 4th edition, 2003.
4. Jain,. M.K. "*Numerical Solution of Differential Equations"*, 2nd edition (Reprint), 2002.
5. Kandasamy. P, etal., "*Numerical Methods"*, S.Chand & Co., New Delhi, 2003.

MA1004 NUMERICAL METHODS												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1-5				1-5						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER V

	COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING	L	T	P	C
CH1013	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	MA1004				

PURPOSE

This course helps the students to understand the applications of numerical techniques in chemical engineering calculations.

INSTRUCTIONAL OBJECTIVES

To familiarize:

1. Numerical solution to algebraic transcendental equation.
2. Solution of linear simultaneous algebraic equations.
3. Numerical integration and differentiation techniques.
4. Solution of ordinary differential equations and unsteady state heat and mass transfer problems
5. Numerical solution to algebraic transcendental equation.
6. Solution of linear simultaneous algebraic equations.

UNIT I - NUMERICAL SOLUTION TO ALGEBRAIC TRANSCENDENTAL EQUATION

Review of iterative methods: bisection, Regula-Falsi and Newton-Raphson.
Phase equilibrium problems, Equation of State, Determination of Bubble and Dew Points, Differential distillation, Minimum reflux ratio and similar problems

UNIT II - SOLUTION OF LINEAR SIMULTANEOUS ALGEBRAIC EQUATION

Gauss Elimination method, Gauss-Siedel iteration, Jacobi's method. Multiple effect evaporators and similar problems based on material balance and energy balance concepts

UNIT III - NUMERICAL INTEGRATION

Trapezoidal rule, Simpson's rule, Weddle's rule, Mass transfer problems- Rayleigh's equation, number of transfer units in absorption, determination of drying time from batch drying data, determination of reactor size.
Numerical differentiation: Batch kinetics, determinations of flux, interpolation-estimation of physical, thermodynamic and transport properties. Curve fitting and linear regression basic concepts.

UNIT IV - SOLUTION OF ORDINARY DIFFERENTIAL EQUATION

Taylor series, Euler's method, Runge- Kutta Method, Predictor - Corrector methods. Heat conduction problems and chemical reaction engineering problems, comparison with analytical solution.

UNIT V - UNSTEADY STATE PROBLEMS

Introduction to Partial differential equations, Numerical solution for PDE's; Unsteady state one and two dimensional heat transfer problems and numerical solution, Unsteady state mass transfer problems.

TEXT BOOKS

1. Santhosh. K, Gupta, "*Numerical Methods for Engineers*", New Academic Science, 2013.

REFERENCES

1. Mickley. H. S, Sherwood. T.K. and Reed C.E., "*Applied Mathematics in Chemical Engineering*", McGraw Hill, New York, 1957.
2. Alan .Myers and Warren. D, Seider., "*Introduction to Chemical Engineering and Computer Calculations*", Prentice Hall, Engle Wood Cliffs (N.J), 1976.

CH1013 COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x		x	x	x	x		x	x
2.	Mapping of instructional objectives with student outcome	1	2		3	4	1	2		3	4	1
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		--		x		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

CATEGORY: ENGINEERING SCIENCES AND TECHNICAL ARTS

COURSE CODE	CATEGORY	COURSE NAME				
SEMESTER I			**L**	**T**	**P**	**C**
CE1001	E	BASIC CIVIL ENGINEERING	2	0	0	2
SEMESTER I / II			**L**	**T**	**P**	**C**
ME1001	E	BASIC MECHANICAL ENGINEERING	2	0	0	2
EE1001	E	BASIC ELECTRICAL ENGINEERING	2	0	0	2
EC1001	E	BASIC ELECTRONICS ENGINEERING	2	0	0	2
ME1004	E	WORKSHOP	0	0	3	2
ME1005	E	ENGINEERING GRAPHICS	1	0	4	3

SEMESTER I

CE1001	BASIC CIVIL ENGINEERING	L	T	P	C
	Total Contact Hours-30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To get exposed to the glimpses of Civil Engineering topics that is essential for an Engineer.

INSTRUCTIONAL OBJECTIVES

1.	To know about different materials and their properties
2.	To know about engineering aspects related to buildings
3.	To know about importance of surveying and the transportation systems
4.	To get exposed to the rudiments of engineering related to dams, water supply, and sewage disposal

UNIT I - BUILDING MATERILAS (6hours)

Introduction – Civil Engineering – Materials: Bricks – composition – classifications – properties –uses. Stone – classification of rocks – quarrying – dressing – properties –uses. Timber - properties –uses –ply wood. Cement – grades –types – properties –uses. Steel – types – mild steel – medium steel – hard steel – properties – uses – market forms. Concrete – grade designation – properties – uses.

UNIT II - MATERIAL PROPERTIES (6hours)

Stress – strain – types – Hook's law – three moduli of elasticity – poisons ratio – relationship – factor of safety. Centroid - center of gravity – problems in symmetrical sections only (I, T and channel sections). Moment of inertia, parallel, perpendicular axis theorems and radius of gyration (definitions only).

UNIT III - BUILDING COMPONENTS (6hours)

Building – selection of site – classification – components. Foundations –functions – classifications – bearing capacity. Flooring – requirements – selection – types – cement concrete marble – terrazzo floorings. Roof – types and requirements.

UNIT IV - SURVEYING AND TRANSPORTATION (6hours)

Surveying – objectives – classification – principles of survey. Transportation – classification – cross section and components of road – classification of roads. Railway – cross section and components of permanent way –functions. Water way – docks and harbor – classifications – components. Bridge – components of bridge.

UNIT V - WATER SUPPLY AND SEWAGE DISPOSAL (6hours)

Dams – purpose – selection of site – types –gravity dam (cross section only). Water supply – objective – quantity of water – sources – standards of drinking water – distribution system. Sewage – classification – technical terms – septic tank – components and functions.

TEXT BOOKS

1. Raju. K.V.B., Ravichandran. P.T, "*Basics of Civil Engineering"*, Ayyappa Publications, Chennai, 2012.
2. Rangwala. S.C," *Engineering Material"s*, Charotar Publishing House, Anand, 2012.

REFERENCES

1. Ramesh Babu, "*Civil Engineering"* , VRB Publishers, Chennai, 2000.
2. National Building Code of India, Part V, "*Building Material"s*, 2005
3. Surendra Singh, "*Building Material"s*, Vikas Publishing Company, New Delhi, 1996.

CE1001 - BASIC CIVIL ENGINEERING												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				X						x
2.	Mapping of instructional objectives with student outcome	1 - 4				1-4						2-4
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		--			x				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER I/II

ME1001	**BASIC MECHANICAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE	
To familiarize the students with the basics of Mechanical Engineering.	
INSTRUCTIONAL OBJECTIVES	
1.	To familiarize with the basic machine elements
2.	To familiarize with the Sources of Energy and Power Generation
3.	To familiarize with the various manufacturing processes

UNIT I – MACHINE ELEMENTS – I **(5 hours)**

Springs: Helical and leaf springs – Springs in series and parallel. **Cams:** Types of cams and followers – Cam profile.

UNIT II - MACHINE ELEMENTS – II **(5 hours)**

Power Transmission: Gears (terminology, spur, helical and bevel gears, gear trains). Belt drives (types). Chain drives. Simple Problems.

UNIT III - ENERGY **(10 hours)**

Sources: Renewable and non-renewable (various types, characteristics, advantages/disadvantages). **Power Generation:** External and internal combustion engines – Hydro, thermal and nuclear power plants (layouts, element/component description, advantages, disadvantages, applications). Simple Problems.

UNIT IV - MANUFACTURING PROCESSES - I **(5 hours)**

Sheet Metal Work: Introduction – Equipments – Tools and accessories – Various processes (applications, advantages / disadvantages). **Welding:** Types – Equipments – Tools and accessories – Techniques employed -applications, advantages / disadvantages – Gas cutting – Brazing and soldering.

UNIT V - MANUFACTURING PROCESSES – II **(5 hours)**

Lathe Practice: Types - Description of main components – Cutting tools – Work holding devices – Basic operations. Simple Problems. **Drilling Practice:** Introduction – Types – Description – Tools. Simple Problems.

TEXT BOOKS:

1. Kumar. T, Leenus Jesu Martin and Murali. G., *"Basic Mechanical Engineering"*, Suma Publications, Chennai, 2007.
2. Prabhu, T. J., Jai Ganesh, V. and Jebaraj, S., *"Basic Mechanical Engineering"*, Scitech Publications, Chennai, 2000.

REFERENCE

1. Hajra Choudhary, S.K, and HajraChoudhary, A. K., "*Elements of Workshop Technology", Vols. I & II*, Indian Book Distributing Company Calcutta, 2007.
2. Nag,.P.K., "*Power Plant Engineering"*, Tata McGraw-Hill, New Delhi, 2008.
3. Rattan. S.S., "*Theory of Machines"*, Tata McGraw-Hill, New Delhi, 2010.

ME1001 BASIC MECHANICAL ENGINEERING												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1- 3				1- 3						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)			Professional Subjects (P)		
		--		--			x			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

EE1001	**BASIC ELECTRICAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

This course provides comprehensive idea about circuit analysis, working principles of machines and common measuring instruments.

INSTRUCTIONAL OBJECTIVES

1. Understand the basic concepts of magnetic circuits, AC & DC circuits.
2. Explain the working principle, construction, applications of DC & AC machines and measuring instruments.
3. Gain knowledge about the fundamentals of wiring and earthing

UNIT I – FUNDAMENTALS OF DC CIRCUITS (6 hours)

Introduction to DC and AC circuits, Active and passive two terminal elements, Ohms law, Voltage-Current relations for resistor, inductor, capacitor , Kirchhoff's laws, Mesh analysis, Nodal analysis, Ideal sources –equivalent resistor, current division, voltage division

UNIT II – MAGNETIC CIRCUIT (6 hours)

Introduction to magnetic circuits-Simple magnetic circuits-Faraday's laws, induced emfs and inductances

UNIT III – AC CIRCUITS (6 hours)

Sinusoids, Generation of AC, Average and RMS values, Form and peak factors, concept of phasor representation, J operator. Analysis of R-L, R-C, R-L-C circuits. Introduction to three phase systems - types of connections, relationship between line and phase values.

UNIT IV – ELECTRICAL MACHINES & MEASURING INSTRUMENTS (6 hours)

Working principle, construction and applications of DC machines and AC machines (1 - phase transformers, single phase induction motors: split phase, capacitor start and capacitor start & run motors). Basic principles and classification of instruments -Moving coil and moving iron instruments.

UNIT V – ELECTRICAL SAFETY, WIRING &INTRODUCTION TO POWER SYSTEM (6 hours)

Safety measures in electrical system- types of wiring- wiring accessories-staircase, fluorescent lamps & corridor wiring- Basic principles of earthing-Types of earthing- Simple layout of generation, transmission & distribution of power.

TEXT BOOK

1. Dash. S.S, Subramani .C, Vijayakumar .K, *"BasicElectrical Engineering"*, First edition,Vijay Nicole Imprints Pvt.Ltd, 2013.

REFERENCES

1. Smarajt Ghosh, "*Fundamentals of Electrical & Electronics Engineering*", Second edition, PHI Learning, 2007.
2. Metha .V.K, Rohit Metha, "*Basic Electrical Engineering*", Fifth edition, S.Chand & Co, 2012.
3. Kothari.D. P and Nagrath IJ, "*Basic Electrical Engineering*", Second edition, Tata McGraw - Hill, 2009.
4. Bhattacharya .S. K, "*Basic Electrical and Electronics Engineering"*, First edition, Pearson Education, 2011.

EE1001 - BASIC ELECTRICAL ENGINEERING												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1-3				1						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		--			x				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

EC1001	BASIC ELECTRONICS ENGINEERING	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

This course provides comprehensive idea about working principle, operation and characteristics of electronic devices, transducers, Digital Electronics and Communication Systems.

INSTRUCTIONAL OBJECTIVES

At the end of the course students will be able to gain knowledge about the

1. Fundamentals of electronic components, devices, transducers
2. Principles of digital electronics
3. Principles of various communication systems

UNIT I - ELECTRONIC COMPONENTS (4 hours)

Passive components – resistors, capacitors & inductors (properties, common types, I-V relationship and uses).

UNIT II - SEMICONDUCTOR DEVICES (7 hours)

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET, optoelectronic devices (LDR, photodiode, phototransistor, solar cell, optocouplers)

UNIT III - TRANSDUCERS (5 hours)

Transducers - Instrumentation – general aspects, classification of transducers, basic requirements of transducers, passive transducers - strain gauge, thermistor, Hall-Effect transducer, LVDT, and active transducers – piezoelectric and thermocouple.

UNIT IV - DIGITAL ELECTRONICS (7 hours)

Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates - standard forms of Boolean expression.

UNIT V - COMMUNICATION SYSTEMS (7 hours)

Block diagram of a basic communication system – frequency spectrum - need for modulation - methods of modulation - principles of AM, FM, pulse analog and pulse digital modulation – AM / FM transmitters & receivers (block diagram description only)

TEXT BOOKS

1. Thyagarajan. T SendurChelvi. K.P. Rangaswamy. T.R. *"Engineering Basics: Electrical, Electronics and Computer Engineering"*, New Age International, Third Edition, 2007.
2. Somanathan. B. Nair. S.R, Deepa, "*Basic Electronics",* I.K. International Pvt. Ltd., 2009.

REFERENCES

1. Thomas. L. Floyd, *"Electronic Devices",* Pearson Education, 9th Edition, 2011.
2. Rajput, *"Basic Electrical and Electronics Engineering"*, Laxmi Publications, First Edition, 2007.

EC1001 BASIC ELECTRONICS ENGINEERING												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x										
2.	Mapping of instructional objectives with student outcome	1,2,3										
3.	Category	General (G)	Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		--	--			x				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

ME1004	**WORKSHOP PRACTICE**	**L**	**T**	**P**	**C**
	Total contact hours - 45	**0**	**0**	**3**	**2**
	Prerequisite				
	Nil				

PURPOSE

To provide the students with hands on experience on different trades of engineering like fitting, carpentry, smithy, welding and sheet metal.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with the basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy
2.	To familiarize with the production of simple models in the above trades.

UNIT I - FITTING **(9 hours)**

Tools & Equipments – Practice in filing.

Making Vee Joints, Square, Dovetail joints and Key making - plumbing.

Mini project – Assembly of simple I.C. engines.

UNIT II - CARPENTRY **(9 hours)**

Tools and Equipments- Planning practice.
Making Half Lap, Dovetail, Mortise &Tenon joints.
Mini project - model of a single door window frame.

UNIT III - SHEET METAL **(9 hours)**

Tools and equipments– practice.
Making rectangular tray, hopper, scoop, etc.
Mini project - Fabrication of a small cabinet, dust bin, etc.

UNIT IV – WELDING **(9 hours)**

Tools and equipments -
Arc welding of butt joint, Lap joint, Tee fillet.
Demonstration of gas welding, TIG & MIG welding.

UNIT V - SMITHY **(9 hours)**

Tools and Equipments –
Making simple parts like hexagonal headed bolt, chisel.

TEXT BOOKS:

1. Gopal,. T.., Kumar. T, and Murali, G., "*A first course on workshop practice – Theory, Practice and Work Book"*, Suma Publications, Chennai, 2005.

REFERENCES

1. Kannaiah. P., and Narayanan, K. C, "*Manual on Workshop Practice"*, Scitech Publications, Chennai, 1999.
2. Venkatachalapathy. V. S, "*First year Engineering Workshop Practice"*, Ramalinga Publications, Madurai, 1999.
3. Laboratory Manual.

ME1004 - WORKSHOP PRACTICE												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			×	×				×		×	×	
2.	Mapping of instructional objectives with student outcome		1, 2	1, 2				1, 2		1, 2	1, 2	
3.	Category	General (G)	Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
		--	--			x				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

ME1005	ENGINEERING GRAPHICS	L	T	P	C
	Total Contact Hours - 75	0	1	4	3
	Prerequisite				
	Nil				

First Angle Projection is to be followed - Practice with Computer Aided Drafting tools

PURPOSE

1.	o draw and interpret various projections of 1D, 2D and 3D objects.
2.	To prepare and interpret the drawings of buildings.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with the construction of geometrical figures
2.	To familiarize with the projection of 1D, 2D and 3D elements
3.	To familiarize with the sectioning of solids and development of surfaces
4.	To familiarize with the Preparation and interpretation of building drawing

UNIT I - FUNDAMENTALS OF ENGINEERING GRAPHICS (2 hours)

Lettering – Two dimensional geometrical constructions – Conics – Representation of three-dimensional objects – Principles of projections – Standard codes – Projection of points.

UNIT II - PROJECTION OF LINES AND SOLIDS (4 hours)

Projection of straight lines – Projection of planes - Projection of solids – Auxiliary projections.

UNIT III - SECTIONS AND DEVELOPMENTS (3 hours)

Sections of solids and development of surfaces.

UNIT IV - PICTORIAL PROJECTIONS (4 hours)

Conversion of Projections: Orthographic projection – Isometric projection of regular solids and combination of solids.

UNIT V - BUILDING DRAWING (2 hours)

Plan, Elevation and section of single storied residential (or) office building with flat RCC roof and brick masonry walls having not more than 3 rooms (planning / designing is not expected in this course) with electrical wiring diagram.

PRACTICAL (60 hours)

TEXT BOOKS

1. Venugopal0. K and Prabhu Raja. V., "*Engineering Graphics"*, Eighth Edition (Revised), New Age International Publishers, Chennai, 2007.
2. Natarajan. K.V, "*A Text Book of Engineering Graphics"*, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
3. Jeyapoovan. T., "*Engineering Drawing and Graphics using AutoCAD"*, Vikas Publishing House Pvt. Ltd., New Delhi, 2010.

REFERENCE

1. Bethune. J.D., "Engineering Graphics with AutoCAD 2013", PHI Learning Private Limited, Delhi, 2013.
2. Bhatt. N.D., "*Elementary Engineering Drawing (First Angle Projection)"*, Charotar Publishing Co., Anand, 1999.
3. Narayanan. K. L, and Kannaiah. P, "*Engineering Graphics"*, Scitech Publications, Chennai, 1999.
4. Shah. M. B and Rana. B. C., "*Engineering Drawing"*, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2005.

ME1005 ENGINEERING GRAPHICS												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			x	x				x				
2.	Mapping of instructional objectives with student outcome		1-4	1-4				1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts(E)				Professional Subjects (P)	
		--		--			x				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

CATEGORY: PROFESSIONAL SUBJECTS

Course code	Category	Course name				
SEMESTER II			**L**	**T**	**P**	**C**
CY1004	P	MATERIAL TECHNOLOGY	3	1	0	3

SEMESTER III			**L**	**T**	**P**	**C**
CH1001	P	ORGANIC CHEMISTRY	3	0	0	3
CH1002	P	CHEMICAL PROCESS CALCULATION	4	0	0	4
CH1003	P	MOMENTUM TRANSFER	4	0	0	4
CH1004	P	MECHANICAL OPERATIONS	3	0	0	3
CH1005	P	MOMENTUM TRANSFER LABORATORY	0	0	3	1
CH1006	P	MECHANICAL OPERATIONS LABORATORY	0	0	3	1

SEMESTER IV			**L**	**T**	**P**	**C**
CH1007	P	PHYSICAL CHEMISTRY	3	0	0	3
CH1008	P	MASS TRANSFER – I	3	0	0	3
CH1009	P	CHEMICAL ENGINEERING THERMODYNAMICS – I	3	0	0	3
CH1010	P	HEAT TRANSFER	4	0	0	4
CH1011	P	PHYSICAL CHEMISTRY LABORATORY	0	0	3	1
CH1012	P	HEAT TRANSFER LABORATORY	0	0	3	1

SEMESTER V			**L**	**T**	**P**	**C**
CH1014	P	CHEMICAL ENGINEERING THERMODYNAMICS II	3	0	0	3
CH1015	P	MASS TRANSFER – II	3	0	0	3
CH1016	P	CHEMICAL REACTION ENGINEERING – I	3	0	0	3
CH1017	P	CLASSICAL AND INSTRUMENTAL METHODS OF ANALYSIS LABORATORY	1	0	3	2

CH1018	P	COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING LABORATORY	0	0	4	2
CH1047	P	INDUSTRIAL TRAINING I	0	0	1	1

SEMESTER VI			**L**	**T**	**P**	**C**
CH1019	P	CHEMICAL PROCESS TECHNOLOGY	4	0	0	4
CH1020	P	CHEMICAL REACTION ENGINEERING - II	3	0	0	3
CH1021	P	PROCESS CONTROL AND INSTRUMENTATION	4	0	0	4
CH1022	P	CHEMICAL PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY – I	1	0	3	2
CH1023	P	MASS TRANSFER LABORATORY	0	0	4	2
CH1049	P	MINOR PROJECT	0	0	2	1

SEMESTER VII			**L**	**T**	**P**	**C**
CH1024	P	TRANSPORT PHENOMENA FUNDAMENTALS	4	0	0	4
CH1025	P	PROCESS MODELING AND SIMULATION	3	0	0	3
CH1026	P	PROCESS ENGINEERING ECONOMICS	3	0	0	3
CH1027	P	CHEMICAL PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY – II	1	0	3	2
CH1028	P	CHEMICAL REACTION ENGINEERING AND PROCESS CONTROL LABORATORY	0	0	4	2
CH1029	P	PROCESS MODELING AND SIMULATION LABORATORY	0	0	4	2
CH1048	P	INDUSTRIAL TRAINING II	0	0	1	1
CH1050	P	MAJOR PROJECT/PRACTICE SCHOOL	0	0	24	12

SEMESTER II

CY1004	**MATERIAL TECHNOLGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course provides the basic concepts of chemistry of materials required for engineering applications

INSTRUCTIONAL OBJECTIVES

1.	To gain knowledge on the nature of materials, its properties, and the use of materials in engineering
2.	To acquire an understanding about metallurgy and phase equilibrium
3.	To understand the important aspects of the chemistry of ferrous metal and non ferrous metals
4.	To gain knowledge on some selected composites, adhesives, FRPs and their applications
5.	To gain an understanding of the properties, manufacture and the applications of building materials

UNIT I - NATURE OF MATERIALS

Selection process of engineering materials (General aspects) - Chemical and physical properties of materials - chemical structure: Micro and macro structure - corrosion resistance - chemical reactivity. Mechanical properties - stress, strain, strength, hardness, malleability, ductility-elasticity-plasticity-toughness, thermal stability. Types of deformation: Plastic, viscous; plastic deformation of single crystal, poly crystalline metals: slip, twinning, dislocations - visco elasticity - creep in metals, amorphous materials

UNIT II - METALLURGY

Extractive Metallurgy: Hydro, pyro and electro metallurgy - refining of metals. Powder Metallurgy: methods of production of metal powder - Mixing of metal powders - compaction of powders - applications. Extraction process of Iron: manufacture of pig iron - blast furnace operations - chemistry of reactions. Manufacture of cast iron - varieties of cast iron - effect of impurities. Production of steel - Bessemer process - open-hearth process - L D methods. Classification of steel - effect of impurities.Heat treatment process: annealing, hardening, tempering, normalizing and gas carburizing.

Fe- Carbon phase diagram.

UNIT III - NON - FERROUS METALS, ALLOYS

Extraction of Copper, Nickel, Lead - methods involved - properties and applications. Alloys of Cu, Ni and Pb - brasses- bronzes-nickel with Cu, Zn, Cr, Fe, Mo - super alloys. Lead alloys - Pb with Sb, Sn. - applications.

UNIT IV - COMPOSITES AND ADHESIVES

Polymer composites - introduction - Types of composites - particle reinforced - fiber reinforced - structural composites - examples. Matrix materials, reinforcement materials- Kevlar, Polyamides, fibers, glass, carbon fibers, ceramics and metals . Techniques for producing FRP - applications.

UNIT V - BUILDING MATERIALS

Cement-types-portland cement-manufature-properties-uses-environmental effectsRefractories: properties of refractories - acidic, basic and neutral - manufacture of refractories - common refractory bricks - insulating refractories. Ceramics: Classification - fabrication methods of clay, silicon carbide, alumina, silicon nitride - Properties of important engineering ceramics - applications. Abrasives: classification - applications.

TEXT BOOK

1. Khanna. O.P, "*A Text book of Material science and Metallurgy"*, Danpat Rai Publications, 1999.
2. Dara .S.S, "*A text book of Engineering Chemistry"*, S.Chand and company Ltd., 2003 .

REFERENCES

1. Rajput. R.K., *A Text book of Material Science and Engineering*, S.K Kataria & sons, Delhi, 2003 .
2. Agarwal. C.V, *Chemistry of Engineering materials*, Tata McCraws Hill, 1997 .
3. William F.Smith, *Foundation of Materials Science and Engineering*, Tata McCraw Hill, 1998 .

CY1004 MATERIAL TECHNOLOGY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x		x		X			x		X	x
2.	Mapping of instructional objectives with student outcome	1		3	4	1			5		5	2
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		x		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

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SEMESTER III

CH1001	ORGANIC CHEMISTRY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate mastery in the chemistry of important organic compounds

INSTRUCTIONAL OBJECTIVES

1. To impart knowledge on synthetic routes to many types of industrially important organic compounds and their characterization

UNIT I - REACTIONS AND REAGENTS

Organometallic compounds - Grignard reagent - synthesis of different types of compounds like alcohol, aldehyde, acid, amine and organometallic. Acetoacetic ester - tautomerism - base hydrolysis - acid hydrolysis, malonic ester, cyano acetic ester - synthesis of dicarboylic acids and unsaturated acids.

UNIT II - CARBOHYDRATES,

Definition, Classification, Monosaccharide, Disaccharides & Polysaccharides, Properties of mono & disaccharides, Structure of Glucose, Fructose, Maltose & Sucrose, Starch, Cellulose, Derivatives of Cellulose, Structural Aspects of Cellulose and starch.

UNIT III - AMINO ACIDS & PROTEINS

Classification, Synthesis & properties of Amino acids, Reactions of Amino Acids, Composition & classification of proteins, Amino Acids in Proteins, General Properties and reactions of Proteins, Hydrolysis of proteins, Polypeptides, Structural Aspects and applications of Proteins.

UNIT IV - OILS, FATS,WAXES & DYES

Nomenclature, Natural Sources, General Properties and Reactions, Hydrogenation of Oils, Analysis of Oils and Fats.Color and Constitution, Chromophores and Auxochromes, Azodyes, - acidic, Basic, Direct, Mordent, Triphenylmethane Dyes- Malachite Green, Chrystal Violet, Rosaniline : Phthalein dyes – Fluoresceni, Eosin, Rhodamines: Xanthene dyes: Pyronine: Anthraquinonoid dyes: Alizarine : Heterocyclic Dyes : Mehtylene Blue: Vat Dyes :- Indigo Tin: , , Preparation, Properties and Applications.

UNIT V-HETEROCYCLIC COMPOUNDS AND PHARMACEUTCAL CHEMISTRY

Heterocyclic compounds-synthesis and reaction of pyrrole, furan, thiophene, pyridine, quinine, isoquinoline. Synthesis of antimalarial drugs – Quinine, Primaquine, chloroquine. Antibacterial drugs, - Synthesis of sulfanilamide, sulphapyridine.

TEXT BOOK

1. Morrison. R.T, & Boyd R, "*Organic Chemistry"* Edn., Prentice Hall India Pvt. Ltd., New Delhi, 1994.
2. Tewari. K.S, VIshnoi. N.K, Malhotra S.N., *A Text Book of Organic Chemistry*, Vikas publishing House Pvt. Ltd., New Delhi, 1986

REFERENCES

1. Lakshmi .S, *Pharmaceutical Chemistry* First Edition (1995), Sultan Chand and Sons, New Delhi
2. Finar .I.L., *Text book of* '*Organic Chemistry*', vol. I & II ELBS Edn, 1986.

CH1001 ORGANIC CHEMISTRY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x										
2.	Mapping of instructional objectives with student outcome	1										
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		x		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

	CHEMICAL PROCESS CALCULATIONS	L	T	P	C
CH1002	Total Contact Hours - 60	**4**	**0**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE

Preparing the students to formulate and solve material and energy balances for chemical process systems.

INSTRUCTIONAL OBJECTIVES	
To familiarize the students with:	
1.	Composition of mixtures
2.	Basic principles of stoichiometry and material balance
3.	Formulation of material balance with and without reactions
4.	Energy balance calculations

UNIT I - INTRODUCTION

Units and dimensions, temperature, concept of mole.
Composition of mixtures, basis of calculations.
Fuels, types of fuel, flue gas, Orsat analysis, theoretical air, excess air
Partial saturation and humidity, types of humidity

UNIT II - GAS MIXTURES AND SOLUTIONS

Predicting P-V-T properties of gases using ideal gas equation, composition of gases based on mole, mass, volume and partial pressure, calculation of density.
Solutions and their concentrations.

UNIT III - MATERIAL BALANCE FOR NON REACTIVE SYSTEMS

Basic concepts involved in material balance calculations, material balance problems without chemical reactions: mixing, drying, crystallization, membrane separation, distillation and extraction.
Material balances involved in two-phase gas-liquid systems as in humidification and dehumidification.
Basic concepts of recycle, bypass and purge streams. Material balances for non reactive systems with recycle stream.

UNIT IV - MATERIAL BALANCE FOR REACTIVE SYSTEMS

Chemical equation and stoichiometry, limiting reactant, excess reactant, conversion, selectivity, yield. Material balances for processes with reactions.
Combustion as special case of material balance with reactions. Analysis of products of combustion, calculation of excess air.

UNIT V - ENERGY BALANCE

Heat capacity, empirical equations for heat capacities, mean heat capacities of gases, Kopp's rule, sensible heat and latent heats, calculation of enthalpy. Heat of formation, standard heat of combustion, law of Hess, calculation of the standard heat of reaction from heats of formation or combustion Enthalpy changes in reactions with different temperatures, calculation of theoretical flame temperature.

TEXT BOOK

1. David. M, Himmelblau, James. B .Riggs "*Basic Principles and Calculations in Chemical Engineering*", 7th Edn., Prentice-Hall of India, New Delhi, 2004.

REFERENCES

1. Richard. M, Felder, Ronald W. Rousseau, "*Elementary Principles of Chemical Processes*", 3rd Edition by John Wiley & Sons, Inc. Singapore, 2000.
2. Bhatt. B. I. and Thakore.. S. B "*Stoichiometry*", 5th Edn., Tata McGraw-Hill Publishing Company, New Delhi, 2010.

CH1002 CHEMICAL PROCESS CALCULATIONS												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						x
2.	Mapping of instructional objectives with student outcome	1,2				2,3,4						2,3,4
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)		Professional Subjects(P)				
		--		--		--		x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications		Advances in Chemical Engineering				
		--		x		x		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1003	**MOMENTUM TRANSFER**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	**4**	**0**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE

To understand the governing principles of momentum transport in chemical process systems.

INSTRUCTIONAL OBJECTIVES

1.	The basic concepts and fluid-flow phenomena
2.	Kinematics of flow
3.	Phenomena of flow past immersed bodies
4.	Various aspects of transportation of fluids
5.	Various aspects of metering of fluids

UNIT I - FLUID FLOW PHENOMENA

Nature of fluids: incompressible and compressible, hydrostatic equilibrium, manometers, potential flow, boundary layer, the velocity field, laminar flow, Newtonian and non-Newtonian fluids, Newton's-law of viscosity, turbulence, Reynolds number and transition from laminar to turbulent flow, Eddy viscosity, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary-layer formation in straight tubes, unsteady flows, dimensional analysis

UNIT II - KINEMATICS OF FLOW

Streamlines and stream tubes, equation of continuity, Euler equation, Bernoulli equation, pump work in Bernoulli equation. Flow of incompressible fluids in conduits and thin layers: friction factor, relationships between skin-friction parameters, average velocity for laminar flow of Newtonian fluids, Hagen-Poiseuille equation, hydraulically smooth pipe, von Karman equation, roughness parameter, friction-factor chart, equivalent diameter, form friction losses in Bernoulli equation, Darcy-Weisbach relation, couette flow.

UNIT III - FLOW PAST IMMERSED BODIES

Drag, drag coefficients, drag coefficients of typical shapes, Ergun equation, terminal settling velocity, free and hindered settlings, Stokes' law, Newton's law, criterion for settling regime, fluidization, conditions for fluidization, minimum fluidization velocity.

UNIT IV - TRANSPORTATION OF FLUIDS

Introduction to: pipe and tubing, joint and fittings, stuffing boxes, mechanical seals, gate valves and globe valves, plug cocks and ball valves, check valves.-Classification and selection of pumps, blowers and compressors. -Pumps: developed head, power requirement, suction lift and cavitation, NPSH, constructional features and working principle of single suction volute centrifugal pump, characteristic curves of a centrifugal pump, reciprocating pumps, comparison of devices for moving fluids, constructional features and working principle of jet ejectors, compressors.

UNIT V - METERING OF FLUIDS

Constructional features and working principles of: venturi meter, orifice meter, rotameters, pitot tube, target meters, vortex-shedding meter, turbine meter, magnetic meters.-Application of Bernouli equation to venturi meter and orifice meter, flow rate calculations from the readings of venture meter, orifice meter and pitot tube.

TEXT BOOK

1. Warren. L, Mccabe, Julian .C, Smith and peter Harriott, "*Unit Operations of Chemical Engineering*", 7th Edn., McGraw Hill International Edition, NewYork 2005.

REFERENCES

1. Coulson. J.M, Richardson J.F., Backhurst J.R. and Harker .J.M., "*Coulson & Richardson's Chemical Engineering*", Vol. I, 6th Edn., Butter worth Heinemann, Oxford, 1999.
2. Noel de Nevers, "*Fluid Mechanical for chemical Engineers*", 2nd Edn., McGraw Hill International Editions, 1991.

CH1003 MOMENTUM TRANSFER												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x			x						
2.	Mapping of instructional objectives with student outcome	1,2,3	1,2,3			1,2,3						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			X			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1004	**MECHANICAL OPERATIONS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course is concerned with the properties, modification and separation of particulate solids.

INSTRUCTIONAL OBJECTIVES

1.	Size analysis using sieves.
2.	Size reduction equipments
3.	Methods of separations based on motion of a particle through fluids
4.	Filtration operations
5.	Agitation and mixing of liquids

UNIT I - PARTICULATE SOLIDS

Characterization of solid particles, particle shape, particle size, mixed particle sizes and size analysis, specific surface of mixture, average particle size, screen analysis: standard screen series. Size measurements with fine particles. Screening, screening equipment: stationary screens and grizzlies, gyrating screens, vibrating screens, comparison of ideal and actual screens, material balances over screen, screen effectiveness, capacity and effectiveness of screens

UNIT II - SIZE REDUCTION

Principles of comminution, energy and power requirements in comminution, crushing efficiency, empirical relationships: Rittinger's and Kick's laws. Bond crushing law and work index. Types size-reduction equipment. Crushers: jaw crushers, gyratory crushers. Grinders: hammer mills and impactors, tumbling mills, action in tumbling mills. Ultrafine grinders: fluid energy mills. Cutting machines: knife cutters. Open-circuit and closedcircuit operation.

UNIT III - SEPARATIONS BASED ON MOTION OF A PARTICLE THROUGH FLUIDS

Gravity settling processes, gravity classifiers, sorting classifiers: sink-and-float methods, differential settling methods. Clarifiers and thickeners, flocculation, batch sedimentation, rate of sedimentation. Equipment for sedimentation: thickeners. Clarifier and thickener design, sedimentation zones in continuous thickeners. Cyclones, hydrocyclones, centrifugal decanters.

UNIT IV - FILTRATION

Introduction, cake filters, discontinuous pressure filter: principle and working of filter press, continuous vacuum filter: principle and working of rotary drum filters, centrifugal filter: principle and working of suspended batch centrifuges, filter media, filter aids, principles of cake filtration, pressure drop through filter cake, compressible and incompressible filter cakes, filter-medium resistance, constant pressure filtration, continuous filtration, constant rate filtration, working principle of centrifugal filters.

UNIT V - AGITATION AND MIXING OF LIQUIDS

Units and Dimensions, dimensional analysis: Buckingham's π theorem. Principles of agitation, agitation equipment, flow patterns: prevention of swirling, draft tubes. Standard turbine design, power consumption, power correlation, significance of dimensionless groups, effect of system geometry, calculation of power consumption in Newtonian liquids. Blending and mixing: blending of miscible liquids, blending in process vessels, stratified blending in storage tanks, jet mixers, motionless mixtures, mixer selection.

TEXT BOOK

1. Warren. L. McCabe, Julian. C. Smith and Peter Harriott, "*Unit Operations of Chemical Engineering*, 7th Edn., McGraw Hill International Edition, New York 2005.

REFERENCES

1. Coulson. J.M, Richardson. J.F, Backhurst.. J.R. and Harker. J.M, *Coulson & Richardson's Chemical Engineering*, Vol. II, 5th Edn., Butter worth Heinemann, Oxford, 2002.
2. Swain. A, Patra H, Roy. G K, Mechanical Operations, Tata McGraw Hill, 2010.

CH1004 MECHANICAL OPERATIONS												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X				X						X
2.	Mapping of instructional objectives with student outcome	1 - 5				1 - 5						1 - 5
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1005	**MOMENTUM TRANSFER LABORATORY**	**L**	**T**	**P**	**C**
	Total contact hours -45	**0**	**0**	**3**	**1**
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to experimentally verify the theoretical concepts learnt in CH1003 Momentum Transfer.

INSTRUCTIONAL OBJECTIVES

1.	The volumetric flow rate of liquid in a pipe
2.	Pressure drop in fluidized bed, packed bed, helical coil and annular pipes
3	Performance characteristics of pumps.

LIST OF EXPERIMENTS:

1. Momentum losses in pipes, fittings and valves
2. Flow measurement using orifice meter, venturi meter and rotameter.
3. Performance characteristics study in single stage Centrifugal pump
4. Flow measurement using V-notch
5. Pressure drop study in packed bed
6. Pressure drop study in fluidized bed
7. Pressure drop study in helical coil
8. Pressure drop study in annular pipes
9. Flow measurement using V-notch
10. Drag study

REFERENCES

Laboratory manual

CH1005 MOMENTUM TRANSFER LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X	X			X						
2.	Mapping of instructional objectives with student outcome	**1,2,3**	**1,2,3**			**1,2,3**						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1006	**MECHANICAL OPERATIONS LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**0**	**0**	**3**	**1**
	Prerequisite				
	CH1004				

PURPOSE

This course helps the students to experimentally verify the theoretical concepts of size reduction principles, filtration, settling and sedimentation, techniques of separation of materials by size.

INSTRUCTIONAL OBJECTIVES	
1.	Sieve efficiency
2.	Critical speed of ball mill
3.	Crushing laws constant
4.	Specific cake and medium resistance in filtration
5.	Average size of the particles in a given feed

Experiments

1. Screening Efficiency
2. Size reduction using Ball Mill
3. Size reduction using Jaw Crusher
4. Drop Wise Crushing
5. Size reduction using Hammer Mill
6. Batch Sedimentation
7. Leaf Filtration
8. Pressure Filtration
9. Rotary Vacuum Filtration
10. Sieve analysis
11. Elutriation
12. ICI Sedimentation
13. Sink and Float Separation

REFERENCE

Laboratory manual

CH1006 MECHANICAL OPERATIONS LABORATORY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
			x		x	x						
2.	Mapping of instructional objectives with student outcome		1 - 5		1 - 5	1 - 5						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)		Professional Subjects(P)				
		--		--		--		x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications		Advances in Chemical Engineering				
		--		--		x		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER IV

CH1007	PHYSICAL CHEMISTRY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate mastery of principles involved in various physical and chemical processes

INSTRUCTIONAL OBJECTIVES

To impart knowledge on the principles of

1. Chemical kinetics
2. Phase equilibria
3. Adsorption
4. Photochemistry.

UNIT I - CHEMICAL KINETICS AND CATALYSIS

The rate equation, order and molecularity of a reaction, half-life time of a reaction, methods of determining order of a reaction. Effect of temperature on reaction rates: concept of activation energy, Arrhenius' equation, collision theory, activated complex theory. General characteristics of catalytic reactions, types of catalysis, acid-base catalysis, enzyme catalysis, mechanism and kinetics of enzyme-catalysed reactions, Michaelis-Menten equation.

UNIT II - PHASE RULE AND SOLUTIONS

Definition of terms, derivation of phase rule, application of phase rule to three component systems: acetic acid - chloroform- water system, system consisting of two salts and water. Raoult's law, ideal and non-ideal solutions, vapour pressure and boiling point diagrams of completely miscible binary solutions, completely immiscible liquids: steam distillation and its application, solubility of partially miscible liquids, solubility of gases in liquids: factors affecting solubility, Henry's law. Vapour pressure lowering, Osmosis and Osmotic pressure, boiling point elevation, freezing point depression, determination of molecular weight from colligative properties.

UNIT III - PHOTOCHEMISTRY

Laws of photochemistry, quantum efficiency, actinometry, photochemical reactions, photochemical rate law, kinetics of: hydrogen-chlorine reaction, hydrogen-bromine reaction.

UNIT IV - COLLOIDAL SYSTEM

Introduction and properties of colloidal systems, (preparation details not required), electrical properties, electro kinetic properties: electrophoresis and electro-Osmosis, gels and emulsions

UNIT V-ADSORPTION

Adsorption, chemisorption, applications of adsorption, adsorption of gases by solids, Freundlich adsorption isotherm, Longmuir's theory of adsorption. B.E.T. theory of multilayer adsorption (quantitative treatment only).

TEXT BOOK

1. Puri. B.R., Sharma. L.R.and Madan. S. Pathania, "*Principles of Physical Chemistry"*, 44th Edn., Vishal Publishing Co, Jallandhar, 2010

REFERENCES

1. Samuel. H, Maron and Carl.F, Prutton, *Principles of Physical Chemistry*, 4th Edn., Amerind Publishing Co., 1972.

CH1007 PHYSICAL CHEMISTRY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X										
2.	Mapping of instructional objectives with student outcome	1										
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1008	**MASS TRANSFER – I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course explains the fundamentals of mass transfer and techniques involved in mass transfer operations of humidification, drying and absorption.

INSTRUCTIONAL OBJECTIVES	
To familiarize:	
1.	Diffusion phenomena of mass transfer operations
2.	Various mass transfer theories
3.	Humidification operations
4.	Drying operation
5.	Absorption operation

UNIT I - DIFFUSION

Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion in gases-steady state diffusion: of A through nondiffusing B, equimolal counter diffusion, in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through nondiffusing B, equimolal counter diffusion. Effect of temperature and pressure on diffusivity

UNIT II - INTERPHASE MASS TRANSFER AND COEFFICIENTS

Mass transfer coefficients, film theory, penetration theory, surface-renewal theories. Mass, Heat, and momentum-transfer analogies, interphase mass transfer: equilibrium, diffusion between phases, local two-phase mass transfer, local overall mass-transfer coefficients. Material Balances: Steady State cocurrent Processes, Steady state counter current processes, Stages.

UNIT III - HUMIDIFICATION OPERATIONS

Definitions, adiabatic saturator, Humidity chart, use of humidity chart, wet-bulb temperature, theory of wet-bulb temperature, psychrometric line and Lewis relation, equations for gas-liquid contacts, air-water system, adiabatic humidification, application of HTU method, water cooling towers

UNIT IV - DRYING

Importance of drying in processes, principles of drying, equilibrium and free moisture, bound and unbound water, constant drying conditions, constant-rate period, critical moisture content and falling-rate period, porous solids and flow by capillarity, calculation of drying time under constant drying conditions. Classification of dryers, solids handling in dryers, equipments for batch and continuous drying processes: working principle of tray driers, tower driers, rotary driers, spray driers. Concept of freeze drying.

UNIT V - ABSORPTION

Introduction, types of tower packing's, contact between liquid and gas, pressure drop and limiting flow rates, material balances, limiting gas-liquid ratio, rate of absorption, calculation of tower height, number of transfer units, alternate forms of transfer coefficients, absorption in plate columns, absorption with chemical reaction.

TEXT BOOK

1. Warren. L, Mccabe, Julian .C. Smith and peter Harriott," *Unit Operations of Chemical Engineering*," 6th Edn., McGraw Hill International Edition, New York 2001.
2. Robert. E, Treybal, *Mass-Transfer Operations*, 3rd Edn., McGraw Hill International Edition, Singapore, 1980 .

REFERENCES

1. Coulson. .J.M, Richardson. J.F. Backhurst. J.R. and. Harker. J.M *Coulson & Richardson's Chemical Engineering*, Vol. I, 6th Edn., Butter worth Heinemann, Oxford, 1999.

CH1008 MASS TRANSFER I												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x						x			x
2.	Mapping of instructional objectives with student outcome	1 - 5	1 - 5						1 - 5			1 - 5
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1009	**CHEMICAL ENGINEERING THERMODYNAMICS – I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

INSTRUCTIONAL OBJECTIVES

To familiarize:

1.	Basic concepts and laws of thermodynamics
2.	Volumetric properties of fluids
3.	Thermodynamic properties of fluids
4.	Ideal behavior of systems of variable compositions

UNIT I - BASIC CONCEPTS & FIRST LAW OF THERMODYNAMICS

Work, energy, heat, internal energy, extensive and intensive properties, state and path functions, equilibrium, the reversible process, enthalpy, heat capacity-

Constant volume and constant pressure processes. First law of thermodynamics, energy balance for closed systems, energy balances for steady-state flow processes.

UNIT II - VOLUMETRIC PROPERTIES OF PURE FLUIDS, EQUATIONS OF STATE & CUBIC EQUATIONS

PVT behavior of pure substances: PT and PV diagram, the ideal gas, equations for process calculations (for an ideal gas in any mechanically reversible closed-system process): isothermal process, isobaric process, isochoric process, adiabatic process, and polytropic process. Ideal gas equation, virial equations of state, Application of the virial equations, introduction to cubic equations of state: Vander Waals equation, Redlich/Kwong equation, theorem of corresponding states; acentric factor.

UNIT III - SECOND & THIRD LAW OF THERMODYNAMICS

Statements, heat engines, Carnot's theorem, ideal-gas temperature scale; Carnot's equations, concept of entropy, entropy changes of an ideal gas undergoing a mechanically reversible process in a closed system, mathematical statement of the second law, entropy balance for open systems. Statement of the third law of thermodynamics.

UNIT IV - THERMODYNAMIC PROPERTIES OF FLUIDS

Property relations for a homogeneous fluid of constant composition in a closed system: Maxwell's equations, enthalpy and entropy as functions of T and P, internal energy as a function of P, internal energy and entropy as functions of T and V. Two-phase systems: temperature dependence of the vapor pressure of liquids, two-phase liquid/vapor systems. Thermodynamic diagrams. Tables of thermodynamic properties.

UNIT V - SYSTEMS OF VARIABLE COMPOSITIONS

Ideal behavior: fundamental property relationships, chemical potential and phase equilibria, ideal gas mixtures, ideal solution.

TEXT BOOK

1. Smith. J.M., Van Ness. H.C., and Abbott,. M.M., "*Introduction to Chemical Engineering Thermodynamics*", 6th Edn., Mc Graw Hill International Edition, Singapore 2001.
2. Stanley. I. Sandler, "*Chemical and Engineering Thermodynamics*", 2nd Edn., John Wiley & Sons, USA, 1989.

REFERENCES

1. Rao Y.V.C, "*Chemical Engineering Thermodynamics*", University Press (I) Ltd., Hyderabad, 1997.
2. Kyle. B.G. "*Chemical Process Thermodynamics*", 2nd Edn., Prentice Hall of India Pvt.Ltd., New Delhi,

CH1009 CHEMICAL ENGINEERING THERMODYNAMICS – I												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x		x	x	x	x		x	x
2.	Mapping of instructional objectives with student outcome	2	2	4		1,2,3&4	2	2	4		1,2,3&4	2
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		x		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1010	HEAT TRANSFER	L	T	P	C
	Total Contact Hours – 60	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate knowledge on different modes of heat transfer and their applications in process industries

INSTRUCTIONAL OBJECTIVES

1.	To impart knowledge on the heat conduction, convection and radiation phenomena
2.	To impart knowledge on the application of heat transfer principles in heat exchanger design.
3.	To impart knowledge on the principles of evaporation and evaporator design
4.	To impart knowledge on the heat conduction, convection and radiation phenomena

UNIT I - HEAT CONDUCTION

Introduction to various modes of heat transfer, Fourier's law of heat conduction, effect of temperature on thermal conductivity, steady-state conduction, compound resistances in series, heat flow through a cylinder, spheres, critical radius of insulation in pipes. Introduction to unsteady state conduction.

UNIT II - CONVECTIVE HEAT TRANSFER

Concept of heat transfer by convection, natural and forced convection, application of dimensional analysis for convection, heat transfer to fluids without phase change: heat transfer coefficient calculation for natural and forced convection, heat transfer to fluids with phase change: heat transfer from condensing vapours, dropwise and film-type condensation, heat transfer coefficients calculation for film-type condensation.Overall heat transfer coefficient, LMTD, individual heat transfer coefficients, relationship between individual and overall heat transfer coefficients.

UNIT III - HEAT-EXCHANGE EQUIPMENT

Typical heat exchange equipment, counter current and parallel-current flow, enthalpy balances in: heat exchanges, total condensers. Double pipe exchanger, single-pass 1-1 exchanger, 1-2 parallel- counterflow exchanger, 2-4 exchanger, heat-transfer coefficients in shell-and-tube exchanger, coefficients for crossflow, correction of LMTD for crossflow. Condensers: shell-and-tube condensers, kettle-type boilers, Calculation of number of tubes in heat exchangers

UNIT IV - RADIATION

Concept of thermal radiation, emissive power, black body radiation, Kirchoff's law, Stephen – Boltzman's law, energy exchange between; two large parallel planes, two parallel planes of different emissivity. Radiation intercepted by a shield, spheres or cylinders with spherical or cylindrical enclosures, radiation energy to a completely absorbing receiver

UNIT V - EVAPORATION

Introduction, single- and multiple- effect operation, long tube vertical evaporators, agitated-film evaporators, evaporator capacity, BPE and Duhring's rule, evaporator economy, enthalpy balances for single effect evaporator. Multiple effect evaporators, methods of feeding, capacity and economy of multiple effect evaporators, multiple effect calculations

TEXT BOOK

1. Warren. L, McCabe, Julian ,C. Smith and Peter Harriott, "*Unit Operations of Chemical Engineering*", 7th Edn., McGraw Hill International Edition, NewYork 2005.
2. Donald Q. Kern, "*Process Heat Transfer*", Tata McGraw Hill Book Co., New Delhi, 2008

REFERENCES

1. Coulson. J.M., Richardson .J.F., Backhurst J.R. and Harker J.H., "*Coulson & Richardson's Chemical Engineering*", Vol. I, 6th Edn., Butterworth Heinemann, Oxford, 2009.
2. Holman. J.P., "*Heat Transfer*" , 9th Edn., Tata McGraw Hill Book Co., New Delhi, 2008.

CH1010 HEAT TRANSFER												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x		x						
2.	Mapping of instructional objectives with student outcome	1	1,2,3	1,2,3		1,2,3						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		--		x		x				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1011	**PHYSICAL CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**0**	**0**	**3**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate mastery of physical chemistry principles through laboratory experiments.

INSTRUCTIONAL OBJECTIVES

To impart practical training on the application of the theoretical principles of

1.	Colligative properties
2.	Kinetics

EXPERIMENTS

1. Determination of Rate constant of first order and Second order reactions,
2. Molecular weight determination by Rast method
3. Adsorption on activated Carbon
4. Determination of critical solution temperature (CST).
5. Partition Co-efficient determinations
6. Three component Systems, Phase Diagram.

REFERENCE

Physical Chemistry Lab manual, Dept of Chemical Engineering, SRM University

CH1011 PHYSICAL CHEMSTRY LABORATORY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
			x									
2.	Mapping of instructional objectives with student outcome		1, 2									
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		x		x		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1012	**HEAT TRANSFER LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**0**	**0**	**3**	**1**
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to experimentally verify the theoretical concepts learnt in CH1010 Heat Transfer.

INSTRUCTIONAL OBJECTIVES

Experimental studies on:

1.	Transient heat conduction
2.	Natural and forced convection
3.	Convective heat transfer in equipments
4.	Radiative heat transfer in grey surface

LIST OF EXPERIMENTS

1. Natural convective heat transfer
2. Forced convective heat transfer
3. Emmisitivity of a grey surface
4. Condensation in vertical pipes
5. Condensation in horizontal pipes
6. Heat transfer in a jacketed kettle
7. Heat transfer in a helical coil
8. Study of single effect evaporator
9. Heat transfer in double pipes
10. Study of shell and tube heat exchanger
11. Transient heat conduction

REFERENCE

Laboratory manual

CH1012 HEAT TRANSFER LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	J	k
			x									
2.	Mapping of instructional objectives with student outcome		1,2,3,4									
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			X			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER V

CH1014	CHEMICAL ENGINEERING THERMODYNAMICS – II	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to be proficient in applying thermodynamic principles to various chemical engineering processes involving energy flow, phase and reaction equilibrium.

INSTRUCTIONAL OBJECTIVES

To familiarize:

1.	Thermodynamics of flow processes
2.	Refrigeration and liquefaction
3.	Concept of vapor / liquid equilibrium
4.	Concept of reaction equilibrium

UNIT I - SYSTEMS OF VARIABLE COMPOSITIONS

Non-Ideal behavior: Partial molar properties and their evaluation

Fugacity and fugacity coefficient of pure substances and components in solution Generalized correlations for the fugacity coefficient, Lewis Randall rule, excess properties

UNIT II - THERMODYNAMICS OF FLOW PROCESSES

Duct flow of compressible fluids: pipe flow, nozzles, throttling process, Turbines.

Compression processes: compressors, pumps, introduction to ejectors.

Power cycles, Rankine cycle. Otto engine, Diesel engine.

UNIT III - REFRIGERATION AND LIQUEFACTION

Principles of refrigeration, Carnot refrigerator, vapor-compression cycle, absorption refrigeration, heat pump.

Liquefaction processes: Linde liquefaction process, Claude liquefaction process.

UNIT IV - INTRODUCTION TO VAPOR/LIQUID EQUILIBRIUM

Criteria for equilibrium between phases, chemical potential and fugacity, phase rule, Duhem's theorem, Pxy and Txy diagrams for homogeneous systemsSimple models for VLE, Raoult's law, Dew point and bubble point calculations with Raoult's law for binary mixtures, VLE by modified Raoult's law, VLE from K-value correlations, flash calculations.

Activity coefficient and its estimation from VLE data: van Laar equation, Margulus equation, Gibbs Duhem's equation.

UNIT V - CHSEMICAL REACTION EQUILIBRIUM

Reaction coordinate, application of equilibrium criteria to chemical reactions, standard Gibbs-energy change and the equilibrium constant

Effect of temperature on the equilibrium constant, evaluation of equilibrium constants. Relation of equilibrium constants to composition: gas-phase reactions, liquid-phase reactions, equilibrium conversions for single reactions in homogeneous phase.

TEXT BOOK

1. Smith. J.M., Van Ness. H.C, and Abbott, M.M., "*Introduction to Chemical Engineering Thermodynamics"*, 7th Edition., McGraw Hill International Edition, 2005.

REFERENCES

1. Sandler. S "*Chemical, Biochemical and Engineering Thermodynamics"*, 4th Edition, Wiley India, 2006.
2. Rao .Y.V.C, "*Chemical Engineering Thermodynamics"*, University Press (I) Ltd., Hyderabad, 1997.
3. Kyle,B.G"*Chemical and Process Thermodynamics"*, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 20000.

CH1014 CHEMICAL ENGINEERING THERMODYNAMICS II												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
2.	Mapping of instructional objectives with student outcome	x	x		x	X						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1015	**MASS TRANSFER – II**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course explains the mass transfer operations of distillation, leaching, extraction, adsorption and membrane separation processes.

INSTRUCTIONAL OBJECTIVES	
To familiarize:	
1.	Distillation operation
2.	The methods of designing distillation columns
3.	Leaching and extraction processes
4.	Adsorption& crystallization operations
5.	Processes such as membrane separation, electro dialysis, thermal & sweep diffusion, ion-exchange

UNIT I - DISTILLATION OPERATIONS

Distillation-Stage wise contact operation. Methods of distillation: batch, continuous, flash, steam, vacuum, molecular distillations.

UNIT II - DESIGN METHODS

McCabe-Thiele and Ponchon-Savarit methods.Design of distillation towers.Azetropic and extractive distillation.Elements of multi component distillation.

UNIT III - LEACHING AND EXTRACTION

General principles of leaching, working principle of moving-bed leaching equipments: Bollman extractor,Hildebrandt extractor. General principles of extraction, working principle of extraction equipments: mixer-settlers, spray and packed extraction towers, agitated tower extractors. Percentage extraction calculation for single stage and multistage crosscurrent operations when liquids are insoluble.Minimum solvent rate and number of theoretical stages for continuous countercurrent, multistage extraction operation when liquids are insoluble.

UNIT IV - ADSORPTION & CRYSTALLIZATION

Introduction to adsorption, adsorbents and adsorption processes, adsorption equipment: fixed-bed adsorbers, gas-drying equipment. Pressure-swing adsorption, adsorption from liquids, adsorption isotherms.

Introduction to crystallization, Mier'ssupersaturation theory, crystallization equipment: continuous vacuum crystallizer, Draft tube-baffle crystallizer (with and without internal system for fines separation and removal), Swenson-walker crystallizer. Material and energy balance calculations in batch crystallizers.

UNIT V - MISCELLANEOUS PROCESSES

Membrane separation process-types of membranes-concepts of osmosis, electro dialysis, their applicationelementary concept of thermal diffusion, sweep diffusion, foam separation process. Ion-exchange-principles and industrial application of Ion exchange, types of ion exchange resins.

TEXT BOOK

1. Robert.. E, Treybal, "*Mass-Transfer Operations"*, 3rd Edn., McGraw Hill International Edition, Singapore, 1980.

REFERENCES

1. Warren L. Mccabe, Julian C. Smith and peter Harriott, *Unit Operations of Chemical Engineering*, 6th Edn., McGraw Hill International Edition, New York 2001
2. Coulson J.M., J.F. Richardson, J.R. Backhurst and J.M. Harker, *Coulson & Richardson's Chemical Engineering*, Vol. I, 6th Edn., Butter worth Heinemann, Oxford, 1999

CH1015 MASS TRANSFER II												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x						x			x
2.	Mapping of instructional objectives with student outcome	1 - 5	1 - 5						1 - 5			1 - 5
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		x		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

UNIT I - BASICS OF REACTOR DESIGN

Kinetics of homogeneous reactions: concentration-dependent term of a rate equation, temperature-dependent term of a rate equation, predictability of reaction rate from theory. Interpretation of batch reactor data: constant-volume batch reactor, varying-volume batch reactor, temperature and reaction rate, search for a rate equation.

UNIT II - IDEAL REACTORS

Introduction to reactor design. Ideal reactors for a single reaction: ideal batch reactors, steady-state mixed flow reactors, steady-state plug flow reactors**.**

UNIT III - SINGLE REACTIONS

Design for single reactions: size comparison of single reactors, multiple-reactor systems, recycle reactor.

UNIT IV - MULTIPLE REACTIONS

Design for parallel reactions. Irreversible first-order reactions in series

UNIT V - TEMPERATURE AND PRESSURE EFFECTS

Single reactions: heats of reaction from thermodynamics, equilibrium constants from thermodynamics, optimum temperature progression, heat effects, adiabatic operations, non adiabatic operations.

TEXT BOOK

1. Octave Levenspiel, "*Chemical Reaction Engineering*", 3rd edition, John Wiley & Sons India edition, 2011.
2. Scott Fogler. H., "*Elements of Chemical Reaction Engineering*", 3rd edition, Prentice Hall of India, New Delhi, 2006.

REFERENCES

1. Smith. J.M., "*Chemical Engineering Kinetics*", 3rd edition, McGraw Hill International Editions, New Delhi, 1981.
2. Ronald. W.Missen, Charles.A.Mions, Bradley.A.Saville, "*Introduction to Chemical Reaction Operation and Kinetics*", John Wiley and Sons, Singapore, 1999.

CH1016 CHEMICAL REACTION ENGINEERING I												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x			x						
2.	Mapping of instructional objectives with student outcome	1	2			3						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		x		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

	CLASSICAL AND INSTRUMENTAL METHODS OF ANALYSIS LABORATORY	L	T	P	C
CH1017	Total Contact Hours – 60	0	1	3	2
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate mastery of analytical methods used for the determination of industrial raw materials and finished products quality.

INSTRUCTIONAL OBJECTIVES

1.	To impart practical training on the analysis of fine chemicals, environment samples, drugs and quality assay of commercial products

Analysis of

- Oils, Soaps
- Cements
- Sugar
- Fertilizer
- Alloys
- Ores
- Drugs
- Vegetable Tannin.

Analysis of products with

- UV–Visbile spectrophotometer
- Conductivity meter
- pH meter
- Turbidity meter
- Flame photometer
- atomic absorption spectrophotometer
- gas chromatograph

REFERENCE

Lab manual

CH1017 CLASSICAL AND INSTRUMENTAL METHODS OF ANALYSIS LABORATORY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
			x									
2.	Mapping of instructional objectives with student outcome		1									
3.	Category	General (G)		Basic Sciences(B)			Engineering Sciences and Technical Arts (E)			Professional Subjects(P)		
		--		--			--			x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles			Chemical Engineering Applications			Advances in Chemical Engineering		
		x		--			--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1018	COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING LABORATORY	L	T	P	C
	Total Contact Hours – 60	0	0	4	2
	Prerequisite				
	Nil				

PURPOSE

To impart computational techniques for chemical engineering calculations

INSTRUCTIONAL OBJECTIVES

To familiarize :

1. Writing Programs Using C/C++ for chemical engineering calculations.
2. Use of software packages such as MATLAB, SCILAB

LIST OF EXPERIMENTS

Writing Programs and Sub Programs using C/C++ and MATLAB/SCILAB for Solving

1. *"Quadratic Equations":Linear Algebraic Equations:* - Gauss Seidel, Gauss Jordan, Gauss Elimination.
2. Jacobi Methods, Cramer's Rule- "*Multiple Effect Evaporator and Similar Problems*."
3. Polynomial root finding Techniques- "*Newton Raphson Method, Secant Method".*
4. Regula *Falsi "Method, Power Method"* to find dominant Eigen Value

5. *"Phase Equilibrium Problems, Equation of State Determination of Bubble and Dew Poin"*t Differential Distillation- Minimum Reflux Ratio Calculations.
6. *"Numerical Integration-Trapezoidal*" Rule, Simpsons 1/3 and 3/8 rule, Weddles Rule
7. *"Mass Transfer Problems- Rayleigh's Equation",* NTU in Absorption, Determination of Drying time from batch drying data- Determination of reactor size.
8. *"Milne's Method, Laplace Equation, Predictor-Corrector Methods"*.
9. *"Heat conduction problems and chemical reaction"* Engineering problems

TEXT BOOK

1. Davis. M.E., *"Numerical Methods and Modeling for Chemical Engineers"*, Wiley 1984.
2. Alan. L,.Myers and Warren. D Seider., "*Introduction to Chemical Engineering and Computer Calculations*", Prentice Hall, Engle Wood Cliffs (N.J), 1976.
3. Robert Lafore, Object Oriented Programming in C++, Galgotia Book House, 1994.

REFERENCES

1. Hanna. O.T., Sandall. O.C., Computational Methods in "*Chemical Engineering*," Prentice Hall, 1975.
2. Santhosh K.Gupta, "*Numerical Methods for Engineers*", New Academic Science, 2013.
3. Kirani Singh. Y, and Chaudhuri B.B., "*MATLAB Programming"*, Prentice-Hall of India, 2007.
4. Lindfield, George and John Penny, "*Numerical Methods Using MATLAB"*, Prentice-Hall, 2000.

CH1018 COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1				2						
3.	Category	General (G)		Basic Sciences(B)			Engineering Sciences and Technical Arts (E)			Professional Subjects(P)		
		--		--			x			--		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles			Chemical Engineering Applications			Advances in Chemical Engineering		
		x		--			--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

	INDUSTRIAL TRAINING I (Training to be undergone after IV semester)	L	T	P	C
CH1047	2 week practical training in industry	0	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To provide hands-on experience on the principles and operations of any chemical process industry.

INSTRUCTIONAL OBJECTIVES

Students have to undergo two week practical training in any Chemical process plant; so that they are made aware of the practical application of theoretical concepts studied in the class rooms.

Students have to undergo two-week practical training in any Chemical industry of their choice but with the approval of the department. At the end of the training, students should submit a report as per the prescribed format to the department.

Assessment process

This course is mandatory and the student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

CH1047 INDUSTRIAL TRAINING I												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
					x		x	x	x	x	x	x
2.	Mapping of instructional objectives with student outcome				1		1	1	1	1	1	1
3.	Category	General (G)			Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)		
		--			--		--			x		
4.	Broad area	Chemical Sciences and Technology			Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering		
		x			x		x			x		
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER VI

CH1019	CHEMICAL PROCESS TECHNOLOGY	L	T	P	C
	Total Contact Hours – 60	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to understand the various processes involved in chemical industries for the production of inorganic and organic chemicals..

INSTRUCTIONAL OBJECTIVES

1.	To provide the essential features of chemical process industries, which will enable the students to understand the engineering principles associated in industrial processes.
2.	To develop an ability to read and abstract the process flow diagrams.
3.	To impart the knowledge on the importance of various unit processes and unit operations involved in industrial processes.

UNIT I - CHLOR-ALKALI INDUSTRIES

Indian chemical industry - An overview, Manufacture of Sodium Chloride, Soda Ash, Sodium bi-carbonate, Chlorine and Caustic Soda.

UNIT II - SULPHUR AND SILICATE INDUSTRIES

Mining of Sulphur and different sources of Sulphur, Manufacture of Sulphuric Acid, Alum, Ceramics, Glass and Cement.

UNIT III - FERTILIZER INDUSTRIES

Nitrogen Industries: Synthetic Ammonia, Nitric Acid, Urea, Diammonium Phosphate, Nitrogenous Fertilizers.

Phosphorous industries: Phosphate rock, manufacturer of phosphorous, Phosphoric Acid, Super phosphate and Triple super phosphate.

Potassium industries: Potassium chloride and potassium sulphate.

UNIT IV - NATURAL PRODUCTS

Edible and essential oils, soaps and detergents, glycerin, pulp and paper, starch and derivatives, sugar.

UNIT V - SYNTHETIC ORGANIC CHEMICALS

Methane and synthesis gas, ethylene, acetylene and propylene. Aromatic chemicals - Benzene, toluene, xylene and naphthalene. Production of thermo-plastic and thermo-setting resins: polyethylene, polypropylene, phenolic and epoxy resins, polymers and their engineering applications. Polyamides, polyesters and acrylics from monomers - processes for the production of natural and synthetic rubber

TEXT BOOK

1. Gopala Rao .M.and Marshall Sittig, "*Dryden's Outlines of Chemical Technology"*, 3rd Edn., East-West Press, New Delhi, 2008.
2. George .T Austin, "*Shreve's Chemical Process Industries"*, 5th Edn., McGraw-Hill International Editions, Singapore, 1984.

REFERENCES

1. Chemical vol. I, II, III, & IV, *Chemical Engineering Education Development Centre*, IIT Madras, 1975-78.

CH1019 CHEMICAL PROCESS TECHNOLOGY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
				x				x				
2.	Mapping of instructional objectives with student outcome			1				2,3				
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		x		--		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1020	CHEMICAL REACTION ENGINEERING – II	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	CH1016				

PURPOSE

This course deals with non-ideal flow pattern and heterogeneous reactors.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize : Methods of accounting non-ideal behavior of ideal reactors, design of reactors for solid catalyzed reactions and design of reactors for fluid-particle reactions
2.	. Kinetics of fluid-particle reactions and aspects of solid catalysts

UNIT I - NON-IDEAL FLOW

Basics of non-ideal flow: **E-**age distribution of fluid-RTD, conversion in non-ideal flow reactors. Dispersion model: axial dispersion, chemical reaction and dispersion. Tanks-in-series model: pulse response experiments and the RTD, chemical conversion.

UNIT II - SOLID CATALYZED REACTIONS

Rate equation for surface kinetics, pore diffusion resistance combined with surface kinetics, performance equations for reactors containing porous catalyst particles, experimental methods for finding rates.

UNIT III - KINETICS OF FLUID-PARTICLE REACTIONS

Selection of a model, shrinking-core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, determination of the rate-controlling step.

UNIT IV - DESIGN OF REACTORS FOR FLUID-PARTICLE REACTIONS

Conversion of a size mixture in plug flow, conversion of a single –sized feed in a mixed flow reactor, conversion of a feed mixture in a mixed flow reactor, finding the size of a fluidized bed, instantaneous reaction.

UNIT V - SOLID CATALYSTS

Determination of surface area, void volume and solid density, pore-volume distribution, catalyst preparation, promoters and inhibitors, catalyst deactivation.

TEXT BOOK

1. Octave Levenspiel, "*Chemical Reaction Engineering*", 3rd edition, John Wiley & Sons India edition, 2011.
2. Scott Fogler. H, "*Elements of Chemical Reaction Engineering*", 3rd edition, Prentice Hall of India, New Delhi, 2006.

REFERENCES

1. Smith. J.M, "*Chemical Engineering Kinetics*", 3rd edition, McGraw Hill International Edition New Delhi, 1981.

CH1020 CHEMICAL REACTION ENGINEERING II												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x			x						
2.	Mapping of instructional objectives with student outcome	1	2			3						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		--		x		--				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1021	PROCESS CONTROL AND INSTRUMENTATION	L	T	P	C
	Total Contact Hours – 60	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

This course enables the students to know about control methods and make the students knowledgeable in various types of measuring instruments used in chemical process industries.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize basic concepts of process control.
2.	To familiarize Stability, frequency response analysis and design.
3.	To familiarize Control schemes and microprocessor

UNIT I - BASIC CONCEPTS OF PROCESS CONTROL

Laplace transform of simple functions, transforms of derivatives, solution of differential equations, inversion by partial fractions: partial fractions. Response of first-order systems, physical examples of first-order systems, response of first-order systems in series, higher order systems: Second-order and transportation lag.

UNIT II - LINEAR CLOSED LOOP SYSTEMS

Controllers and final control element, principles of pneumatic and electronic controllers, closed-loop transfer functions-servo and regulator problems, transient response of closed-loop control systems and their stability.

UNIT III - STABILITY, FREQUENCY RESPONSE ANALYSIS AND DESIGN

Stability: characteristic equation, Routh-Hurwitz criterion, Root-Locus analysis. Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram-stability criterion, Nyquist diagram; Tuning of controller settings.

UNIT IV - CONTROL SCHEMES AND MICRO PROCESSOR

Cascade control for: jacketed CSTR, heat exchanger, distillation column and process furnace. Selective control systems: override control, auctioneering control, spilt rage control of: a chemical reactor and steam header. Control schemes for heat exchangers and chemical reactors. Control of distillation column: control of composition, feed rate, pressure and feed temperature. Microprocessor-based controllers: Introduction to PLC's and DCS.

UNIT V - MEASURING DEVICES

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, flow rate, viscosity, pH, concentration, thermal conductivity and humidity of gases. Composition by physical and chemical properties and spectroscopy.

TEXT BOOK

1. Coughanowr. D.R, "*Process system Analysis & Contro"l*, 2nd Edition, McGraw Hill, Singapore, 1991.
2. Donald. P, Eckman, *Industrial Instrumentation*, Wiley Eastern Limited, 1993.

REFERENCES

1. George Stephanopoulos, "*Chemical Process Control-An Introduction to Theory and Practice*," 1st Edition, Prentice Hall of India, New Delhi, 1998.
2. Peter Harriott, "*Process Control"*, McGraw Hill, New York, 1972.

CH1021 PROCESS CONTROL AND INSTRUMENTATION												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1				2,3,4						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)		Professional Subjects(P)				
		--		--		--		x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications		Advances in Chemical Engineering				
		--		--		x		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

	CHEMICAL PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY – I	L	T	P	C
CH1022	Total Contact Hours – 60	**0**	**1**	**3**	**2**
	Prerequisite				
	Nil				

PURPOSE

Enabling the students to learn the methods and practices followed in the design of process equipments and to draw the designed equipments to scale.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with Design and drawing of major types of vessels, enclosures and supports.
2.	Design and drawing of physical separation equipments
3.	Introduction to computer aided design

LIST OF EXERCISES:

1. Detailed design and drawing of enclosures and supports
2. Detailed design and drawing of agitated vessel.
3. Detailed design and drawing of basket centrifuge.
4. Detailed design and drawing of gravity thickener.
5. Detailed design and drawing of cyclone separator.
6. Detailed design and drawing of crystallizer.
7. Detailed design and drawing of cooling towers.
8. Introduction to computer aided design of equipments
9. Process flow sheeting.

TEXT BOOK

1. Sinnott. R.K, Coulson & Richardson's, "*Chemical Engineering"*, Volume 6, 3rd Edn., Butterworth Heinemann, New Delhi, 1999.
2. Perry. R.H., et al., Perry's, "*Chemical Engineers Handbook*," 7th Edn., McGraw Hill, NewYork, 1997.

REFERENCES

1. Joshi. M.V, and Mahajani. V.V, "*Process Equipment Design*," 3rd Edn., Macmillan India Limited, New Delhi, 1996
2. Bownell, L.E., and Young, E.M., "*Process Equipment Design"*, Wiley Eastern, 1968.

CH1022 CHEMICAL PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY –I													
Course Designed by		Department of Chemical Engineering											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
				x		x							
2.	Mapping of instructional objectives with student outcome			1,2,3		1,2,3							
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)				
		--		--		--			x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering				
		--		--		x			--				
5.	Approval	23rd Meeting of Academic Council, May 2013											

CH1023	MASS TRANSFER LABORATORY	L	T	P	C
	Total Contact Hours – 60	0	0	4	2
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to experimentally verify the theoretical concepts they learnt in the course: Mass Transfer-I, Mass Transfer-II.

INSTRUCTIONAL OBJECTIVES

1.	Make the students to understand the Unit Operations carried out in Industry
2.	Verification of equations involved in the unit operations
3.	Analyze the result for controlling the operation

LIST OF EXPERIMENTS

1. Simple distillation
2. Packed column distillation
3. Steam Distillation
4. Drying Characteristics
5. Solvent Extraction
6. Leaching Single stage
7. Leaching Multistage
8. Ternary Liquid Equilibrium
9. Batch adsorption
10. Vapor Liquid Equilibrium
11. Diffusion

REFERENCE

Laboratory manual

CH1023 MASS TRANSFER LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x		x	x					
2.	Mapping of instructional objectives with student outcome	1-3	1-3	1-3		1-3	1-3					
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		--		x		x				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1049	**MINOR PROJECT**	**L**	**T**	**P**	**C**
	Prerequisite	**0**	**0**	**2**	**1**
	Nil				

PURPOSE

To apply the chemical engineering principles in understanding and to provide solution to practical problems faced in Chemical processes.

INSTRUCTIONAL OBJECTIVES

1. To understand the operations involved in Chemical Processes.
2. Develop and provide solutions to engineering problems.

Students have to choose and work on a problem related to Chemical Engineering and related area. At the end of the work, students should submit a report as per the prescribed format to the department.

Students are expected to work on areas that involve:

a. Understanding the operation of chemical processes by observation, operating procedures, construction details, and management procedures.
b. Developing experimental setup and studying the effect of operating parameters on process performance
c. Providing solutions to existing industrial problems or to improve the performance.

ASSESSMENT

The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded and grades assigned as per the regulations.

CH1049 MINOR PROJECT												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	B	c	d	E	f	g	h	i	J	k
		x	x	x		x		x		x		x
2.	Mapping of instructional objectives with student outcome	1	1	1		1		1		1		1
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		x		x		x				x		
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER VII

CH1024	**TRANSPORT PHENOMENA FUNDAMENTALS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	**4**	**0**	**0**	**4**
	Prerequisite				
	Momentum, Heat and Mass Transport				

PURPOSE

To provide the fundamentals for the application of basic laws of mass, momentum, and energy transport in engineering analysis

INSTRUCTIONAL OBJECTIVES

1.	To develop sound physical understanding of flows.
2.	Tofamiliarize various aspects of velocity, temperature and concentration distribution in laminar and turbulent flow.
3.	To familiarize the equation of change for isothermal processes.

UNIT I - FUNDAMENTALS OF TRANSPORT PHENOMENA AND VELOCITY DISTRIBUTION IN LAMINAR FLOW

Importance of transport phenomena: analogous nature of transport process, basic concepts, conservation laws. Phenomenological laws of transport properties Newtonian and Non-Newtonian fluids, Rheological models, Theories of transport properties of gases and liquids, effects of pressure and temperature.

Shell Momentum Balances and Boundary conditions- Flow of a Falling Film- Flow Through a Circular Tube- Flow through an Annulus- Flow of Two Adjacent Immiscible Fluids- Creeping Flow around a Sphere.

UNIT II - EQUATION OF CHANGE FOR ISOTHERMAL PROCESS

The Equations of Change in Terms of the Substantial Derivative-The Equation of Continuity- The Equation of Motion- Use of the Equations of Change to Solve Flow Problems- Dimensional Analysis of the Equations of Change.

UNIT III - VELOCITY DISTRIBUTION IN TURBULENT FLOW

Comparisons of Laminar and Turbulent Flows- Time-Smoothed Equations of Change for incompressible Fluids- The Time-Smoothed Velocity Profile near a Wall- Empirical Expressions for the Turbulent Momentum Flux- interphase transport in isothermal system- Definition of Friction Factors- Friction Factors for Flow in Tubes- Friction Factors for Flow around Spheres - Friction Factors for Packed Columns-Ergun equation.

UNIT IV - SHELL ENERGY BALANCES AND TEMPERATURE DISTRIBUTIONS IN SOLIDS AND LAMINAR FLOW

Shell Energy Balances; Boundary Conditions-Heat Conduction with an Electrical Heat Source- Heat Conduction with a Nuclear Heat Source- Heat Conduction with

a Viscous Heat Source- Heat Conduction through Composite Walls- Heat Conduction in a Cooling Fin- Forced Convection- Free Convection-Use of equations of change to setup steady state heat transfer problems.

UNIT V - CONCENTRATION DISTRIBUTIONS IN SOLIDS AND LAMINAR FLOW

Shell Mass Balances; Boundary Conditions- Diffusion through a Stagnant Gas Film- Diffusion with a Heterogeneous Chemical Reaction- Diffusion with a Homogeneous Chemical Reaction- Diffusion into a Falling Liquid Film (Gas Absorption)- Diffusion into a Falling Liquid Film (Solid Dissolution)- Diffusion and Chemical Reaction inside a Porous Catalyst- Diffusion in a Three-Component Gas System- equations for change for Multi Component Systems- The Equations of Continuity for a Multicomponent Mixture

TEXT BOOK

1. Byron R.Bird, Warren E. Stewart and Edwin N. Lightfoot, *Transport Phenomena*, 2nd edition, John Wiley & Sons, New York, 2002.
2. Sissom L.E., and Pitts D.R., *Elements of Transport Phenomena*, McGraw Hill, New York, 1972

REFERENCES

1. Brodkey R.S. and Hershey H.C., *Transport Phenomena - A United Approach*, McGraw Hill, 1988.
2. R.W.Fahien., *Elementary Transport Phenomena*, McGraw Hill, New York, 1983.
3. Welty J.R.,Wicks C.E., Wilson R.E. and Rorer G.L, *Fundamentals of momentum, heat and mass transfer*, 5th edition, John Wiley & sons, New York 2007.

CH1024 TRANSPORT PHENOMENA FUNDAMENTALS												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1,2,3				1,2,3						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1025	PROCESS MODELING AND SIMULATION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	CH1015, CH1016				

PURPOSE

To provide an adequate knowledge of modeling in chemical engineering process system and also familiarize the numerical simulation of model equations

INSTRUCTIONAL OBJECTIVES

1.	To understand the terms involved in conservation of mass momentum and energy equations
2.	To provide training to develop models for CSTR's, batch reactors, distillation columns
3.	To provide training to solve the model equations using numerical techniques

UNIT I - Fundamental Laws of Modeling

Fundamental laws – Continuity equation, Energy equation, Equations of motion, Transport equations, Equations of state, Phase and Chemical Equilibrium, Chemical kinetics

UNIT II - Modeling of Chemical Engineering System –I

Series of isothermal constant holpup Continuous Stirred Tank Reactor (CSTR), CSTR with variable holdup, Two heated tanks, Gas phase pressurized CSTR, Non-isothermal CSTR, Single component vaporizer.

UNIT III - Modeling of Chemical Engineering System – II

Batch Reactor, Reactor with mass transfer, Multi-component flash drum, Ideal binary distillation column, Batch distillation with holdup

UNIT IV - Dynamic Simulations –I

Batch reactor, Gravity flow tank, Three CSTR in series, Non-isothermal CSTR

UNIT V-Dynamic Simulations – II

Binary distillation column, Multi-component distillation column, Variable pressure distillation column, Ternary batch distillation with holdup

TEXT BOOK

1. William L. Luyben, Process Modeling simulation and control for chemical Engineers, 2nd Edn., McGraw Hill International Editions, New York, 1990

REFERENCES

1. Ismail Tosun, Modeling in Transport Phenomena – A Conceptual Approach, 2nd Edn., Elsevier Publications 2007
2. Davis M.E., Numerical Methods and Modeling for Chemical Engineers, Wiley, New York, 1984

CH1025 PROCESS MODELING AND SIMULATION												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
						x						x
2.	Mapping of instructional objectives with student outcome					1,2, 3						1,2, 3

3.	Category	General (G)	Basic Sciences(B)	Engineering Sciences and Technical Arts (E)	Professional Subjects(P)
		--	--	--	x
4.	Broad area	Chemical Sciences and Technology	Chemical Principles	Chemical Engineering Applications	Advances in Chemical Engineering
		--	--	x	x
5.	Approval	23rd Meeting of Academic Council, May 2013			

CH1026	PROCESS ENGINEERING ECONOMICS	L	T	P	C
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course presents the economic principles as applied in chemical engineering

INSTRUCTIONAL OBJECTIVES

1. To provide the basic concepts of economics for the students of chemical engineering which will enable them to understand the economic feasibility of chemical engineering processes and design

UNIT I - INTRODUCTION

Time value of money, Equivalence, Equations for economic studies and Equivalence, Amortization, Depreciation, Depletion

UNIT II - BALANCE SHEET AND COST ACCOUNTING

Capital requirements for process plants - balance sheet charts - earnings, process and returns - economic production, break-even analysis charts - cost accounting - pre construction cost estimation - allocation of cost.

UNIT III - ECONOMICS OF SELECTING ALTERNATIVE

Annual cost method, present worth method. Replacement: Rate of return method and pay out time method.

UNIT IV - ECONOMIC BALANCE

Economic balance in batch operations, cycle operations and multiple equipment units

UNIT V - ECONOMIC ANALYSIS

Economic analysis of a operating plant- Appraisal value, Earning value, Stock and Bond Value, Economic analysis of a proposed plant – Capital requirements and Estimated Annual Returns

TEXT BOOK

1. Max. S,Peters and Klaus. D Timmerhaus, "*Plant Design and Economics for Chemical Engineers"*, 5th Edn., Mc Graw Hill International Editions, New York, 2004.

REFERENCES

1. Schweyer. H.E, "*Process Engineering Economics"*, Mc Graw Hill, 1969
2. F.C. Jelen and J.H. Black, "*Cost and Optimization Engineering"*, McGraw Hill, 3rd Edn., 1992.

CH1026 PROCESS ENGINEERING ECONOMICS													
Course Designed by		**Department of Chemical Engineering**											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
				x		x						x	
2.	Mapping of instructional objectives with student outcome			1		1						1	
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)			
		--		--		--				x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering			
		--		--		x				x			
5.	Approval	23rd Meeting of Academic Council, May 2013											

	CHEMICAL PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY – II	L	T	P	C
CH1027	Total Contact Hours – 60	**0**	**1**	**3**	**2**
	Prerequisite				
	Nil				

PURPOSE

Enabling the students to learn the methods and practices followed in the design of process equipments and to draw the designed equipments to scale.

INSTRUCTIONAL OBJECTIVES

1. To familiarize with
   Design and drawing of major heat transfer and mass transfer equipments
2. Role of process equipment design in plant design

List of exercises:

1. Detailed design and drawing of various types of heat exchangers.
2. Detailed design and drawing of various types of evaporators.
3. Detailed design and drawing of distillation column.
4. Detailed design and drawing of absorber.
5. Detailed design and drawing of rotary dryer.
6. Design using spread sheet
7. Illustrative Case Study in Process Equipment Design

TEXT BOOK

1. Sinnott. R.K, Coulson & Richardson's *Chemical Engineering*, Volume 6, 3rd Edn., Butterworth Heinemann, New Delhi, 1999.
2. Perry. R.H, et al., Perry's, *Chemical Engineers Handbook*, 7th Edn., McGraw Hill, NewYork, 1997.

REFERENCES

1. Joshi. M.V, and Mahajan. V.V, "*Process Equipment Design"*, 3rd Edn., Macmillan India Limited, New Delhi, 1996.
2. Bownell. L.E., and Young. E.M., *Process Equipment Design*, Wiley Eastern, 1968.

CH1027 CHEMICAL PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY – II													
Course Designed by		Department of Chemical Engineering											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
				x		x						x	
2.	Mapping of instructional objectives with student outcome			1		1						1	
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)				
		--		--		--			x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering				
		--		--		x			--				
5.	Approval	23rd Meeting of Academic Council, May 2013											

CH1028	CHEMICAL REACTION ENGINEERING AND PROCESS CONTROL LABORATORY	L	T	P	C
	Total Contact Hours – 60	0	0	4	2
	Prerequisite				
	CREI, CRE II, Process control and Instrumentation				

PURPOSE

This course helps the students to experimentally verify the theoretical concepts they learnt in the courses:
Chemical Reaction Engineering -I,
Chemical Reaction Engineering -II
This course also helps the students to experimentally verify the theoretical concepts they learnt in the course: Process Control

INSTRUCTIONAL OBJECTIVES

1.	To make the students to experimentally determine The kinetic constant of a given reaction
2.	The parameters of non-ideal flow models
3.	The conversion in a batch reactor, tubular reactor and mixed flow reactor and compare with the theoretically predicted conversions
4.	To experimentally study the various aspects of controllers and transmitters

LIST OF EXPERIMENTS FOR CHEMICAL REACTION ENGINEERING

1. Irreversible reaction in a Batch Reactor
2. Reversible reaction in a Batch Reactor

3. Study of Tubular Flow Reactor
4. Study of Mixed Flow Reactor
5. Study of adiabatic reactor
6. Study of combined reactors: Mixed flow-Tubular flow
7. Study of combined reactors: Tubular flow-Mixed flow
8. Study of heterogeneous catalytic reaction
9. Study of photochemical reaction
10. Study of biochemical reaction
11. Study of Sono Chemical Reactor
12. Study of semi batch reactor

LIST OF EXPERIMENTS FOR CHEMICAL REACTION ENGINEERING

1. On off control of thermal process
2. Study the action of Proportional Control
3. Study of flow controller
4. Study of flow transmitter
5. Study of level controller
6. Study of level transmitter
7. Study of effect of PI controller of flow control loop
8. Study of P controller of flow controller
9. Control valve characteristics
10. P,PI,PID control of pressure controlled loop

REFERENCE

Laboratory manual

CH1028 CHEMICAL REACTION ENGINEERING AND PROCESS CONTROL LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	J	k
			x									
2.	Mapping of instructional objectives with student outcome		1,2,3,4									
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		x			--			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			x			
5.	Approval	23rd Meeting of Academic Council, May 2013										

	PROCESS MODELING AND SIMULATION LABORATORY	L	T	P	C
CH1029	Total Contact Hours – 60	**0**	**0**	**4**	**2**
	Prerequisite				
	CH1025				

PURPOSE

To provide hands on experience in simulation packages those are widely used by process engineers.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize The students to solve the steady and unsteady state problems using software packages such as MATLAB, SCILAB and ASPEN PLUS

INTRODUCTION

Basics of theoretical modeling- Fundamental laws, an overview of Process Simulation and its Applications

Matrix Computations

1. Gauss elimination
2. Gauss Seidel
3. Gauss Jordan
4. Gauss Jacobi

APPLICATIONS

1. Equation of State
2. Determination of Bubble and Dew Point
3. Chemical Reaction Engineering – Batch Reactor
4. Three CSTR in Series
5. Non-Isothermal CSTR
6. Multi component Flash Drum
7. Batch Distillation with Holdup
8. Binary Distillation

TEXT BOOK

1. Bequette. B.W, "*Process Dynamics":* Modelling, Analysis and Simulation," Prentice Hall (1998)
2. Denn .M.., "*Process Modelling*," Wiley, New york,1986.

REFERENCES

1. Himmelblau. D.M. and Bischoff .K.B, "*Process Analysis and Simulation"*, Wiley, 1988.
2. Strang .G.," *Introduction to Linear Algebra"*, Cambridge Press, 4th edition, 2009.
3. William. L. Luyben, "*Process Modelling, simulation and control for Chemical Engineer"s*, 2nd Edn., McGraw Hill International Editions, New York, 1990
4. Chapra. S.C. and Canale. R.P. "*Numerical Methods for Engineers"*, McGraw Hill, 2001.
5. Bisio A., and Robert L. Kabel, "*Scale-up of Chemical Processes"*, Wiley, New York, 1985.
6. Patankar. S.V., "*Numerical Heat Transfer and Fluid Flow"*, Hemisphere Publishing, 1980.

CH1029 PROCESS MODELING AND SIMULATION LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	J	k
			x									
2.	Mapping of instructional objectives with student outcome		1,2,3,4									
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)		Professional Subjects(P)				
		--		--		--		x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications		Advances in Chemical Engineering				
		--		x		x		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

	INDUSTRIAL TRAINING II (Training to be undergone after VI semester)	L	T	P	C
CH1048	2 week practical training in industry	**0**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide hands-on experience on the principles and operations of any chemical process industry.

INSTRUCTIONAL OBJECTIVES

1. Students have to undergo two week practical training in any Chemical process plant; so that they are made aware of the practical application of theoretical concepts studied in the class rooms.

Students have to undergo two-week practical training in any Chemical industry of their choice but with the approval of the department. At the end of the training, students should submit a report as per the prescribed format to the department.

Assessment process

This course is mandatory and the student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

CH1048 INDUSTRIAL TRAINING II												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
					x		x	x	x	x	x	x
2.	Mapping of instructional objectives with student outcome				1		1	1	1	1	1	1
3.	Category	General (G)			Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)	
		--			--		--				x	
4.	Broad area	Chemical Sciences and Technology			Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering	
		x			x		x				x	
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1050	MAJOR PROJECT	L	T	P	C
	(Entire Eighth semester)	0	0	24	12
	Prerequisite				
	Nil				

PURPOSE

To apply the various chemical engineering principles, techniques and tools into simulated/ real processes of chemical and interdisciplinary areas.

INSTRUCTIONAL OBJECTIVES

1. To test the ability and capacity of the student to work individually and in a team.
2. To apply his/her knowledge of chemical engineering to design / simulate / do research on chemical and related processes and to determine his/her proficiency level of the subjects learnt in the entire course.

PROJECT WORK

Each student shall, on individual or in a group of not more than three students, work under the supervision of a faculty on their chosen /allotted area.

The project work may be carried out on one of the following broad areas.

a) Comprehensive design project of a Chemical Process

b) Modeling & Simulation of any Chemical Engineering Process

c) Experimental work on an industrial research problem with engineering interpretations.

d) Work involving application of Chemical engineering principles into interdisciplinary areas.

The work should be oriented with, but not limited to, the following:

Screening of processes with alternatives; Computational strategies for preliminary material and energy balances; Sizing of process equipment(s); Cost estimation, economics, and evaluation; Strategies for synthesizing energy networks and separation sequences; Preliminary design of a large industrial project; Development of models for evaluation and optimization of parameters; Experimental setup to optimize process variables; Solution through Chemical principles for interdisciplinary problems.

ASSESSMENT

The students have to prepare and submit a detailed report on their work.

Assessment would be made on the basis of the submitted report and the presentation cum viva voce examination conducted by a board of examiners constituted by the Department.

CH1050 MAJOR PROJECT												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x	x	x	x	x	x	x	x	x
2.	Mapping of instructional objectives with student outcome	2	2	2	1	2	1	1	2	2	2	2
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		x		x		x				x		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CATEGORY: DEPARTMENTAL ELECTIVES

CH1101	**ENERGY TECHNOLOGY AND MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To motivate the students by highlighting the importance of Energy technology and various energy management concepts

INSTRUCTIONAL OBJECTIVES

1.	To familiarize basics of fossil fuels and their production
2.	combustion process of fuels
3.	recent energy generation techniques
4.	energy audit principles and concepts
5.	various methods of energy management

UNIT I - FUELS TECHNOLOGY

Introduction – Solid fuels – Coal origin, analysis and properties, efficient utilisation, storage and applications, Liquid fuels – Petroleum- Production and consumption, refining, properties and petroleum products, Gaseous fuels – natural gas, producer gas, water gas, gasification of coal; gases from biomass

UNIT II - COMBUSTION

Distinct features of combustion of solid, liquid and gaseous fuels - determination of gross and net calorific values - combustion of solid fuels including pulverized fuels, stoking and ash removal - fluidized bed combustion of solid fuels - combustion of liquid fuels - burners and nozzles - combustion of gaseous fuels - types of combustion: surface combustion, submerged combustion and pulsating combustion

UNIT III - HYBRID SYSTEMS

Wind-PV systems, Wind-DG systems, Wind-Hydel systems, Gasifier DG- Wind systems and Application areas, Hybrid conventional and geothermal power plants, Integrated coal gasifier and fuel cell power plant

UNIT IV - ENERGY AUDIT

Energy Audit: Types and Methodology; Energy Audit Reporting Format; Understanding

Energy Costs; Benchmarking and Energy Performance; Matching Energy Usage to Requirement; Maximising System Efficiency; Fuel and Energy Substitution; Energy Audit Instruments; Duties and responsibilities of energy auditors

UNIT V - ENERGY MANAGEMENT

Definition and objectives of Energy Management; Importance; Indian need of Energy

Management; Energy action planning, Energy organisation, energy costing, budgeting, Equipment professionals, staffing, Monitoring and targeting - Data and Information Analysis; Relating Energy Consumption and Production, Design of energy management programs

TEXT BOOK

1. Gupta, "*Elements of fuels, furnaces and refractories"*, Khanna Publishers, New Delhi, 2010.
2. Rao S.& Dr. Parulakar B.B., "*Energy Technology"*, Khanna Publishers, New Delhi, 1994
3. Samir Sarkar, "*Fuels and Combustion",* University Press (India) private limited, 2009.

REFERENCES

1. Haslam. R.J,. Russal. R.P, *Fuels and their combustion*,1997.
2. David. S, *Handbook of Industrial energy conservation*, Van Nostrand, New York, USA, 1997.
3. Altert P.E.Thimann, *Handbook of Energy Audit*, The Fairmount Press Inc. Georgia, USA,
4. Murphy. W.R..Mckay. G *Energy Management*, Butterworths.
5. .Smith. C.B *Energy Management Principles,* Pergamon Press
6. Energy Auditing, The Fairmont Press Inc. Published by Atlanta, Georgia
7. Hunt. V.D, "*Wind power: A handbook on Wind energy Conversion systems"*. Van Nostrand Reinhold Company, 1981.
8. Agrawal. R.D. "*Organization and Management"*, Tata McGrew Hill, New Delhi

CH1101 ENERGY TECHNOLOGY AND MANAGEMENT												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x		x						x		x
2.	Mapping of instructional objectives with student outcome	2,4,5		2,3,4,5						1 , 4 , 5		2 , 3
3.	Category	General (G)		Basic Sciences(B)			Engineering Sciences and Technical Arts (E)			Professional Subjects(P)		
		--		--			--			x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles			Chemical Engineering Applications			Advances in Chemical Engineering		
		--		x			x			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1102	RENEWABLE ENERGY ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to understand the importance, availability, conversion technologies of renewable energy resources and its applications

INSTRUCTIONAL OBJECTIVES

1.	To emphasize The current energy status and role of renewable energy sources
2.	Various aspects of solar energy and utilization
3.	Familiarize various aspects of Biomass energy and utilization
4.	Familiarize other renewable energy sources

UNIT I - INTRODUCTION

World energy status, Current energy scenario in India, Environmental aspects of energy utilization, Environment - Economy - Energy and Sustainable Development, Energy planning.Classification of Energy resources, Advantages and Disadvantages of Non-Conventional source of energy, Renewable energy resources - potentials -achievements – applications.

UNIT II - SOLAR ENERGY

Basic concepts, Solar thermal systems – Flat plate and concentrating collectors, Solar passive space - Solar heating and cooling techniques – Solar desalination – Solar Pond - Solar cooker - Solar dryers-Solar furnaces - Solar pumping, Solar

green house- Solar thermal power plant – Solar photo voltaic conversion – Solar cells – PV applications

UNIT III - WINDENERGY

Introduction-Background-Availability- wind power plants , Power from the wind, Wind energy conversion systems, site characteristics, Wind turbines types – Horizontal and vertical axis-design principles of wind turbine, Magnus effect-Performance.

Wind energy Applications – New developments - Safety and environmental aspects

UNIT IV - BIOMASS ENERGY

Biomass – usable forms- composition- fuel properties – applications, Biomass resources, Biomass conversion technologies - direction combustion - pyrolysis – gasification -anaerobic digestion, Bioethanol and Biodiesel Production - Recent developments.Energy farming, Biogas technology - Family biogas plants, Community and institutional biogas plants – design consideration – applications**.**

UNIT V - OTHER RENEWABLE ENERGY SOURCES

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro – Geothermal energy Fuel cell technology - types, principle of operation – applications.Hydrogen energy production - Storage system.

TEXT BOOK

1. Rai. G.D. "*Non Conventional Energy Sources"*, Khanna Publishers, New Delhi, 1999.
2. Sukhatme.. S.P. "*Solar Energ"*, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
3. *"Renewable energy sources of conversion technology":* Bansal..N.K Manfred Kleen Man and Michael Meliss, TMH Publication.

REFERENCES

1. Kothari. P, K C, Singal and Rakesh Ranjan, "*Renewable Energy Sources and Emerging Technologies*", PHI Pvt. Ltd., New Delhi, 2008
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford UniversityPress, U.K, 1996.
3. Twidell. J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
4. Tiwari. G.N. Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, NewDelhi, 2002.

5. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.
6. Johnson Gary, L., Wind Energy Systems, Prentice Hall, New York, 1985.
7. Energy planning in Developed countries (U.N.), Oxford University Press, 1984.

CH1102 RENEWABLE ENERGY ENGINEERING												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
			x	x	x		x		x			x
2.	Mapping of instructional objectives with student outcome		2,3,4,5	2,3,4,5	1,2,3,4,5		1		1			2, 3, 4,5
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		X		--		X			X			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		X		X		X			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1103	ENERGY ENGINEERING AND TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To motivate the students by highlighting the importance of Energy technology and various energy engineering concepts and energy generation principles.

INSTRUCTIONAL OBJECTIVES

1.	To familiarise the basics of energy concepts, demand and utilization
2.	To understand the various energy conversion technologies
3.	To impart the knowledge of thermo nuclear fusion energy and their concepts
4.	To familiarise the energy conservation and its utilization
5.	To study the various energy storage systems and distribution

UNIT I - INTRODUCTION

Energy Overview: Basics of energy, Types of energy and its utilization, EnergyCharacteristics, Energy Chains, Energy Resources, Energy demand – Supply Network, Depletion – Conventional energy sources, Fallouts of energy usage, application of carbon credit, Changing energy consumption trends, Energy Conservation opportunities, New energy technologies.

UNIT II - ENERGY CONVERSION TECHNOLOGIES

MHD Generators - Basic, Principle, Open Cycle and Closed Cycle MHD Technologies, Materials, Applications, Advantages & Disadvantages.Types of energy conversion plants for various primary energy sources.Power plants with conventional energy sources, nuclear fission reaction power plants, Gas-Turbine power plants, Integrated Coal Gasification combined cycle power plant.

UNIT II - THERMO NUCLEAR FUSION ENERGY

The Basic: Nuclear Fusion and reactions, Requirements for nuclear fusion, Plasma Confinement, Magnetic-Confinement fusion, Inertial-confinement fusion, Muon Catalysed fusion, Characteristics of D-T reaction, Advantages of Nuclear fusion, Fusion Hybrid, Environmental and safety with nuclear fusion.

UNIT IV - ENERGY CONSERVATION

Principles of energy conservation, Energy conservation approach – Opportunities-boilers, heaters and coolers, Co-Generation, Waste heat Utilisation, Heat Recuperators, Heat Regenerators, Heat pipes, Stirling Engine, Heat pumps, Renewable energy devices.

UNIT V - ENERGY STORAGE AND DISTRIBUTION

Energy storage systems: Mechanical - Pumped hydroelectric storage, compressed air, energy storage via flywheels, electrical – lead acid battery, Chemical, Electromagnetic energy, Thermal energy- Sensible heat, latent heat, Biological, Distribution of energy

TEXT BOOK

1. Rai, G.D, *Non-Conventional Sources of Energy*, Khanna Publishers, New Delhi, 1999.
2. Rao, S.and Dr. Parulakar B.B., *Energy Technology*, Khanna Publishers, New Delhi, 1994.

REFERENCES

1. Tiwari. G. N. and. Ghosal. M. K *"Fundamentals of Renewable energy Sources",* Narosa Publishing House, New Delhi, 2007.
2. Energy Studies. *W*. "Shepherd and D. W. Shepherd, Second Edition, Imperial College Press, London, 2004.

CH1103 ENERGY ENGINEERING AND TECHNOLOGY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
			x	x	x		x		x			x
2.	Mapping of instructional objectives with student outcome		2,3,4,5	2,3,4,5	1,2,3,4,5		1		1			2, 3, 4,5
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		x		--		x				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		x		x		x				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1104	INDUSTRIAL POLLUTION PREVENTION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course makes the students knowledgeable in various pollution prevention methods employed in chemical industries

INSTRUCTIONAL OBJECTIVES

1. To familiarize
   Methods of pollution prevention in industries
2. Life cycle assessment and design for environment
3. Cleaner technologies and sustainability

UNIT I - INTRODUCTION

Industrial activity and environment, industrialization and sustainable development-indicators of sustainability-sustainability strategies-Barriers to sustainability-Pollution prevention in achieving sustainability

UNIT II - POLICIES AND REGULATIONS

Prevention vs control of industrial pollution-Environment policies and Regulations to encourage pollution prevention

UNIT III - ENVIRONMENTAL CONTAMINANTS

Environment friendly chemical processes-Properties of environmental contaminants - Regulations for clean environment and implications for industries

UNIT IV - LIFE CYCLE ASSESSMENT

Life cycle assessment and pollution prevention economics-Design for the environment-International environmental standards-Environmental technology assessment.

UNIT V - INDUSTRIAL APPLICATIONS OF POLLUTION PREVENTION

Water, energy and reagent conservation-residuals management-Economic recovery and recycling of wastes. Industrial applications of pollution prevention, Life cycle assessment, waste audits and technology assessments

TEXT BOOK

1. Bishop .P, "*Pollution Prevention: Fundamentals and Practice*", McGraw Hill International Edn., McGraw Hill Book Co., Singapore, 2000.
2. Roy T.K. (Editor), "*Chemical Technology for better Environment*", Allied Publishers Ltd., Chennai, 1998.

REFERENCES

1. Freeman. H.M , "*Industrial Pollution Prevention Hand Book*", McGraw Hill, 1995.
2. James G. Mann and Y.A.Liu, "*Industrial Water Reuse and Waste Water Minimization*", McGraw Hill, 1999.

CH1104 INDUSTRIAL POLLUTION PREVENTION												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
				x			x		x			
2.	Mapping of instructional objectives with student outcome			1,2,3			1,2,3		1,2,3			
3.	Category	General (G)		Basic Sciences(B)			Engineering Sciences and Technical Arts (E)			Professional Subjects(P)		
		--		--			--			x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles			Chemical Engineering Applications			Advances in Chemical Engineering		
		--		--			x			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1105	INDUSTRIAL POLLUTION CONTROL	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate mastery of principles and processes involved in various Industries to control the pollution

INSTRUCTIONAL OBJECTIVES

1.	To impart knowledge on the principles of various processes involved in the treatment of Industrial Pollutants such as Air, Water and Solid

UNIT I - INTRODUCTION

Definition of pollutant, types of pollution; Air, Water, Land, noise- adverse effects of pollutants eco system and human health - need for effluent treatment and toxicity, control.Water standards for portable, agricultural and left-off streams- air standards for cities, industrial areas, resorts.

UNIT II - AIR POLLUTION CONTROL METHODS

Particulate emission control- gravitational settling chambers- cyclone separators, fabric filters, electrostatic precipitators, wet scrubbers, absorbers. Control of sulphur di oxide, oxides of nitrogen, carbon monoxide and hydrocarbons. Noise pollution measurements and its control.

UNIT III - WASTE WATER

Origin of waste water, types of water pollutants and their effects, waste water sampling and analysis, determination of organic and inorganic matters, physical characteristics, bacteriological measurements

UNIT IV - BASIC PROCESS OF WATER TREATMENT

Primary, secondary and tertiary treatments - advanced waste water treatments; recovery of metals from process effluents

UNIT V - POLLUTION CONTROL ASPECTS IN TYPICAL CHEMICAL PROCESS INDUSTRIES

Fertilizer, petroleum refinery, petrochemical, pulp and paper, tanning, sugar, distilleries, textile industries

TEXT BOOK

1. Rose. G.R.D, *Air pollution and Industry*, Van Nostrand Reinhold Co., New York 1972.
2. Pandey G.N. and Carney G.C., Environmental Engineering, Tata McGraw Hill, New Delhi,1989.

REFERENCES

1. Kapoor .B.S, Environmental Engineering, 3rd Edn., Khanna publishers,1997.
2. Mahajan S.P., Pollution Control in Process Industries, 1st Edn., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1995.

CH1105 INDUSTRIAL POLLUTION CONTROL												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x										
2.	Mapping of instructional objectives with student outcome	1										
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		x		--		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1106	INTRODUCTION TO BIOCHEMICAL PRINCIPLES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This subject puts emphasis on the basic engineering principles of biochemical process. It also highlights the modern application of biotechnological process and the role of chemical engineer in biotechnological industry

1.	To study the chronological development of bio process technology design and construction of fermentor and parameters to be monitored and controlled in biochemical process.
2.	To study the various media for fermentation process
3.	To teach the principle and kinetics of sterilization methods
4.	To study the stoichiometry and energetics of cell growth and product formation
5.	To evaluate the kinetics and mechanism of microbial growth

UNIT I - FERMENTATION PROCESS

Introduction: Chronological development of bioprocess technologies, basic configuration of fermentor and accessories, outline of an integrated bioprocess and the various unit operations involved in bioprocesses, Monitored and controlled of various parameter in fermentation process

UNIT II - RAW MATERIALS AND MEDIA DESIGN

Media: Selection of good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements. Designing of media for fermentation processes, Types of media-simple, complex and crude media, design and usage of various commercial media for industrial fermentations

UNIT III - STERILIZATION METHOD

Sterilization: Types- Thermal death kinetics of micro organisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media and air.

Microorganism: Isolation, preservation and improvement of industrially important micro- organisms, development of inocula for industrial fermentations. Different types of fermentations process and its applications

UNIT IV - METABOLIC STOICHIOMETRY AND ENERGETICS

Stoichiometry: Cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass available, electron balances, yield coefficient of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth

UNIT V - GROWTH AND PRODUCT FORMATION KINETIC

Kinetics: Phases of cell growth in batch cultures, simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms. Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudking – Piret models, substrate and product inhibition on cell growth and product formation

TEXT BOOK

1. Pauline. M, .Doran ., "*Bioprocess Engineering Principles*";Academic press. 1995.
2. Peter. F, .Stanbury, Allan Whitaker, "*Principles of Fermentation Technology*" 2ndEdition, Butterworth – Heinemann (an imprint of Elsevier), 1995.

REFERENCES

1. Michael L.Shuler and Fikret Kargi, "*Bioprocess Engineering Basic concepts*", Prentice Hall, 1992.
2. Blanch, H.W,and D.S. Clark. "*Biochemical Engineering*". Marcal & Dekker, Inc., 1997.
3. Bailey. J.E. and Ollis. D.F, "*Biochemical Engineering Fundamentals*" 2nd Edition, McGraw– Hill, 1988.

CH1106 INTRODUCTION TO BIOCHEMICAL PRINCIPLES												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	J	k
			x	x		x						
2.	Mapping of instructional objectives with student outcome		1	2,3		4,5						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		x		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1107	**BIOCHEMICAL PROCESS DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To introduce the biochemical process design, analysis and scale up of biochemical reactors.

INSTRUCTIONAL OBJECTIVES

1.	To strengthen the knowledge on design operation and stability analysis of biochemical reactors
2.	To study the Biochemical reactor scale up operation
3.	To teach the Methods of on line and off line monitoring of fermentation process
4.	To study the Fundamentals of modeling of fermentation process
5.	To study the Modern bio technological process

UNIT I - DESIGN AND ANALYSIS OF BIOCHEMICAL REACTORS

Modelling of Non-ideal Behavior in Biochemical reactors -Tanks-in-series and Dispersion models-applications to design of continuous sterilizers; Design and operation of novel Biochemical reactors -Air-lift loop reactors; Fluidized bed-Biochemical reactors; Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors. Stability analysis of Biochemical reactors.

UNIT II - BIOCHEMICAL REACTOR SCALE-UP

Transport phenomena in Bioprocess systems, Regime analysis of Biochemical reactors processes, Correlations for oxygen transfer; Scale-up criteria for bioreactors based on oxygen transfer and power consumption.

UNIT III - MONITORING OF BIOPROCESSES

On-line data analysis for measurement of important physico-chemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry; Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes. Computer based data acquisition, monitoring and control.

UNIT IV - MODELLING OF BIOPROCESSES

Study of structured models for analysis of various bioprocesses – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model.

UNIT V - MODERN BIOTECHNOLOGICAL PROCESSES

Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture, limits to over expression, Biochemical reactors strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures.

TEXT BOOK

1. Shuler. M.L. and Kargi. F, "*Bioprocess Engineering: Basic Concepts*", 2ndEdition, PHI,2002.
2. Bailey. J.E, and Ollis, D.F. "*Biochemical Engineering Fundamentals*" 2nd Edition, McGraw– Hill, 1988.

REFERENCES

1. Lee, James .,. "*Biochemical Engineering*", PHI, 1992.
2. Blanch, H.W. and Clark, D.S. "*Biochemical Engineering*", Marcel Decker Inc., 1997.

CH1107 BIOCHEMICAL PROCESS DESIGN												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x		x						
2.	Mapping of instructional objectives with student outcome	5	1	2,3		4						
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		x		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1108	ENZYME ENGINEERING AND TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The course aims to provide knowledge on enzymology and kinetics of enzyme. It also highlights the industrial application of various enzyme.

INSTRUCTIONAL OBJECTIVES

1.	To introduce the basic concepts about enzymes, action and principle
2.	To study the kinetics of enzyme action in substrate and inhibiter
3.	To provide information about immobilized enzyme systems and kinetics
4.	To study the application of various enzyme in developing industry

UNIT I - ENZYMES ACTION

Introduction: Enzyme and its Classification, Mechanisms of enzyme action– concept of active site and energetic of enzyme substrate complex formation; specificity of enzyme action– principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT II - KINETICS OF ENZYME ACTION

Kinetics: Kinetics of single substrate reactions; estimation of Michelis-Menten parameters– kinetics plots– multisubstrate reactions mechanisms– Allosteric regulation of enzymes– Monod changeux wyman model.

Inhibition: Inhibiter–types of inhibition mechanism–competitive, Uncompetative and Noncompetative mechanism– Comparisation of mechanism.

UNIT III - DEACTIVATION ENZYME KINETICS

Enzyme kinetic for reversible enzyme modulator, the effect of pH and temperature on enzyme reaction, Enzyme deactivation: mechanisms and manifestations of protein denaturation, deactivation models and kinetics. Mechanical forces acting and enzyme, strategies for enzyme stabilization

UNIT IV - ENZYME IMMOBILISATION TECHNOLOGY

Immobilization: Types – adsorption, matrix entrapment, encapsulation, cross linking, covalent binding; advantages and disadvantages of different immobilization techniques, immobilization enzyme kinetics: effects of external mass-transfer resistance, analysis of intraparticle diffusion and reaction, simultaneous film and intraparticle mass-transfer resistances, effects of inhibitors-temperature-pH on immobilized enzyme

UNIT V - APPLICATIONS OF ENZYME

Application of enzyme in analysis; Design of enzyme electrodes and their application as biosensors in industry. Application of hydrolytic enzyme-amylase, cellulase, protease, lipase, medical applications of enzymes, nonhydrolytic enzyme in current and developing industry.

TEXT BOOK

1. Palmer, Trevor "*Enzymes : Biochemistry, Biotechnology, Clinical Chemistry*", Affiliated East-West Press Pvt. Ltd., 2004.
2. Bailey, J.E. and Ollis, D.F. "*Biochemical Engineering Fundamentals*", 2nd Edition, McGraw-Hill, 1986.

REFERENCE

1. Blanch .H.W. and D.S. Clark. "*Biochemical Engineering*". Marcal & Dekker, Inc., 1997.

CH1108 ENZYME ENGINEEING AND TECHNOLOGY													
Course Designed by		**Department of Chemical Engineering**											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
		x		x		x							
2.	Mapping of instructional objectives with student outcome	1		2,3		4,5							
3.	Category	General (G)		Basic Sciences(B)			Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--			--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles			Chemical Engineering Applications				Advances in Chemical Engineering		
		--		--			x				--		
5.	Approval	23rd Meeting of Academic Council, May 2013											

CH1109	**BIOREACTOR ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The course aims to provide knowledge on analysis of microbial growth kinetics in bioreactor

INSTRUCTIONAL OBJECTIVES

1.	To study the kinetics of balanced and transient growth
2.	To study the various kinetic models
3.	To provide information about analysis of ideal and non-ideal bioreactors
4.	To study the sterilization reactors and multiphase bioreactors
5.	To study the transport phenomena in bioprocess systems

UNIT I - KINETICS OF BALANCED AND TRANSIENT GROWTH

Ideal reactors for kinetics measurements: the ideal batch reactor, the ideal continuous-flow stirred-tank reactor (CSTR).-Kinetics of balanced growth: monod growth kinetics, kinetic implications of endogenous and maintenance metabolism, other forms of growth kinetics, other environmental effects on growth kinetics.-Transient growth kinetics: growth-cycle phases for batch cultivation, unstructured batch growth models, growth of filamentous organisms

UNIT II - KINETIC MODELS

Structured kinetic models: compartmental models, metabolic models, modeling cell growth as an optimum process.-Product formation kinetics: unstructured models, chemically structured product formation kinetics models, product formation kinetics based on molecular mechanisms-genetically structure models, product formation kinetics by filamentous organisms.-Segregated kinetic models of growth and product formation, thermal-death kinetics of cells and spores.

UNIT III - IDEAL AND NON-IDEAL BIOREACTORS

Ideal bioreactors: fed-batch reactors, enzyme-catalyzed reaction in CSTRs, CSTR reactors with recycle and wall growth, the ideal plug-flow tubular reactor. -Reactors with nonideal mixing: mixing times in agitated tanks, residence time distribution, models for nonideal reactors, mixing-bioreaction interactions.

UNIT IV - STERILIZATION OF BIOREACTORS AND MULTIPHASE BIOREACTORS

Sterilization reactors: batch sterilization, continuous sterilization.-Immobilized biocatalysts: formulation and characterization of immobilized cell biocatalysts, applications of immobilized cell biocatalysts.-Multiphase bioreactors: conversion of heterogeneous substrates, packed-bed reactors, bubble-column bioreactors, fluidizedbed bioreactors, trickle-bed reactors.

UNIT V - TRANSPORT PHENOMENA IN BIOPROCESS SYSTEMS

Gas-liquid mass transfer in cellular systems: basic mass transfer concepts, rates of metabolic oxygen utilization.-Determination of oxygen transfer rates: measurement of k1a' using gas-liquid reactions.-Mass transfer for freely rising or falling bodies: mass transfer coefficients for bubbles and bubble swarms, estimation of dispersed phase interfacial area and holdup.-Forced concepts and key dimensionless groups., correlations for mass transfer coefficients and interfacial area.-Overall k1a'estimates and power requirements for sparged and agitated vessels

TEXT BOOK

1. Bailey and Ollis, "Biochemical Engineering Fundamentals", 2nd ed., McGraw-Hill Book Company, New York, 1986.
2. Doran. M, Paulines, "Bioprocess Engineering Principles", 8th ed., Academic press, New York, 2003.

REFERENCES

1. Klaas Van't Riet, Johannes Tramper, "Basic Bioreactor Design", 2nd ed., Marcel Dekker, Inc., New York,

CH1109 BIOREACTOR ANALYSIS													
Course Designed by		Department of Chemical Engineering											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
		x		x		x							
2.	Mapping of instructional objectives with student outcome	1		2 , 3		4 , 5							
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)			
		--		--		--				x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering			
		--		--		x				--			
5.	Approval	23rd Meeting of Academic Council, May 2013											

CH1110	BIOREACTOR DESIGN	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course introduces the design of bioreactors for efficient utilization of principles in bioprocess technology

INSTRUCTIONAL OBJECTIVES

1.	To introduction about Basic concepts of bioreactor design
2.	To study the Bioreactor instrumentation and control
3.	To teach the Methods and strategies for fermentation control
4.	To study the Modelling and simulation of fermentation processes
5.	To study the Modern bio technological process

UNIT I - INTRODUCTION TO DESIGN OF BIO REACTOR

Types of Bioreactor, Heat transfer, Scale – up, Airlift Bioreactors, Introduction, Design and construction of the airlift – loop reactor, Hydrodynamics, Three – phase flow, Mixing, Oxygen transfer

UNIT II - MICROBIAL GROWTH

Growth, Measurement of microbial growth (direct), Measurement of microbial growth (indirect), Kinetics of cell growth in batch culture, Continuous culture.

UNIT III - INSTRUMENTATION CONTROL OF BIOREACTORS

Introduction, Mass transfer, Theory of mixing, Rheological properties, Bioreactor sensor characterizes, Temperature measurement control, principles of dissolved oxygen measurement and control, principles of PH / redox measurement and control, deduction and prevention of foam, determination of biomass and application of biosensors

UNIT IV - GAS ANALYSIS

Study of structured models for analysis of various bioprocesses – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model.

UNIT V - MODELING OF PLANT AND ANIMAL CELL BIOREACTORS

Modelling, digital simulation, formulation and solution of problems by simulations, digital simulation programming languages, ISIM (interactive simulation language) Plant cells, Animal cells.

TEXT BOOK

1. SCRAGG . A.H, "*Bioreactors in Biotechnology*", Ellis Horwood series, 1991.

REFERENCES

1. Bailey. J.E, and Ollis. D.F. "*Biochemical Engineering Fundamentals*" 2nd Edition, McGraw– Hill, 1988.

CH1110 BIO REACTOR DESIGN												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x		x	x					
2.	Mapping of instructional objectives with student outcome	5	1	2 , 3		4	5					
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		--		x		--				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

	FERTILIZER TECHNOLOGY	L	T	P	C
CH1111	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate mastery of leading practices and their Physio-chemical foundations involved in the production of various types of fertilizers.

INSTRUCTIONAL OBJECTIVES

1. To impart knowledge on the principles of various processes involved in the Fertilizer technology

UNIT I - INTRODUCTION

Role of organic manures and Chemical Fertilizers, Types of Chemical fertilizers, growth of fertilizer industry in India, their location, energy consumption in various fertilizer processes, materials of various fertilizer processes, materials of consumption in fertilizer industry.

UNIT II - NITROGENOUS FERTILIZERS

Feed stock for production of Ammonia, Natural gas, Associated gas, Coke oven gas Ammonium sulphate, Ammonium Nitrate, Urea, Calcium Ammonia Nitrate, Ammonium chlorides; Methods of Production, characteristics and specification, storage and handling.

UNIT III - PHOSPHATE FERTILIZERS

Raw materials for the manufacture of Phosphate fertilizer - Phosphate Rock, Sulphur, Pyrites etc - processes for the production of Sulfuric and Phosphoric acid - Phosphatic fertilizers - ground Rock Phosphate, Bone Meal - methods of production, characteristics and specifications for single superphosphate, triple superphosphate

UNIT IV - POTASH FERTILIZERS

Methods of production, Characteristics and specifications for complex fertilizers, methods of production of Ammonia phosphate, Sulphate, Di-ammonium phosphate and Nitrophosphates.

NPK Fertilizers: Urea Ammonium Phosphate, Monoammonium Phosphate and various grades of NPK fertilizers produced in the country

UNIT V - MISCELLANEOUS FERTILIZER

Mixed fertilizers, granulated mixtures, Bio-fertilizers, Secondary & Micro Nutrients, Fluid Fertilizers, Controlled release fertilizers, pollution from fertilizer industry, solid, liquid and gaseous pollution standard laid down for them.

TEXT BOOK

1. Hand book of Fertilizer Association of India, New Delhi, 1998

REFERENCES

1. Slack A.V., Chemistry & Technology of Fertilizers, Interscience, New York, 1967

CH1111 FERTILIZER TECHNOLOGY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		x										
2.	Mapping of instructional objectives with student outcome	1										
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		x		--		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1112	PETROLEUM REFINING TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course explains thermal cracking, catalytic cracking and multicomponent distillation operations involved with petroleum refining industries, in addition to storage and transportation of petroleum products.

INSTRUCTIONAL OBJECTIVES

1.	Petroleum refining and thermal cracking processes
2.	Catalytic cracking and catalytic reforming processes
3.	Petroleum compounds treatment methods
4.	Production of fuels such as aviation gasoline, motor fuel, kerosene, jet fuel
5.	Storage and transportation of petroleum products

UNIT I - THERMAL CRACKING AND THERMAL REFORMING

Origin occurrence of petroleum, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Petroleum refining processes, general processing, topping and vacuum distillations. Thermal cracking in vapor, liquid and mixed phase. Overview of Refinery Products

UNIT II - CATALYTIC CRACKING AND CATALYTIC REFORMING

Catalytic cracking - houdry fixed bed, fluidized bed, T.C.C. Houder flow etc. Catalytic reforming - conversion of petroleum gases into motor fuel with special reference to alkylation, polymerization, hydrogenation and dehydrogenation.

UNIT III - TREATMENT TECHNIQUES

Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance, Destruction of Sulphur Compounds and Catalytic Desulphurization, Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining.

UNIT IV - PRODUCTION OF FUELS

Production of aviation gasoline, motor fuel, kerosene, diesel oil, tractor fuel and jet fuel, hydrodesulfurisation, Lubricating oil manufacture, Petroleum waxes and asphalts.

UNIT V - STORAGE AND TRANSPORTATION

Octane number, Cetane number, Diesel index, their determination and importance Storage of petroleum products: tanks, bullets, special types of spheres etc. Transportation of petroleum products: road, rail, sea and pipeline; Importance of pipeline transportation.

TEXT BOOK

1. Bhaskara Rao. B.K., *"Modern Petroleum Refining Process"*, 3rd Edn., Oxford & IBH, New Delhi, 1984

REFERENCES

1. Nelson W.L. "*Petroleum Refinery Engineering*", 4th Edn., McGraw Hill, New York, 1958
2. Watkins. R. N. "*Petroleum Refinery Distillations*", 2nd Edition, Gulf Publishing Company, Texas, 1981.
3. Hobson. G. D. "*Modern Petroleum Refining Technology*", 4th Edition, Institute of Petroleum, U. K. 1973.

CH1112 PETROLEUM REFINING TECHNOLOGY													
Course Designed by		Department of Chemical Engineering											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
		x		x									
2.	Mapping of instructional objectives with student outcome	1 , 2		3,4,5									
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)				
		--		--		--			x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering				
		--		--		x			--				
5.	Approval	23rd Meeting of Academic Council, May 2013											

CH1113	POLYMER TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course makes the students to understand the technology involved in the manufacturing processes of various types of polymers

INSTRUCTIONAL OBJECTIVES

1. To Impart knowledge on: Various types and aspects of polymers
2. Various types and aspects of Elastomers
3. Various processing methods of polymers and elastomers
4. Various properties and application of polymers

UNIT I - INTRODUCTION

Polymers - Classification of polymers, Chemistry of polymerization, molecular weight & polydispersity, Crystallinity and glass transition temperature(Tg), polymerization techniques- bulk, dispersion, solution, suspension and emulsion polymerisations

UNIT II - THERMOPLASTIC AND THERMOSETTING POLYMERS

Thermoplastic Polymers – polyolefins – vinyl polymers – poly vinyl chloride-polystyrene – PMMA – SAN – PAN - Teflon – polyamides – polycarbonates and their applications. Thermosetting Polymers – Phenolic resins –– UF- MF - polyesters –epoxies – bisphenol A - polyurethanes – silicone resins and their applications.

UNIT III - ELASTOMERS

Natural rubber – Isoprene rubber, Synthetic rubbers - Butadiene rubber- Butyl rubber- Styrene Butadiene Rubber-Chloroprene rubber- Nitrile rubber–- EPDM rubber and Silicone rubber and their applications.

UNIT IV - POLYMER PROCESSING

Polymer processing, Processing of thermoplastics and thermosetting plastics, compounding, processing aids – injection moulding – extrusion moulding – blow moulding.Processing of natural and synthetic rubbers – vulcanisation, mastication – calendaring– reaction injection moulding – sintering - solution casting – SMC and DMC – fibre spinning and drawing.

UNIT V - PROPERTIES & APPLICATIONS OF POLYMERS

Rheology & mechanical properties- thermal and optical properties. Application of Polymers -Electrical and electronics- high temperature applications- Polymer blends, alloys and liquid crystals- lithography and water treatment- biomedical, automotives.

TEXT BOOK

1. Gowariker. V R, Vasant R. Gowariker, N V Viswanathan, Jayadev Sreedhar, "*Polymer Science*, New Age International, 1986.
2. Billmeyer F.W., "*Text book of Polymer Science*," 3rd edn., Wiley, Singapore, 1984.

REFERENCES

1. Dyson. R.W. Speciality Polymers, Chapman and Hall, New York, 1987.
2. Mark. H.F, (Ed), Encyclopedia of Polymer Science and Engineering, Wiley – Interscience, New York, 1991.
3. Morton. D.H and Jones, Polymer Processing, Chapman and Hall, London, 1989.
4. Brydson. A. Plastic materials, 4th edition, Butterworth – Heinamann Ltd., London, 2002.
5. Maurice Morton, Rubber Technology, Van Nostrand Reinhold, New York, 2002.

CH1113 POLYMER TECHNOLOGY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1,2,3,4,5				
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			X			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		X		--		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1114	DRUG AND PHARMACEUTICAL TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to understand the applications of various unit processes in drugs and pharmaceutical industries and also gives an outline of manufacturing principles and product formulations

INSTRUCTIONAL OBJECTIVES

1.	To familiarize: Basics of drugs and pharmaceuticals
2.	Important unit processes and their applications
3.	The manufacturing principles involved in drugs and pharmaceuticals
4.	Pharmaceutical products formulations
5.	Various aspects of microbiological & Animal products

UNIT I - INTRODUCTION

Development of drugs and pharmaceutical industry; Organic therapeutic agents uses and Economics; Drug Metabolism and Pharmaco Kinetics; Drug Metabolism: Physio Chemical principles; Radioactivity; Pharma kinetic reaction of Drugs on Human bodies.

UNIT II - IMPORTANT UNIT PROCESS AND THEIR APPLICATIONS

Chemical conversion processes; Alkylation; Carboxylation; Condensation & Cyclisation; Dehydration; Esterification; Halogenation; Oxidation; Sulfonation; Complex Chemical conversions; Fermentation.

UNIT III - MANUFACTURING PRINCIPLES & EMULSIONS

Compressed Tablets; Wet granulation - dry granulation or slugging; Direct compression Tablet Presses Formulation; Coating Pills; Capsules; Sustained dosage Forms; Parental Solution; Oral liquids - Injections External preparations - Ointments; Standard of Hygiene and Good Manufacturing practice as per Drugs & Cosmetics Act as amended update.

UNIT IV - PHARMACEUTICAL PRODUCTS FORMULATIONS

Based on Antipyretic & anti inflammatory, Respiratory, Cardio intestinal & Liver, Hormones, C.N.S Stimulants, Histamine and Anti Histamine, Vitamins and other nutrients, Sedatives, Analgesics

UNIT V - MICROBIOLOGICAL & ANIMAL PRODUCTS

Antibiotics, Anti Infective, Biological, Hormones, Vitamins and Preservation, Pharmaceutical Analysis, Analytical methods and Tests for various Drugs and Pharmaceuticals, Packing Techniques, Quality Control.

TEXT BOOK

1. Rawlins .E.A, *Bentleys Text Book of Pharmaceutics*, A.I.T.B.S.Publisher & Distributors, Delhi, 1996.

REFERENCES

1. Remingtons, "*The Science Practice of Pharmacy"*, Edited by Alfonso R. Gennaro, Mack Publishing Company of Eastern, Pennsylvania, 1997.

CH1114 DRUG AND PHARMACEUTICAL TECHNOLOGY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
								x		x		x
2.	Mapping of instructional objectives with student outcome											1,4,5
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		x		--		--				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1115	PULP AND PAPER TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course makes the students to understand the technologies involved in the manufacture of pulp and paper

INSTRUCTIONAL OBJECTIVES

1. To provide the basic concepts of pulp and paper manufacturing process to the chemical engineering students which will enable them to understand and acquire knowledge in pulp and paper sector

UNIT I - INTRODUCTION

Pulp and Paper Industry Scenario in India, Chronological development of pulp and paper technology, Definitions of pulp and paper, Flow sheet of complete pulp and paper manufacturing process

UNIT II -RAW MATERIAL SELECTION

Types of wood – softwood, hardwood and non-wood, composition of wood-cellulose, hemicellulose, lignin, extractives, and inorganic components, comparison with other raw materials

UNIT III - PULPING PROCESS

Pulping processes – Mechanical Pulping, Kraft Pulping, Sulfite Pulping, Cooking equipment, washing, screening and thickening, Stock Preparation

UNIT IV - CHEMICAL RECOVERY

Black liquor oxidation, Recaustizing, Calcining, Alternate kraft recovery systems

UNIT V - PAPER MACHINE

Introduction to paper machine, Wet and dry end operations, finishing, properties and testing of paper, End uses of paper

TEXT BOOK

1. Smook. G. A, "*Hand book for Pulp and Paper Technologists",* 7th Edn*.,* TAAPI Press 1989
2. Mc Donald. R. G,. and Franklin J. N. Pulp and Paper Manufacture" Vol 2. Mc Graw Hill. 1969.

REFERENCES

1. Gopala Rao .M and Marshall Sittig, *Dryden's Outlines of Chemical Technology*, 3rd Edn., East-West Press, New Delhi, 2004.
2. George. T, Austin, *Shreve's Chemical Process Industries*, 5th Edn., McGraw-Hill International Editions, Singapore, 1984.

CH1115 PULP AND PAPER TECHNOLOGY												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
2.	Mapping of instructional objectives with student outcome											
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		x		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1116	PETROCHEMICAL TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to know about the various raw materials and manufacturing processes involved in the petrochemical industries.

INSTRUCTIONAL OBJECTIVES

1.	To give an introduction to petrochemical industries
2.	.To familiarize various aspects of production of olefin containing gases
3.	To familiarize various aspects of important intermediate material for petrochemical industries
4.	To familiarize various aspects of cracking and polymerization processes
5.	To familiarize the manufacturing methods of important petrochemicals

UNIT I - INTRODUCTION

Petro chemicals - Definition, overview of petrochemical, importance and growth potential of petrochemical in india, Economics and feedstock selection for petrochemical

UNIT II - OLEFIN GASES

Reforming and cracking: Cracking of Naphtha and Feed stock gas for the production of C_2 and C_3 Compounds-Ethylene, Acetylene, Propylene, Isobutylene and Butadiene. Ammonia, Alcohol and synthesis gas

UNIT III - INTERMEDIATES COMPOUNDS

Production of intermediate chemicals: Acrylonitrile, ethylene oxide, propylene oxide, ethyl chloride **UNIT I** –, vinyl acetate and vinyl chloride.

Higher olefins: Benzene, toluene, xylene, phenol and Styrene

UNIT IV - IMPORTANT PETROCHEMICALS

Polymerization process: Plastics-Ethenic and polycondensation polymers, Elastomers- synthetic rubber, Polymeric Oils-Silicones, Synthetic fibers-Cellulosic, polyamides and polyesters.

UNIT V - INDUSTRIAL PETROCHEMICALS

Agrochemicals, synthetic detergents, Carbon black and pharmaceuticals. Concepts of quality and environmental pollution control in petrochemical industries.

TEXT BOOK

1. Bhaskara Rao. B.K, "*Modern Petroleum Refinery Process*", Oxford & IBH Publishing Co.Pvt.Ltd, New Delhi, 1984.
2. Steiner H. "*Introduction to Petroleum Chemicals*", Pergammon Press, 1992.

REFERENCES

1. Brownstein. A.M. "*Trends in Petrochemical Technology*", Petroleum Publishing Company, 1976.
2. Sittig, M. "*Aromatic Hydrocarban, Manufacture and Technology*", Noyes Data Corporation, 1976.
3. Gopala Rao M. and Marshall Sittig. "*Dryden's Outlines of Chemical Technology*", 3rd Edn.,East-West Press, New Delhi, 1997.

CH1116 PETROCHEMICAL TECHNOLOGY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
			x	x	x							
2.	Mapping of instructional objectives with student outcome		2	1	3,4,5							
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1117	FOOD TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to understand the properties of food material, the methods of processing and handling of food materials and pollution control methods used in food industries

INSTRUCTIONAL OBJECTIVES

1.	To familiarize General aspects of food industry and role of Chemical Engineers in Food industry
2.	Composition and nutritional aspects of food
3.	Food deterioration, preservation and packing method
4.	Various aspects of bakery, confectionery and chocolate products

UNIT I - INTRODUCTION

Characteristics of food industry and role of Engineers, Constituents of food- Carbohydrates, Proteins, Fats and Oils and additional food constituents, Nutritive aspects of food constituents, Food additives, Quality factors in foods and Quality standards

UNIT II - UNIT OPERATION IN FOOD PROCESSING

Material handling; Heat exchanging- Heating,Cooling, Evaporation, Drying; Forming, Packaging, Controlling; Overlapping unit operations; Energy conservation and new processes.

UNIT III - DETERIORATION AND PRESERVATION

Deteriorative factors and their control; Kinetics of chemical reactions in foods; Preservation by heat and cold; Dehydration, concentration, drying, Irradiation, Microwave heating.

UNIT IV - FOOD PRODUCTS

Bakery, confectionary and chocolate products, Soft and alcoholic beverages, Dairy products; Meat, Poultry and fish products, Cereal, grains, pulses, vegetables, fruits, and spices.

UNIT V - PACKING METHODS AND WASTE DISPOSAL

Principles of food packaging- Requirements of effective food packaging, Types of containers, Food packaing materials and forms, Package testing, Packages with special features. Factory Hygiene - Wastewater disposal and pollution control in food industry

TEXT BOOK

1. Potter. JH, Hotchkiss NN, "*Food Science"*, 5th edn., The CBS Publishing Co, Delhi, 2007.
2. Toldeo. RT, "*The Fundamentals of Food Engineering"*, The CBS Publishing Co, Delhi, 2000.

REFERENCES

1. Sivasankar.,B, "Food Processing and Preservation", Prentice-Hall of India, New Delhi, 2002.
2. "Desrosier, NW., "*The Technology of Food Preservation*," The CBS Publishers & Distributors, 1998.

CH1117 FOOD TECHNOLOGY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	C	d	e	f	g	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcome	1			1							
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		--		--		x				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1118	**CHEMICAL PLANT SAFETY AND OCCUPATIONAL HAZARD**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				

PURPOSE

This course helps the students to understand the various aspects of Industrial safety and occupational hazards existing in chemical industries.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize Basics of Industrial Safety Management
2.	Various aspects of Chemical plant safety
3.	Various aspects of Industrial accidents and Fire safety
4.	Hazard identification techniques
5.	Various aspect of industrial hygiene and Occupational Health hazards, Safety legislation in chemical industries

UNIT I - INDUSTRIAL SAFETY MANAGEMENT

Importance of Safety consciousness in Indian Chemical Industries - Development of Industrial Health and Safety, Safety Organization –Polices-Culture -Planning-Promotion – Inspection –Rules- Responsibility – Supervision, Safety Committee – role of safety functionaries, Elements of work place Safety Program, Economic and Social Benefits from Safety Program- Effective Safety Education and Training – Communication at various levels of production and operation, Safety slogans

UNIT II - CHEMICAL PLANT SAFETY

Chemical process Industries - Sitting and Layout of a Chemical plant, Safety in transportation, storage and handling of hazardous chemicals, Chemical process hazards and their control - First degree and second degree hazards. Lines of defense - High pressure - High temperature operations – Case studies, Emergency preparation: On-site and Offsite , Safety aspects of maintenance in chemical plant -Effective steps to implement safety procedures-Periodic Advice and checking to follow safety procedures and rules- Safe guarding of Machines – Ergonomics -Proper selection and replacement of handling equipment -Safe handling and operation of materials and machineries

UNIT III - ACCIDENT AND THEIR PREVENTION

Definitions, H.W.Henrich, Frank bird & Multiple Causation theories of accident occurrences, Classification, Causes, Costs -Industrial accidents, Principles of Accident prevention, Accident prevention technique – Plant and Chemical job safety analysis, Accident proneness-vocational guidance, Safety performance measurement tools - FR. SR, (FSI), Safe-T-Score, Accident rate per 1000 workers, Disabling injury index, Accident Compensation Statutes, Accident Investigation reporting and Analysis - Case studies. Conditions -Fire triangle-Classification of fires, Common causes of industrial fires, Fire protection systems-prevention- Case studies, Safety in Explosive

UNIT IV - HAZARD IDENTIFIATION TECHNIQUES

Safety Appraisal - Risk Assessment -Hazard identification techniques with examples such as FMEA, CMA, Fault Tree Analysis, Preliminary Hazard Analysis (PHA), Hazard and operability (HAZOP) study, Quantitative risk analysis-Out line of methodology, Consequences analysis (Calculation of release rates of liquids under ambient pressure and liquids under pressure, Calculation of dispersion of released gases and vapors and platting of equal concentration contours), Dow (Index) Fire and Explosion Index System of Risk Analysis, Safety Audit.

UNIT V - INDUSTRIAL HYGIENE AND OCCUPATIONAL HEALTH HAZARDS

Concepts - Industrial and Occupational health hazards, Housekeeping, human factors and error, stress at work, Personnel protective equipments, Role of trade unions in Industrial safety and health.

SAFETY AND LAW

Introduction to ILO, Safety legislation in India, Factories act 1948, Employees welfare and legislation , Provisions relating to safety , health & environment in other important legislations - Indian boilers act and regulations, Indian electricity act and rules, Indian explosives act and rules, Mines act, Petroleum act and rules. Environmental protection act.

TEXT BOOK

1. Sarma. A M "*Safety and Health in Industry"* -A Hand book, BS Publications , 2009.
2. Fulekar. M.H, "*Industrial Hygiene and Chemical Safety"*, I.K International Publishing house Pvt Ltd., 2006.

REFERENCES

1. Fawcett .H.H, and Wood .W.S, Safety and Accident Prevention in Chemical Operations, John Wiley & sons, U.S.A.,1965.
2. Willie Hammer &Dennis Price, Occupational safety management and Engineering, Prentice Hall, 2001.
3. William Handley, Industrial safety hand book, McGraw- Hill, 1969.
4. Daniel. A, Crowl & Joseph. F Louvar Chemical Process safety: fundamentals with applications, Prentice Hall international series.

CH1117 FOOD TECHNOLOGY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
2.	Mapping of instructional objectives with student outcome	4	2,3,4	1,2,3,4,5	4	1,2,3,5	1	1 , 5	1, 1, 1, 1, 1	5	4	4
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		x		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		x		x		x				--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1119	ELECTROCHEMICAL ENGINEERING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To Provide an adequate mastery in the Principles involved in the electrochemical process and its applications.

INSTRUCTIONAL OBJECTIVES

1. To impart knowledge on basic electrochemical concepts, thermal balance, transport properties & potential theory in electrochemical processes

UNIT I - BASIC ELECTROCHEMICAL CONCEPTS

Introduction - electrode potential - phase equilibrium, chemical and electrochemical potentials, cells with solution of uniform concentration, transport processes in junction regions, electrolyte concentration cells. The electric potential-the electrostatic potential, intermolecular forces, outer and inner potential, potentials of reference electrode, the electric potential in thermodynamics. Activity coefficients-ionic distributions in dilute solutions, electrical contribution to the free energy, measurement of activity coefficients

UNIT II - REFERENCE ELECTRODE AND ELECTRICAL DOUBLE LAYER

Reference electrode-criteria of reference electrodes, hydrogen electrode, the calomelelectrode and other mercury and mercurous salt electrodes, silver-silver halide electrodes.Potentials of cells with junction- the Nernst equation, types of liquid junctions, cells with liquid junction, potentials across membranes. Structure of the electric double layer- qualitative description of double layers, the Gibbs adsorption isotherm, the Lippmann equation, the diffused part of the double layer. Electrode kinetics, electro kinetic phenomena, Electro capillary phenomena.

UNIT III - INFINITELY DILUTE SOLUTIONS AND THERMAL BALANCE

Infinitely dilute solutions-transport laws, conductivity, diffusional potential and transference numbers, conservation of charge, binary electrolyte, supporting electrolyte, multicomponent diffusion by elimination of the electric field. Mobilities and diffusion coefficients. Neutrality and Laplace's equation. Concentrated solutions-liquid junction potentials.

Thermal effects-thermal diffusion, heat generation, conservation and transfer, Thermo galvanic cells.

UNIT IV - TRANSPORT PROPERTIES

Transport properties- single and multicomponent solutions. Fluid mechanics-stress in aNewtonian fluid, magnitude of electrical forces. Transport in dilute solutions, simplification for convective transport, the Graetz problem, two-dimensional diffusion layer in laminar force convection, axisymmetric diffusion layers in forced convection.

UNIT V - POTENTIAL THEORY

Application of potential theory- primary and secondary current distribution. Numerical solution. Effect of migration on limiting currents-Correction factors for limiting currents. Concentration variation of supporting electrolyte, limiting currents for free convection.Concentration over potential- binary electrolyte, supporting electrolyte. Currents below the limiting current

TEXT BOOK

1. Prentice. G, "Electrochemical Engineering Principles", Englewood Cliffs, Prentice Hall, NJ, 1986.

REFERENCES

1. Newman. J, "Electrochemical Systems", Englewood Cliffs, Prentice Hall, NJ, 1991.
2. Rousar. I, Micka,.K., & Kimla, A., "Electrochemical Engineering I & I

CH1119 ELECTROCHEMICAL ENGINEERING													
Course Designed by		Department of Chemical Engineering											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
		x											
2.	Mapping of instructional objectives with student outcome	1											
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)				
		--		--		--			x				
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering				
		x		--		--			--				
5.	Approval	23rd Meeting of Academic Council, May 2013											

CH1120	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To solve the conservation laws (mass, momentum and energy) using finite volume method and apply to industrial engineering problems

INSTRUCTIONAL OBJECTIVES

1. To understand the flow and temperature field in engineering problems
2. To provide training to the engineering students which will enable them to develop a Computational Fluid Dynamics code

UNIT I - CONSERVATION LAWS OF FLUID MOTION

Governing equations of fluid flow and heat transfer - Equation of state – Navier Stokes equations for a Newtonian fluid – Governing equations of the flow of compressible Newtonian fluid – Differential and integral forms of the general transport equations

UNIT II - FINITE VOLUME METHOD FOR DIFFUSION PROBLEMS

One-dimensional, two dimensional and three dimensional steady state diffusion problems – One dimensional unsteady heat conduction

UNIT III - THE FINITE VOLUME METHOD FOR CONVECTIVE-DIFFUSION PROBLEMS

Steady one-dimensional convective and diffusion – Assessment of the central differencing scheme for convective diffusion problems – The upwind differencing scheme – The hybrid differencing scheme – Higher order differencing schemes for convective diffusion – Discretisation of transient convection-diffusion equation

UNIT IV - SOLUTION ALGORITHMS FOR PRESSURE-VELOCITY COUPLING IN STEADY FLOWS

Introduction – The staggered grid – The momentum equations – The SIMPLE algorithm – The SIMPLER algorithm – The SIMPLEC algorithm – The PISO algorithm – Transient SIMPLE algorithm

UNIT V - SOLUTION OF DISCRETISED EQUATIONS

Introduction – The tri-diagonal matrix algorithm – Application of TDMA to two-dimensional problems – Application of the TDMA method to three-dimensional problems

TEXT BOOK

1. Versteeg. H. K and Malalasekera. W. "*An introduction to computational fluid dynamics – The finite volume method"*, Longman Group Ltd 1995

REFERENCES

1. Ferziger. J.H, and Peric. M. "*Computational Methods for Fluid Dynamics*," Springer, 2002

CH1120 COMPUTATIONAL FLUID DYNAMICS												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
						x						x
2.	Mapping of instructional objectives with student outcome					1 , 2						2
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1121	INTRODUCTION TO STATISTICAL THERMODYNAMICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	CH1009 and CH1014				

PURPOSE

Classical thermodynamics takes a macroscopic, bulk point of view, whereas statistical thermodynamics establishes the principles of equilibrium at the microscopic, molecular level. The main aim of this course is to provide the statistical basis for thermodynamics, including ensemble theory and its applications to physical and chemical systems.

INSTRUCTIONAL OBJECTIVES

1.	The student will acquire an introduction to concepts that link classical and statistical thermodynamics.
2.	The course will also provide the student with the basic knowledge of statistical thermodynamics and its applications in chemistry and chemical engineering

UNIT I - STATISTICAL-MECHANICAL ENSEMBLES AND THERMODYNAMICS

Ensembles and Postulates, Canonical Ensemble and Thermodynamics, Grand Canonical Ensemble, Microcanonical Ensemble, Entropy, Other ensembles, characteristic equations, Fluctuations

UNIT II - GENERAL RELATIONS FOR INDEPENDENT MOLECULES

Thermodynamic equivalence of ensembles, Second law, Crriteria for spontaneous change, Systems of distinguishable and indistinguishable particles, Boltzmann Statistics,
Translational Partition Function

UNIT III - IDEAL MONOATOMIC AND DIATOMIC GAS

Ideal Monatomic Gas, Density of States, Thermodynamic Functions, Internal Degrees of Feedom, Homonuclear Diatomics, Molecular Partition Functions, Ideal Diatomic Gas, Vibrational, Rotational, Gas of Homonuclear Diatomics at Low Temperature, Quantum Statistics, Polyatomic Molecules

UNIT IV - CHEMICAL EQUILIBRIUM IN IDEAL MIXTURES

Chemical Equilibrium, General Relations, Statistical Derivation in a Special Case, Fluctuations in a Simple Chemical Equilibrium, Examples of Chemical Equilibriua

UNIT V - RATES OF CHEMICAL REACTIONS IN IDEAL MIXTURES

Potential Surfaces, Absolute Rate Theory, A Non-Chemical Application of the Eyering Theory.

TEXT BOOK

1. Terrell. L, Hill, An Introduction to Statistical Thermodynamics, Dover Publications, 1987.

REFERENCES

1. Donald. A, McQuarrie, Statistical Mechanics, University Science Books Publishers, 2nd edition, 2000.

CH1121 INTRODUCTION TO STATISTICAL THERMODYNAMICS												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
2.	Mapping of instructional objectives with student outcome	x										x
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
		--		--		--			x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications			Advances in Chemical Engineering			
		--		--		x			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1122	EQUILIBRIUM STAGE OPERATIONS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	CH1014 and CH1015				

PURPOSE

To provide an adequate knowledge of equilibrium stage operations such as multi component multistage separations – distillation, absorption, stripping and extraction.

INSTRUCTIONAL OBJECTIVES

1.	To understand the cascade configurations in chemical process systems
2.	To introduce approximation technique and its algorithms for multicomponent multistage separations.
3.	To present the fundamentals of enhanced distillation and adsorption

UNIT I - CASCADES

Typical cascade configurations, Solid-liquid cascades, Single-section Liquid-Liquid extraction cascades, Degrees of freedom and specifications for countercurrent cascades

UNIT II - APPROXIMATE METHODS FOR MULTICOMPONENT, MULTISTAGE SEPARATIONS

Fenske-Underwood – Gilliland Method, Kremser Group Method

UNIT III - EQUILIBRIUM – BASED METHODS FOR MULTICOMPONENT ABSORPTION, STRIPPING AND EXTRACTION

Theoretical Model for an Equilibrium Stage, General Strategy of Mathematical Solution, Equation – Tearing Procedures – Tridiagonal Matrix Algorithm, Bubble Point Method for Distillation

UNIT IV - ENHANCED DISTILLATION

Use of triangular graphs – Extractive Distillation, Azeotropic Distillation, Reactive Distillation

UNIT V - ADSORPTION

Equilibrium Consideration – Liquid adsorption, Kinetic and Transport Considerations

TEXT BOOK

1. Treybal. R .E, "*Mass Transfer Operations*", 3rd Edition, McGraw Hill, 1980.

REFERENCES

1. Seader. J D, & E J Henley, "*Separation Process Principles*", John Wiley & Sons Inc., 1998.

CH1122 EQUILIBRIUM STAGE OPERATIONS												
Course Designed by		Department of Chemical Engineering										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
				x		x					x	
2.	Mapping of instructional objectives with student outcome			1 , 2		1 , 2					3	
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)					Professional Subjects(P)	
		--		--		--					x	
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications					Advances in Chemical Engineering	
		--				x					x	
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1123	CHEMICAL PLANT UTILITIES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

Equipping the students with knowledge on the various process utilities and their importance in chemical process plants..

INSTRUCTIONAL OBJECTIVES

1.	Cooling requirements and control of heat losses.
2.	Process Piping
3.	Pinch analysis

UNIT I - STEAM, COMPRESSORS AND VACUUM PUMPS

Steam generation and its application in chemical process plants, steam distribution including appropriate mechanical valves and instrumentation, steam utilization, design of efficient steam heating systems, steam nozzles.

Compressed air, process pumps, compressors, vacuum pumps, pressurized air distribution systems. Types of compressors and vacuum pumps.

UNIT II - REFRIGERATION SYSTEMS AND INSULATION

Refrigeration system and their characteristics, load calculation and load calculation and humidification and de humidification equipments, drying and cooling tower, air blending, exhaust, ventilation, cryogenics, their characteristics and production of liquid N2 and O2

Importance of insulation for meeting for the process equipment, insulation material and their effect on various materials of equipment piping, fitting and valves, insulation for high, intermediate, low and sub zero temperatures including cryogenic insulation, determination of optimum insulation thickness.

UNIT III - WATER

Water Resources, process water, boiler feed water, storage and distribution of water, reuse and conservation of water.

UNIT IV - PIPING

Piping: Role & scope of piping, line diagram, Process flow diagram and piping and instrumentation diagram

UNIT V - PINCH ANALYSIS

Pinch Analysis: Problem representation, temperature enthalpy diagram, simple match matrix. Heat content diagram, Temperature interval diagram. Heat Exchanger Network Synthesis using Pinch technology

TEXT BOOK

1. Jack Broughton, *Process Utility Systems*: *Introduction to Design, Operation and Maintenance*, IChemE, 1994.

REFERENCES

1. Mahesh Rathore, "*Thermal Engineering*," Tata McGraw Hill India, New Delhi, 2010.
2. Robin M. Smith, "*Chemical Process: Design and Integration",* John Wiley & Sons Ltd., 2005.

CH1123 CHEMICAL PLANT UTILITIES													
Course Designed by		**Department of Chemical Engineering**											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k	
				x		x					x	x	
2.	Mapping of instructional objectives with student outcome			1,2,3,4		3 , 4					4	3 , 4	
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)			
		--		--		--				x			
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering			
		--		x		x				--			
5.	Approval	23rd Meeting of Academic Council, May 2013											

CH1124	**CHEMICAL PROCESS OPTIMIZATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To impart the fundamentals of optimization methods in solving chemical engineering problems.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize Basic concepts of optimization
2.	Various models available
3.	Applications of optimization in chemical processes

UNIT I - OPTIMISATION

Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum

UNIT II - MODELS

Unimodal, multimodal functions; analytical methods lagrange multiplier methods. direct methods; random, grid. hooke's nelder and mead methods; powell's technique; indirect methods; gradient and conjugate gradient methods; secant methods.

UNIT III - NUMERICAL METHODS

newton's quasi newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum.

UNIT IV - LINEAR AND NON-LINEAR PROGRAMMING

Review on basic concepts of LP formulations; Simplex methods; Integer, quadratic, geometric and dynamic programming.

UNIT V - APPLICATIONS

Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

TEXT BOOK

1. Edgar. T.., Himmelblau. D.M, "*Optimization of Chemical Processes"*, McGraw-Hill Book Co., New York, 1985.

REFERENCES

1. Reklaitis,. G.V, Ravindran. A, Ragsdell. K.M, "*Engineering Optimization*," John Wiley, New York, 1980
2. Biles. W.E, Swain. J.J, "*Optimization and Industrial Experimentation, Inter Science",* New York, 1980.

CH1124 CHEMICAL PROCESS OPTIMIZATION												
Course Designed by		**Department of Chemical Engineering**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
						x				x		x
2.	Mapping of instructional objectives with student outcome					1, 2, 3				1 , 2 , 3		3
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		--		--		--				x		
4.	Broad area	Chemical Sciences and Technology		Chemical Principles		Chemical Engineering Applications				Advances in Chemical Engineering		
		--		--		x				x		
5.	Approval	23rd Meeting of Academic Council, May 2013										

AMENDMENTS

S.No.	Details of Amendment	Effective from	Approval with date