UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science & Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global Institutions of Excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation

VISION AND MISSION OF THE DEPARTMENT OF POLYMER ENGINEERING

VISION

To offer quality education and training in Polymer Engineering through well structured curriculum and syllabi to produce engineers with sound technical knowledge and expertise to meet the needs of the society

MISSION

- To impart knowledge and skill in the field of Polymer Science and Engineering through well designed programs
- To equip the students with necessary skill in the development of polymers and polymeric products using appropriate techniques and software
- To promote engineering spirit for the product development through effective integration of design engineering and material technology
- To undertake research in multi- disciplinary polymer science and engineering and related areas and to encourage enterprise, innovation, growth and development in the emerging areas of new technology
- To develop analytical skills, leadership quality and team sprit through balanced curriculum and a judicial mix of co-curricular, extra-curricular and professional society activities
- To disseminate knowledge through seminars, conference and research publications for the benefit of society

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES
B.Tech. (Polymer Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES

- To impart basic knowledge in mathematics, science and engineering principles required for understanding the concepts in polymer science and technology
- To provide knowledge in synthesis & characterization of materials and design & manufacture of polymer products
- To impart practical skills in design, development and processing of polymer compounds and products
- To equip with necessary knowledge in developing advanced materials for engineering applications
- To provide necessary managerial and soft skills to become an effective professional
- To provide broad exposure to various societal, ecological, ethical and commercial issues

PROGRAMME OUTCOMES

On completion of the program the graduates will have

- Apply knowledge of mathematics, science and engineering in developing materials and designing of products
- Design and conduct experiments in polymer synthesis and characterization, as well as to analyze and interpret data
- Design moulds, products and process for the development of polymer products to meet the needs of industries and society
- Employ advanced techniques, skills, and modern engineering tools necessary for synthesis, testing and processing of polymers.
- Identify, formulate, and solve engineering problems related to polymer science and technology
- Ability to communicate and function effectively in multi-disciplinary teams

B.S.ABDUR RAHMAN
UNIVERSITY
B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd.u/s 3 of the UGC Act, 1956)
(FORMERLY B.S.ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS 2013
FOR
B.TECH. DEGREE PROGRAMMES

(WITH AMENDMENTS INCORPORATED TILL JUNE 2014)

REGULATIONS - 2013 FOR
B.TECH. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech Degree Programme like Civil Engineering, Mechanical Engineering, etc.,

iii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, Computer Practice, etc.,

iv) **"University"** means B.S.Abdur Rahman University.

v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S. Abdur Rahman University.

vi) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of B.S.Abdur Rahman University.

vii) **"Controller of Examinations"** means the Controller of Examination of B.S. Abdur Rahman University, who is responsible for conduct of examinations and declaration of results.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight semester B.Tech. degree programme shall be required to have passed the Higher Secondary Examination of the (10+2) curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any university or authority accepted by the University as equivalent thereto.

2.1b) Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the University as equivalent thereto.

2.2 Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the University for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for plus two academic stream.

2.3 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the University from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. degree programmes in various branches of Engineering and Technology, each distributed over eight semesters with two semesters per academic year.

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Manufacturing Engineering
10. Mechanical Engineering
11. Polymer Engineering
12. Biotechnology
13. Cancer Biotechnology
14. Food Biotechnology

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every Programme will have a curriculum with syllabi consisting of theory and practical courses such as,

i) Basic Sciences (BS)

ii) Humanities & Social Sciences (HS)

iii) Management Sciences (MS)

iv) Engineering Sciences Fundamentals (ESF)

v) Engineering Core Courses (EC)

vi) Professional Electives (PE)

vii) General Electives (GE)

viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

4.2 Each course is normally assigned certain number of credits :

one credit per lecture period per week

one credit per tutorial period per week

one credit for two to three periods and two credits for four periods of laboratory or practical courses

one credit for two periods of seminar / project work per week

one credit for two weeks of industrial training

4.3 Each semester curriculum shall normally have a blend of lecture courses not exceeding seven and practical courses not exceeding four.

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the relevant branch of study. This minimum will be between 175 and 185 credits, depending on the program.

4.5 The medium of instruction, examinations and project report shall be English, except for courses on languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is ordinarily expected to complete the B.Tech. programme in eight semesters (six semesters in the case of a lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry student).

5.2 Each semester shall consist of a minimum of 90 working days or 450 periods.

5.3 Semester end examination will normally follow immediately after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the whole class (2^{nd} to 8^{th} semester).

He/she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

However, for the first semester alone the class advisors and faculty advisors will be nominated by first year coordinator.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty member of the department who shall function as Faculty Advisor for the students throughout their period of study. Such Faculty Advisor shall offer advice to the students on academic and personal matters, and guide the students in taking up courses for registration and enrolment every semester.

7.0 COURSE COMMITTEE

Common course offered to more than one discipline or group, shall have a "Course Committee", comprising all the faculty members teaching the common course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs), depending on whether all the faculty members teaching the common course belong to the same department / different departments.

8.0 CLASS COMMITTEE

For the first semester, a common Class Committee will be constituted for all branches by the Dean (Academic Affairs). During other semesters, separate Class Committees will be constituted by the respective Head of the Department of the students

8.1 The first semester Class Committee composition will be as follows:

i) The first semester Coordinator shall be the Chairman of the class committee

ii) Course coordinators of all common courses.

iii) Faculty members of all individual courses.

iv) One male and one female first semester student of each class of B.Tech, program to be nominated by the first semester coordinator

v) All first semester class advisors and faculty advisors

8.2 The composition of the class committee for each branch of B.Tech, from 2nd to 8th semester, will be as follows:

i) One senior faculty member preferably not teaching to the concerned class, appointed as Chairman by the Head of the Department

ii) Faculty members of individual courses

iii) Two students, (preferably one male and one female) of the class per group of 30 students or part thereof, to be nominated by the Head of the Department, in consultation with the faculty advisors.

iv) All faculty advisors and the class advisor of the class

v) Head of the Department

8.3 The class committee shall meet at least thrice during the semester. The first meeting will be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment will be decided for the first, second and third assessments. The second meeting will be held within a week after the date of first assessment report, to review the students' performance and for follow up action. The third meeting will be held within a week after the second assessment report, to review the students' performance and for follow up action.

8.4 During these three meetings the student members representing the entire class, shall meaningfully interact and express opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.

8.5 The class committee, excluding the student members, shall meet within 10 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide the grades for students in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLMENT

9.1 Except for the first semester, every student shall register for the ensuing semester during a specified week before the semester end examination of the current semester. Every student shall submit a completed Registration form indicating the list of courses intended to be enrolled during the ensuing semester. Late registration along with a late fee will be permitted up to the last working day of the current semester.

9.2 From the second year onwards, all students shall pay the prescribed fees for the year on a specific day at the beginning of the semester confirming the registered courses. Late enrolment along with a late fee will be permitted up to two weeks from the date of commencement of classes. If a student does not enroll, his/her name will be removed from rolls.

9.3 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.

9.4 A student should have registered for all preceding semesters before registering for a particular semester.

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 15 days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

10.2 WITHDRAWAL FROM A COURSE

A student can withdraw from an enrolled course at any time before the second assessment for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

11.0 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

A student can avail a onetime temporary break of study covering the current semester and/or next semester period with the approval of the Head of the Institution at any time before the start of third assessment of current semester, within the maximum period of 14 or 12 semesters as the case may be. If any student is debarred for want of attendance or suspended due to any act of indiscipline it will not be considered as break of study.

A student availed break of study has to rejoin only in the same semester from where he left.

12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 30 credits during a semester including redo courses.

12.2 The minimum credit requirement to move to the higher semester is

- Not less than a total of 20 credits, to move to the 3rd semester
- Not less than a total of 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than a total of 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

13.1 Every theory course shall have a total of four assessments during a semester as given below:

Assessment No.	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 4	1.5 hours	15%
Assessment 2	5 to 8	1.5 hours	15%
Assessment 3	9 to 12	1.5 hours	15%
Attendance #	-	-	5%
Semester End Exam	Full course	3 hours	50 %

\# 76-80% - 1 Mark ; 81-85 – 2 Marks ; 86-90 – 3 Marks ; 91-95 – 4 Marks and 96 – 100 – 5 Marks

13.2 Appearing for semester end examination for each course is mandatory and a student should secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

13.3 Every practical course will have 60% weightage for continuous assessment and 40% for semester end examination. However, a student should have secured a minimum of 50% marks in the semester end practical examination.

13.4 In the case of Industrial training, the student shall submit a report, which will be evaluated along with an oral examination by a committee of faculty members, constituted by the Head of the department. A progress report from the industry will also be taken into account for evaluation.

13.5 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student(s), an oral examination (viva-voce) will be conducted as the semester end examination, for which one external examiner, approved by the Controller of Examinations, will be included. The weightage for periodic review will be 50% and remaining 50% for the project report and Viva Voce examination.

13.6 Assessment of seminars and comprehension will be carried out by a committee of faculty members constituted by the Head of the Department.

13.7 The continuous assessment marks earned for a course during his/her first appearance will be used for grading along with the marks earned in the semester-end examination / arrear examination for that course until he/she completes.

14.0 SUBSTITUTE EXAMINATIONS

14.1 A student who has missed, for genuine reasons, a maximum of one of the four assessments of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident, admission to a hospital due to illness, etc.

14.2 A student who misses any assessment in a course shall apply in a prescribed form to the Head of the department / Dean within a week from the date of missed assessment. However the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

15.1 A student should secure not less than 75% overall attendance in that semester taking into account the total no. of periods in all courses put together attended by the student as against the total no. of periods in all courses offered during that semester. If a student who could secure overall attendance between 65%

and 75% only in a particular semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level sports events with prior permission from the Officials concerned shall be given exemption from the prescribed attendance requirement and he / she shall be permitted to appear for the current semester examinations.

The students who do not fulfill the above attendance requirement will not be permitted to write the semester end examination and will not be permitted to move to next semester. Such students should repeat all the courses of the semester in the next Academic year.

15.2 The faculty member of each course shall furnish the cumulative attendance details to the class advisor. The class advisor will consolidate and furnish the list of students who have earned less than 75% overall attendance, to the Dean (Academic Affairs) through the Head of the Department / School Dean. Thereupon, the Dean (Academic Affairs) shall issue orders preventing students from appearing for the semester end examination of all the courses of that semester.

15.3 A student who is awarded "U" grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course whenever the course is offered. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the end-semester (re-do) examination. If any student obtained "U" grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

15.4 If a student with "U" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will not be permitted to write the semester end examination and his / her earlier 'U' grade and continuous assessment marks shall continue.

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course will be made on absolute marks basis. However, the Class Committee without the student members shall meet within 10 days after the semester-end examination and analyze the performance of students in all assessments of a course and award letter grade. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	--
AB	--

"W" denotes withdrawal from the course.

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

16.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student.

16.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department and declared by the Controller of Examinations.

16.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester-end theory examination answer scripts of courses, on payment of prescribed fee, through proper application to Controller of Examinations. HOD/Dean shall constitute a revaluation committee consisting of Chairman of the class committee as convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

16.5 After results are declared, grade sheets shall be issued to each student, which will contain the following details. The list of courses enrolled during the semester including Redo courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards. GPA is the ratio of the sum

of the products of the number of credits of courses registered and the points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If Ci, is the number of credits assigned for the ith course and GPi is the Grade Point in the ith course

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i} \qquad Where\ \ n = number\ of\ courses$$

The Cumulative Grade Point Average CGPA shall be calculated in a similar manner, considering all the courses enrolled from first semester.

"W" grades will be excluded for calculating GPA .

"U", "AB" and **"W"** grades will be excluded for calculating CGPA

16.6 After successful completion of the programme, the Degree will be awarded with the following classifications based on CGPA.

Classification	**CGPA**
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the normal 8 or 6 (for lateral entry) semesters
First Class	6.50 and above and completing the programme within a maximum of 10 or 8 (for lateral entry) semesters.
Second Class	All others

However, to be eligible for First Class with Distinction, a student should not have obtained U grade in any course during his/her study and should have completed the U.G. programme within a minimum period covered by the minimum duration plus authorized break of study, if any (clause 11). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

17.0 ELECTIVE CHOICE: OPTION TO DO PROJECT ALONE IN FINAL SEMESTER

17.1 Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.

17.2 In the curriculum of eighth Semester, along with the project work, if two elective courses alone are listed, then the Dean (Academic Affairs) may permit a student, as per approved guidelines, on the recommendation of the Head of the department, to do a full semester major industrial project work. In such a case, the above two elective courses or any other two elective courses in lieu thereof have to be enrolled during any semester preceding or succeeding the project work, if offered.

18.0 PERSONALITY AND CHARACTER DEVELOPMENT

18.1 All students shall enroll, on admission, in any of the personality and character development programmes, NCC / NSS / NSO / YRC / Rotaract and undergo practical training.

- **National Cadet Corps (NCC)** will have to undergo specified number of parades.
- **National Service Scheme (NSS)** will have social service activities in and around Chennai.
- **National Sports Organization (NSO)** will have sports, games, drills and physical exercises.
- **Youth Red Cross (YRC)** will have social service activities in and around Chennai.
- **Rotaract** will have social service activities in and around Chennai.

19.0 DISCIPLINE

19.1 Every student is required to observe disciplined and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

19.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean will be referred to a Discipline and Welfare Committee, nominated by the Vice-Chancellor, for taking appropriate action.

20.0 ELIGIBILITY FOR THE AWARD OF DEGREE

20.1 A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study.

ii) no dues to the Institution, Library, Hostels

iii) no disciplinary action pending against him/her.

20.2 The award of the degree must have been approved by the University.

21.0 POWER TO MODIFY

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time.

CURRICULUM AND SYLLABI FOR B.TECH. POLYMER ENGINEERING (Eight Semesters / Full Time)

CURRICULUM

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB1181	Algebra, Geometry and Calculus	3	1	0	4
2	HS	ENB1181 FRB1181 ISB1181	English* French* Arabic*	3	0	0	3
3	BS	PHB1181	Physics	3	0	0	3
4	BS	CHB1181	Chemistry	3	0	0	3
5	ESF	GEB1101	Engineering Graphics	2	0	3	3
6	HS	SSB1182	Sociology, Ethics and Human Values	3	0	0	3
7	BS	PHB1182	Physics Lab	0	0	2	1
8	BS	CHB1182	Chemistry Lab	0	0	2	1
9	ESF	GEB1102	Basic Engineering Practices Laboratory	0	0	2	1
10	ESF	GEB1103	Computer Programming & Applications	2	0	2	3
							25

* Any one language

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB1282	Advanced Calculus	3	1	0	4
2	BS	CHB1289	Organic Chemistry	3	0	0	3
3	HS	SSB1181	Introduction to Economics	3	0	0	3
4	ESF	GEB1211	Basic Engineering Mechanics	3	1	0	4
5	ESF	PEB1211	Materials Science and Engineering	3	1	0	4

6	ESF	PEB1212	Principles of Chemical Engineering	3	1	0	4
7	HS	ENB1282	Written Communication	0	0	2	1
8	BS	CHB1290	Organic Chemistry Lab	0	0	3	1
9	ESF	PEB1213	Chemical Engineering Lab	0	0	3	1
							25

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB2181	Transforms and Applications	3	1	0	4
2	BS	LSB2181	Biology for Engineers	3	0	0	3
3	EC	PEB2101	Chemistry of Macromolecules	3	0	0	3
4	EC	PEB2102	Thermoplastic Materials Engineering	3	0	0	3
5	EC	PEB2103	Basic Mechanical Operations	3	0	0	3
6	ESF	EEB1281	Introduction to Electrical and Electronics Engineering	3	0	0	3
7	HS	ENB2181	Oral Communication	0	0	2	1
8	EC	PEB2104	Machining Practice Lab	0	0	2	1
9	ESF	EEB1282	Electrical and Electronics Engineering Lab	0	0	3	1
							22

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB2283	Applied Numerical Methods	3	1	0	4
2	EC	PEB2211	Physics of Macromolecules	3	0	0	3
3	EC	PEB2212	Thermosets and Additives	3	0	0	3
4	EC	PEB2213	Polymer Rheology	3	0	0	3

5	EC	PEB2214	Polymer Analysis and Characterization	3	1	0	4
6	HS	SSB2181	Law for Engineers	3	0	0	3
7	HS	ENB2282	Confidence Building & Behavioral Skill	0	0	2	1
8	EC	PEB2215	Polymer Synthesis Lab	0	0	3	1
9	EC	PEB2216	Polymer Characterization Lab I	0	0	3	1
							23

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	EC	PEB3101	Plastics Process Engineering	3	1	0	4
2	EC	PEB3102	Rubber Science and Technology	3	0	0	3
3	EC	PEB3103	Polymer Testing Technology	3	1	0	4
4	EC	PEB3104	Strength of Materials	3	1	0	4
5	BS	GEB3201	Environmental Science and Engineering	3	0	0	3
6	PE		Professional Elective I	3	0	0	3
7	HS	ENB3181	Career Building & People Skill	0	0	2	1
8	EC	PEB3105	Plastics Processing Lab	0	0	3	1
9	EC	PEB3106	Polymer Characterization Lab II	0	0	3	1
							24

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	EC	PEB3211	Computer Aided Modeling and Manufacturing	3	1	0	4
2	MS	MSB3181	Management of Business Organization	3	0	0	3
3	EC	PEB3212	Polymer Product Design	3	1	0	4
4	EC	PEB3213	Polymer Composites Engineering	3	0	0	3

5	PE		Professional Elective II	3	0	0	3
6	PE		Professional Elective III	3	0	0	3
7	EC	PEB3214	Plastic Product Design Lab	0	0	3	1
8	EC	PEB3215	Rubber and Composite Processing Lab	0	0	3	1
9	EC	PEB3216	Polymer Testing Lab I	0	0	3	1
							23

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	EC	PEB4101	Mould and Die Design	3	1	0	4
2	EC	PEB4102	Polymer Reaction Engineering	3	1	0	4
3	EC	PEB4103	Polymer Blends and Nanocomposites	3	1	0	4
4	PE		Professional Elective IV	3	0	0	3
5	PE		Professional Elective V	3	0	0	3
6	GE		General Elective I	3	0	0	3
7	EC	PEB4104	Mini Project	0	0	3	1
8	EC	PEB4105	Mould and Die Design Lab	0	0	3	1
9	EC	PEB4106	Polymer Testing Lab II	0	0	3	1
							24

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PE		Professional Elective VI	3	0	0	3
2	GE		General Elective II	3	0	0	3
3	EC	PEB4211	Project	0	0	18	9
							15

TOTAL CREDITS: 181

PROFESSIONAL ELECTIVES

Sl. No.	Course Group	Course Code	Course Title
			MATERIALS
1.	PE	PEBX01	Thermoplastic Polyesters
2.	PE	PEBX02	Nylon Technology
3.	PE	PEBX03	Biodegradable Plastics
4.	PE	PEBX04	Biomedical Polymers
5.	PE	PEBX05	Electroactive Polymers
6.	PE	PEBX06	Specialty Polymers
			PROCESS ENGINEERING
1.	PE	PEBX07	Injection Moulding Technology
2.	PE	PEBX08	Extrusion and Blow Moulding Technology
3.	PE	PEBX09	Polymer Post Processing Operations
4.	PE	PEBX10	Rubber Product Manufacturing Technology
5.	PE	PEBX11	Tyre Manufacturing Technology
6.	PE	PEBX12	Polymer Recycling and Waste management
			BLENDS, COMPOSITES, ADHESIVES AND COATINGS
1.	PE	PEBX13	Fibre Reinforced Plastics
2.	PE	PEBX14	Mechanics of Composites
3.	PE	PEBX15	Design of Composite Structure
4.	PE	PEBX16	Polymer Blends and Alloys
5.	PE	PEBX17	Adhesives and Surface Coatings
6.	PE	PEBX18	Paints and Surface Coatings

GENERAL ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	Offering Department
1.	GE	GEBX01	Disaster Management	Civil
2.	GE	GEBX02	Nano Technology	Physics
3.	GE	GEBX03	Control Systems	EEE
4.	GE	GEBX04	Green Design and Sustainability	Civil
5.	GE	GEBX05	Knowledge Management	CSE
6.	GE	GEBX06	Appropriate Technology	Civil / Mechanical
7.	GE	GEBX07	System Analysis and Design	Mechanical
8.	GE	GEBX08	Value Analysis and Engineering	Mechanical
9.	GE	GEBX09	Optimization Techniques	Mathematics
10.	GE	GEBX10	Engineering System Modeling and Simulation	Mechanical
11.	GE	GEBX11	Supply Chain Management	CBS
12.	GE	GEBX12	Total Quality Management	Mechanical
13.	GE	GEBX13	Energy Studies	Mechanical
14.	GE	GEBX14	Robotics	Mechanical
15.	GE	GEBX15	Cyber security	IT
16.	GE	GEBX16	Usability Engineering	CSE
17.	GE	GEBX17	Industrial Safety	Mechanical

SEMESTER I

MAB1181 ALGEBRA, GEOMETRY AND CALCULUS L T P C
3 1 0 4

OBJECTIVES:

The course is aimed at

- developing the skills of engineering students in the basics of chosen topics of Mathematics that are imperative for effective understanding of engineering subjects.
- laying the foundation for learning further topics of Mathematics in higher semesters in a graded manner.
- enabling the learners to appreciate the important role of mathematical concepts in engineering applications.

MODULE I MATRICES 8

Eigenvalue Problems – Eigenvalues and Eigenvectors of a real matrix, Engineering Applications –Properties of Eigenvalues and Eigenvectors – Cayley Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE II VECTOR ALGEBRA 6

Operations on vectors – Scalar Product, Vector Product, Projection of Vectors - Angle between two vectors - Gradient, divergence and curl.

MODULE III THREE DIMENSIONAL ANALYTICAL GEOMETRY 8

Direction cosines & ratios – angle between two lines – equations of a plane – equations of a straight line - coplanar lines - shortest distance between skew lines – sphere – tangent plane – plane section of a sphere – orthogonal spheres.

MODULE IV DIFFERENTIAL GEOMETRY 7

Curvature – Cartesian and polar coordinates – centre and radius of curvature – circle of curvature – involutes & evolutes – envelopes – properties of envelopes and evolutes.

MODULE V MULTI-VARIATE FUNCTIONS **8**

Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobians - Taylor's series expansion – maxima and minima – Lagrange's multiplier method.

MODULE VI ORDINARY DIFFERENTIAL EQUATIONS **8**

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients – homogeneous equations of Euler's type – method of undetermined co-efficients, method of variation of parameters.

L – 45; T – 15; Total Hours– 60

TEXT BOOKS:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Grewal B.S., "Higher Engineering Mathematics" (42nd edition), Khanna Publishers, New Delhi, 2012.

REFERENCES:

1. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana, B.V, "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.

OUTCOMES:

On completion of the course the students will be able to

- solve Eigenvalue and Eigenvector problems
- solve three dimensional geometry problems.
- use differential calculus for solving problems pertaining to engineering applications.

ENB1181	ENGLISH	L T P C 3 0 0 3

OBJECTIVES:

- To enable students to use language appropriately and effectively
- To help learners improve their vocabulary and to enable them speak fluently and appropriately in different contexts.
- To help students develop listening skills for academic and professional purposes
- To develop reading comprehension skills and enhance their ability to read official documents.
- To develop their creative thinking and practice creative writing.

MODULE I BASIC LANGUAGE SKILLS AND GRAMMAR 4

Conducting a language proficiency test in the language laboratory to assess the use of various parts of speech, vocabulary, phrasal verbs and idiomatic expressions of students.

MODULE II LISTENING 8

Listening to BBC radio plays and VOA special lessons to teach Phonetics, accent and intonation of spoken English

Appreciation and critical review of popular movies like 'My Fair Lady', 'Sound of Music'. (Excerpts from the movies) - Historical/popular speeches made by Winston Churchill, Abraham Lincoln (Gettysberg's Address), Swami Vivekananda.

MODULE III SPEAKING 8

(a) Self introduction – pair work – introducing one another – short conversations – exchanging opinions – agreement /disagreement

(b) Short presentation (extempore speech) based on visuals – Personal narrations

MODULE IV READING 8

Newspaper articles, circular, notices – Note making – vocabulary extension – Critical review of newspaper articles.

(a) Science fiction- Issac Asimov's "The Dead Past"(Abridged version) - Wings of Fire – Creative thinking – retelling a story with different ending; critical appreciation of plot and characters

MODULE V CREATIVE WRITING 8

(a) Writing slogans for Advertisements

(b) Writing descriptive paragraphs based on visuals

MODULE VI ENGLISH FOR ACADEMIC AND BUSINESS PURPOSES 9

(a) English for academic purpose: letters to the editor, letter seeking permission for industrial visit, letter inviting a dignitary for technical symposium

(b) English for Business purpose: Telephone etiquette – telephone conversations – taking and leaving phone messages.

Total Hours: 45

REFERENCES:

1. Mohan, Krishna, Meera Bannerjee, 'Developing Communication Skills', Macmillan India Ltd. Chennai (2001).
2. Sen , Leena 'Communication Skills' Prentice Hall, New Delhi (2004).
3. Rutherford , Andrea J. 'Basic Communication Skills For Technology' Pearson Education Asia (2002).
4. Grant Taylor, ' English Conversation Practice' Tata Mcgraw Hill , New Delhi (2001)
5. P.K.Dutt, G. Rajeevan and C.L.N. Prakash, 'A Course in Communication Skills', Cambridge University Press, India (2007).

OUTCOME:

- After completion of the course, students will have the ability to communicate correctly and effectively in academic and professional contexts through exposure and practice in LSRW skills.

FRB1181	FRENCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve their proficiency in French language.
- To empower them for successful communication in their professional contexts.

DOSSIER 0 FENÊTRE SUR… 7

Contenus –l'alphabet - se présenter – les langues – les nationalités – les nombres de 0 à 60 – les adjectifs de nationalités – les verbes : s'appeler, être.

L'acte de parole

DOSSIER 1 LES UNS, LES AUTRES…. 12

Contenus - Les salutations (formelles et informelles) - les jours de la semaine – Les articles définis – les adjectifs possessifs – la négation (ne…..pas) – les verbes : avoir.

Demander quelque chose – les mois de l'année – les nombres de 70 à 99 – les articles indéfinis – l'adjectif interrogatif (quel, quelle)

Quelques événements culturels – donner des informations personnelles – indiquer ses gouts – l'expression des gouts – les prépositions (les noms de pays).

L'acte de parole

DOSSIER 2 ICI /AILLEURS 12

Contenus – Parler de sa ville – Donner/ Demander des explications – les prépositions de lieu – articles contractés – pourquoi / parce que

Auberges de jeunesse et hôtels – s'informer sur un hébérgement- quelques verbes et indications de direction – quelques formules de politesse.

Le code postal et les départements le libellé d'une adresse en France – Ecrire une carte postale – Dire le temps qu'il fait – les adjectifs démonstratifs - Formules pour commencer / terminer.

L'acte de parole

DOSSIER 3 SOLO OU DUO **14**

Contenus – Les animaux de compagnie les animaux préférés des Français - parler de sa profession – les professions - les activités sportifs - les noms animaux – les verbes : aimer , adorer, détester, faire, aller.

Nouveaux mode de rencontres – caractériser une personne (physique et psychologique) – les adjectifs qualificatifs – les pronoms toniques.

Les sorties – proposer, refuser, accepter une sortie – fixer un rendez-vous – inviter – Donner des instructions – L'impératif : 2^{e} personne – Le pronom on=nous – Les verbes : Pouvoir, vouloir, devoir.

L'acte de parole

L'examen oral

Total Hours: 45

TEXT BOOK:

1. Alter EGO I – Goyal – Langers (0 – 5 Lessons)

OUTCOMES:

On completion of the course,

- The students will be able to deal with their clients effectively at global level.
- Their proficiency in French Language will have improved.

ISB1181	ARABIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

MODULE I PREPARATORY ARABIC **7**

Introducing Arabic Alphabets.

Listening and Reading.

Audio & Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected & unconnected).

Introducing words.

Reading simple sentences.

Learning names of the things in and around the class room.

Exercises.

MODULE II FUNCTIONAL ARABIC **7**

Listening Arabic texts, stories and action verbs

Communicating Simple sentences.

Jumla' Ismiyya and Jumla' Fi'liyya

Situational Conversation:

Greetings, Introduction.

Classroom, College, Picnic.

Dining and Kitchen.

Reading skills.

Exercises

MODULE III FUNCTIONAL ARABIC **8**

Implication of effective listening.

Audio aids.

Writing Simple sentences.

Communicating ordinal and cardinal numbers.

Situational communication:

Playground, library.

Forms of plural – Sample sentences.

Introduction to tenses.

Exercises.

MODULE IV FUNCTIONAL ARABIC **8**

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

MODULE V TECHNICAL ARABIC **8**

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration,

passport, visa.

Exercises.

MODULE VI TECHNICAL ARABIC **7**

Situation communication:

Contractual work, machineries and equipments..

Computer, internet browsing.

Banking,

Exercises.

Total Hours: 45

TEXT BOOK:

1. Arabic for professionals and employees, Kilakarai Bukhari Aalim Arabic College, Chennai, India, 2013.

REFERENCES:

1. Arabic Reader for Non Arabs (Ummul Qura University, Makkah), Kilakarai Bukhari Aalim Arabic College, 2005.

OUTCOMES:

On successful completion of the course, the student will be able to:

- Write correct sentences in Arabic.
- Communicate in Arabic at primary level in working situations in the fields of engineering and administration.

PHB1181	PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce basic physics concepts relevant to Engineering and Technology students.
- To get familiarize with solving problems in basic physics.
- To acquaint applications of physics for Engineering issues.

MODULE I PROPERTIES OF MATTER **7**

Elasticity – Stress strain diagram – Factors affecting elasticity – Twisting couple on a wire – Shaft – Torsion pendulum – Depression on a cantilever – Young's modulus by cantilever – Uniform and non-uniform bending – Viscosity.

MODULE II CRYSTAL PHYSICS **6**

Introduction – Space lattice – unit cell – Bravais lattices – Miller Indices for cubic crystals – Inter planar spacing in cubic lattice – Simple crystal structures – SC, BCC, FCC and HCP structures – Atomic radius, coordination number, Packing factor calculation – Crystal imperfections.

MODULE III QUANTUM PHYSICS **7**

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jeans law from Planck's theory – Compton effect – Theory and experimental verification – Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schroedinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box.

MODULE IV WAVE OPTICS **9**

Interference theory – Air wedge – Michelson interferometer – Diffraction – Fresnel and Fraunhofer diffraction - Polarization – Double refraction – Theory of plane polarized, circularly polarized and elliptically polarized light – Quarter wave plate, Half wave plate – Production and detection of plane, circularly and elliptically polarized lights – Photoelasticity – Photo elastic effect – Stress optic law – Effect of stressed model in a plane polariscope (qualitative) –Photo elastic bench.

MODULE V LASER & FIBRE OPTICS **9**

Principle of spontaneous emission and stimulated emission - Characteristics of laser light -Einstein's A & B coefficients (derivation) – Population inversion - pumping - Nd:YAG laser – CO2 laser – Applications – Material processing and holography (construction and reconstruction of hologram)- Optical fibre – Principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – Types of optical fibers - applications – Fibre optic communication system (block diagram only)- Fibre optic sensors (displacement and pressure sensors (qualitative), Medical endoscope.

MODULE VI ULTROSONICS AND NDT **7**

Ultrasonics – Production – Magnetostriction and piezo electric methods – Properties of ultrasonic waves – Detection of ultrasonic waves – Applications –Ultrasonic interferometer- Acoustical grating – SONAR – Depth of sea – Measurement of velocity of blood flow – Non Destructive Testing (NDT) methods – Ultrasonic flaw detector – A,B & C scanning methods.

Total Hours: 45

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2003.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.

REFERENCES:

1. Uma Mukherji, "Engineering Physics", Narosa Publishing House, New Delhi, 2007.
2. Charles Kittel, "Introduction to solid state physics", 7th Edition, John Wiley & sons (ASIA) Pvt. Ltd, 2008.
3. Avadhanulu M.N., "Engineering Physics", 1st Edition, S.Chand & Company Ltd., New Delhi, 2007.
4. Schiff, "Quantum Mechanics", 3rd Edition, Tata McGraw-Hill Education, 2010.
5. Rajendran V. and Marikani A., "Applied Physics for Engineers", 3rd Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2003.

6. William T. Silfvast, “Laser Fundamentals”, 2nd edition, Cambridge University Press, 2004.

7. Arumugam M., “Engineering Physics”, 5th Edition, Anuradha Agencies, 2003.

OUTCOMES:

At the end of the course, the students will be able to

- Apply the knowledge of properties of matter in Engineering Mechanics and Fluid Dynamics.
- Characterize Engineering materials
- Use Lasers for Fiber Optics Technology and Material Processing
- Do non-destrictive testing using Ultrasonic Techniques

CHB1181 CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

To make students conversant with the

- Water quality for potable and industrial purposes.
- Different engineering materials, their physico-chemical properties and specific applications.
- Concept of electrochemistry, corrosion and theories of corrosion.
- Principles of spectroscopy and applications.
- Basic principles of green chemistry and the need for green processes in industries.

MODULE I WATER TECHNOLOGY 8

Introduction – Impurities present in water – Hardness, Types of Hardness, Estimation of Hardness (EDTA method) (Problems) – Alkalinity, Estimation of Alkalinity – Disadvantages of hard water in industries – Conditioning methods: external treatment method: Ion exchange method – internal treatment: colloidal, phosphate, calgon, carbonate methods – drinking water standards (BIS) – treatment of domestic water: screening, sedimentation, coagulation, filtration, disinfection: by chlorination, UV treatment, ozonization – desalination and reverse osmosis (principle only).

MODULE II ENGINEERING MATERIALS 8

Abrasives: Moh's scale of hardness – natural abrasives: diamond, corundum, emery, garnets and quartz – artificial abrasives: silicon carbide, boron carbide.

Refractories: characteristics, classification – acidic, basic and neutral refractories, properties – refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling – general method of manufacture of refractories, properties and uses of high alumina bricks, magnesite and zirconia bricks.

Nanomaterials: Definition – types of Nanomaterials; nanofilms, nanowires, carbon nanotubes, quantum dots and fullerenes (C_{60}) – Size and shape

dependent optical, electrical, thermal and mechanical properties; Synthesis of nanomaterials – Top down and bottom up approach; Applications of nanomaterials – Catalysis, Electronics and Telecommunication, Medicines, Composites and Energy.

MODULE III ELECTROCHEMISTRY AND CORROSION 9

Construction of a cell – Standard and single electrode potential – electrochemical series – EMF and its measurement – Nernst equation, application and problems – Types of electrodes: standard hydrogen electrode, calomel electrode, ion selective electrode - glass electrode and determination of pH using glass electrode – polarization, overvoltage, decomposition potential (statements only) – Conductometric and potentiometric titrations.

Corrosion: Definition – Dry corrosion and Wet corrosion with mechanisms – Factors influencing corrosion.

MODULE IV CHEMISTRY OF POLYMERS 6

Monomers – functionality – polymer – degree of polymerization – classification – Polymerization techniques: addition, condensation and co-polymerization with example – mechanism of polymerization: free radical, cationic and anionic mechanism – thermoplastics and thermosetting plastics with examples – compounding and moulding of plastics: injection moulding and compression moulding.

MODULE V SPECTROSCOPY 9

Electromagnetic spectrum – absorption of radiation – electronic, vibrational, translational and rotational – intensities of spectral lines – Beer-Lambert's Law (Problems) – Colorimetric analysis: estimation of concentration of a solution – Flame photometry: theory, instrumentation (block diagram only) and application – UV-Visible spectroscopy: Principles, instrumentation (block diagram only) and simple applications – IR spectroscopy – simple applications only.

MODULE VI GREEN CHEMISTRY 5

Introduction – Significance – Industrial applications of green chemistry; Green technology – Latest green laboratory technique for saving experimental resources and infrastructural framework; Principles of green chemistry – R4M4

model (Reduce, Reuse, Recycle, Redesign; Multipurpose, Multidimensional, Multitasking, Multi-tracking) – Life cycle analysis technique (cradle to grave approach)

Total Hours: 45

TEXT BOOKS:

1. Jain P.C and Renuka Jain, 'Physical Chemistry for Engineers', Dhanpat Rai and Sons, New Delhi. (2001).
2. Paul T. Anastas, John C. Warner, 'Green Chemistry: Theory and Practice', Oxford University Press, (1998).

REFERENCES:

1. Bahl B.S., Tuli and Arun Bahl, 'Essentials of Physical Chemistry', S. Chand and Company Ltd., New Delhi, (2004).
2. Kuriacose J.C. and Rajaram J, 'Chemistry in Engineering and Technology', Volume1, Tata McGraw- Hill publishing company, New Delhi, (1996).
3. Puri B.R., Sharma L.R. and Madan S. Pathania, 'Principles of Physical Chemistry', Shoban Lal Nagin Chand and Co., Jalandhar, (2000).

OUTCOMES:

At the end of the course, students will be able to

- estimate the degree of hardness in water; solve related problems and treatment methods for potable water.
- select materials for specific engineering applications.
- use electrochemistry principles to understand the mechanism of corrosion.
- analyze trace quantity of metals using instrumental methods.
- realise the need of green practices in industries.

GEB1101 ENGINEERING GRAPHICS L T P C
2 0 3 3

OBJECTIVES:

- To introduce the students of all engineering programs, the basic concepts of engineering drawing, which is the basic communication medium for all engineers
- To provide an exposure to the appropriate standards for technical drawings
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, pictorial views and free hand drawing
- To introduce computerized drafting

MODULE I BASICS AND ENGINEERING CURVES 10

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola

Special curves: Cycloid, epicycloid, hypocycloid, involutes, helix

MODULE II ORTHOGRAPHIC PROJECTION 8

Orthographic projection – first angle, third angle projection methods, free hand sketching of orthographic views of simple machine parts as per first angle projection. Projection of points. Commands and demonstration of drafting packages.

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

Straight lines in first quadrant – true length and true inclinations, traces – rotating line and trapezoidal methods. Projection of plane lamina in first quadrant – trace of plane.

MODULE IV PROJECTION OF SOLIDS 10

Projection of solids: Axis inclined to one reference plane only - prism, pyramid, cone, cylinder – change of position and auxiliary projection methods.

MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **10**

Section of solids: prism, pyramid, cone, cylinder, and sphere – sectional views – true shape of sections - solids in simple position and cutting plane inclined to one reference plane only.

Development of surfaces: truncated solids - prism, pyramid, cone, cylinder, frustum of cone and pyramid.

MODULE VI PICTORIAL PROJECTIONS **12**

Isometric projection: isometric scale - isometric projection and view of prism, pyramid, cylinder, cone, frustums and truncated solids.

Perspective projection: prism, pyramid, cylinder, frustums – visual ray and vanishing point methods.

Total Hours: 60

TEXT BOOK:

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 46th Edition, (2003)

REFERENCES:

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai. (2006)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

OUTCOMES:

Students who complete this course will be able to:

- draw various views of engineering components
- graphically communicate their concepts and ideas on new designs

SSB1182 SOCIOLOGY, ETHICS AND HUMAN VALUES L T P C
3 0 0 3

OBJECTIVES:

- To give an overview of the fundamental of sociology.
- To expose how society developed in India, classes and impact.
- To introduce sociological aspects relating to industry
- To provide some basic concepts on ethics and human rights.
- To stress the role of engineer to the society, environment and sustainability.

MODULE I FUNDAMENTALS OF SOCIOLOGY 7

Sociology - definition, evolution – scope – basic concepts – social process, sociological theories, social institutions, culture and social stratification – family – economic – politics – religion – education, state and civil society – social control.

MODULE II SOCIOLOGY IN INDIAN CONTEXT 7

Development – Institutions, classes – women and society – impact of social laws, social change in contemporary India – secularism and communalism – social exclusion and inclusion.

MODULE III INDUSTRIAL SOCIOLOGY 7

Definition and perspectives – industry in India – social groups in industry, behaviour pattern – group dynamics – focus groups – team – enhancing group behaviour.

MODULE IV INDUSTRIAL – SOCIETY INTERFACE 8

Perspectives – social responsibilities – sociological effect on industrialization – urbanization, child labour, psychological impact, Impact of technology, modernization – globalization – challenges – role of engineers.

MODULE V ETHICS AND HUMAN VALUES 8

Ethics and values – organizational values – personal worth, ethical behavior, professional ethics, whistle blowing, international ethics, corruption.

MODULE VI ENGINEERS AND SOCIETY **8**

Quality of life and society – engineer in economic development, technology development – invention, innovation and diffusion – appropriate technology – engineer's contribution, ecology and environment – sustainability – role of engineers.

Total Hours: 45

REFERENCES:

1. Samir Das Gupta and Paulomi Saha, An Introduction to Sociology, Pearson, Delhi, 2012.
2. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
3. Vidya Bhushan and D.R. Sachdeva, Fundamental of Sociology, Pearson, Delhi, 2012.
4. Deshpande, Satish, Contemporary India : A Sociological view, Viking (2002)
5. Thopar, Romila, Early India, Penguin (2003).
6. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996.

OUTCOMES:

- Students will have an exposure to the fundamentals and basic concepts of Sociology.
- Students will gain knowledge in Industrial Sociology.
- Students will have gained knowledge about the impact of technology, modernization, globalization and their contribution towards society.

PHB1182	PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the basic concepts of properties of matter, wave optics.
- To understand the properties of ultrasonic and Laser.
- To understand the crystal growth technique.
- To correlate the experimental results with the theoretical values.

LIST OF EXPERIMENTS:

1. Torsional Pendulum- Determination of rigidity modulus of a given wire.
2. Determination of coefficient of viscosity of a liquid by Poiseuille's method.
3. Determination of Young's modulus of a beam using non – uniform bending method.
4. Determination of a thickness of a given wire – Air wedge.
5. Spectrometer- determination of wavelength of given source by using grating.
6. Determination of velocity of ultra sonic waves – Ultrasonic Interferometer.
7. Determination of numerical aperture and acceptance angle of an optical fiber.
8. Determination of particle size using Laser.
9. Growth of crystal by slow evaporation technique.
10. Determination of angle of divergence of Laser beam.
11. Photo electric effect experiment.

OUTCOMES:

On completion of this course, the student will know

- Properties of matter, wave optics and quantum physics
- Properties and application of Ultrasonic and Laser
- Principle and concept of crystal growth technique

CHB1182	CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

To make students conversant with the

- Estimation of hardness and TDS in water samples.
- Construction of cell and determination of EMF.
- Estimation of pH of solutions.
- Verification of Beer Lambert's law.

LIST OF EXPERIMENTS:

1. Estimation of hardness in domestic water.
2. Estimation of total dissolved solids (TDS) in domestic water
3. Construction and determination of emf of a cell.
4. Determination of single electrode potential.
5. Estimation of strong acid in the industrial effluents
6. Estimation of Fe^{2+} present in unknown sample – by Potentiometry
7. Verification of Beer-Lambert's law and estimation of Cu^{2+} present in unknown sample.
8. Estimation of Na and K present in the agricultural field – by flame photometry.
9. Study of effect of inhibitors in free radical polymerization (Demo)

OUTCOMES:

At the end of the course, students will be able to

- estimate the degree of hardness and TDS in water samples.
- construct and calculate EMF of cell.
- apply the concept of Beer lamberts law.

GEB1102	BASIC ENGINEERING PRACTICES LABORATORY	L T P C 0 0 2 1

OBJECTIVES:

- To provide a practical exposure to basic engineering practices like carpentry, fitting, plumbing, welding and making of simple electrical and electronic circuits
- To have an understanding on the use of various tools, instruments and methods
- To enable the students to appreciate the practical difficulties and safety issues

CIVIL ENGINEERING PRACTICE

1. Study of plumbing in general household and industrial systems
2. Making a small window frame with Lap and Mortise & Tenon Joints

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints
2. Machining of a simple component like a table weight using lathe
3. Mould preparation for simple component

ELECTRICAL ENGINEERING PRACTICE

1. Comparison of incandescent, Fluorescent, CFL and LED lamps.
2. Study of Protection Circuits (small relay, fuse, MCB, HRC,MCCB,ECCB).
3. Familiarization of households Electrical Gadgets (Iron Box, Wet Grinder).
4. Understanding of Domestic and Industrial wiring.
5. Earthing and its significance.
6. Troubleshooting in Electrical Circuits.
7. Study of inverter fed UPS/Emergency lamp.

ELECTRONIC ENGINEERING PRACTICE

1. Identifications symbolic representation of active and passive electronic components
2. Solderingand tracing of electronic circuits and checking its continuity
3. Assembling of A.C. to D.C, D.C to A.C. Circuits in bread Board and Mini project

OUTCOMES:

Students who complete this course

- Should be able to appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Should be able to attend minor defects especially in items used in day to day life
- Should be aware of the safety aspects involved in using tools and instruments

GEB1103	COMPUTER PROGRAMMING & APPLICATIONS	L T P C 2 0 2 3

OBJECTIVES:

- Expose fundamental concepts and techniques in programming
- Give coverage on application logic in programming
- Focus on solving practical problems based on analyzing, designing, and implementing computer programs

MODULE I FUNDAMENTALS OF COMPUTERS **5**

Evolution – Generations - Classifications – Applications – Computer organization –Hardware in a typical computer Identification - Booting – Booting error messages - Number system - Number system conversions

MODULE II BASIC PROGRAMMING AND DEBUGGING **5**

Software types – Types of Operating systems - Software development steps – Information technology and internet - The programming tool - Structure of a basic program - Hello world program – Debugging it – Character set – Delimiters – Keywords, identifiers – Constants – Variables –- Tools and help features – Comments in a program

MODULE III INPUT AND OUTPUT **5**

Data types - Type conversions - Input/Output: Formatted functions – Unformatted functions – Library functions – Debugging the code – Systems software: Compiler – interpreter- linker – loader - Finding the correct answer given a code snippet and justifying it

MODULE IV PROBLEM SOLVING **5**

Problem solving techniques: Algorithm, flowchart – Pseudo-code – Examples of simple problems in algorithms and flowcharts – Sorting and Searching - Characteristics of a good program – Generations of programming language

MODULE V OPERATORS AND DECISION STATEMENTS **5**

Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators – If –if else- nested if else- goto- switch case – nested switch case – for loops – nested for loops – while loop – do-while loop – break and continue statement

MODULE VI ARRAYS AND LOOP CONTROL STATEMENTS 5

Arrays – Initialization – Definition – Characteristics – One dimensional array – Two dimensional arrays - Multi dimensional arrays – Predefined streams - Operation with arrays – Sorting and searching – Structures – Operations on structures

LIST OF EXPERIMENTS: 30

1. Computer organization –Hardware in a typical computer Identification – Booting - error messages and what it means
2. Types of Operating systems – Windows and Linux
3. Structure of a basic program - Hello world program – Debugging it
4. Data types Type conversions
5. Input/Output: Formatted functions – Unformatted functions – Library functions
6. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
7. If – if else- nested if else- goto- switch case – nested switch case – for loops – nested for loops – while loop – do-while loop – break and continue statement
8. Arrays – Operation with arrays
9. Sorting and searching

Total Hours: 60

TEXTBOOKS:

1. Ashok N Kamthane, “Computer Programming”, 2nd Edition, Pearson Education, 2012.
2. Paul J. Deitel, Deitel & Associates, “C How to Program”, 7th Edition, Pearson, Education, 2012.

OUTCOMES:

Students who complete this course will be able to:

- Understand Modular design, logic flow, data abstraction
- Describe basic programming constructs, functions, and I/O.
- Write down programs for sorting and searching algorithms
- Write down programmes developing cycle for different applications
- The students will be able to debug the programs while solving some practical problems in programming

SEMESTER II

		L	T	P	C
MAB1282	**ADVANCED CALCULUS**	**3**	**1**	**0**	**4**

OBJECTIVE:

The aim of the course is to

- train the students in additional areas of Engineering Mathematics, necessary for grooming them into successful engineers. The topics will serve as basic tools for specialized studies in many engineering fields, significantly in fluid mechanics, field theory and communication engineering.

MODULE I DOUBLE INTEGRALS **7**

Double integration – Cartesian and Polar coordinates – change of order of integration – area as a double integral — change of variables between Cartesian and polar coordinates.

MODULE II TRIPLE INTEGRALS AND SPECIAL FUNCTIONS **7**

Triple integration in Cartesian coordinates - change of variables between cartesian, cylindrical and spherical polar coordinates - Beta and Gamma functions.

MODULE III VECTOR INTEGRATION **7**

Line, surface and volume integrals – Green's, Gauss Divergence and Stoke's theorems (without proof) – verification and evaluation of integrals using them.

MODULE IV ANALYTIC FUNCTION **8**

Analytic function - Necessary and Sufficient condition (Proof not included) – Cauchy-Riemann equations in polar coordinates - properties of analytic function – determination of analytic function – conformal mapping (w = z+a, az and 1/z) and bilinear transformation.

MODULE V COMPLEX INTEGRATION **8**

Statement and application of Cauchy's integral theorem – Cauchy's integral formula – Taylor's series and Laurent's series expansion – singularities - classification – residues - Cauchy's residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis).

MODULE VI PARTIAL DIFFERENTIAL EQUATIONS 8

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

L – 45; T – 15; Total Hours- 60

TEXT BOOKS:

1. Veerarajan.T., "Engineering Mathematics "(5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Grewal B.S., "Higher Engineering Mathematics" (42nd edition), Khanna Publishers, New Delhi, 2012.

REFERENCES:

1. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana, B.V., "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., "Engineering Mathematics", Volume 2, 2nd edition, National Publishing Co., Chennai, 2003.

OUTCOMES:

On completion of the course the students will be able to

- solve integrals of higher orders.
- apply vector calculus for solving engineering problems.
- solve complex differentiation and integration problems related to engineering.
- formulate practical problems in terms of partial differential equations, solve them and physically interpret the results.

CHB1289	ORGANIC CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

Students are trained to be acquainted with

- Fundamentals of Organic Chemistry
- Various petroleum and coal products
- Properties of vinyl, carbonyl, amine and carboxylic acid compounds
- Principles of various spectroscopic Techniques and structural elucidation of organic compounds

MODULE I STRUCTURE AND REACTIVITY 5

Structure reactivity and mechanism: classification and IUPAC nomenclature of organic compounds. Stereochemistry: optical, stereo and geometrical isomerism. Types of reagents- Electrophiles and Nucleophiles. Types of reactions-addition, substitution, elimination and rearrangement reactions.

MODULE II PETROLEUM AND COAL PRODUCTS 8

Petroleum and petroleum products- coal and coal products - Preparation, properties and uses of ethylene- propylene - butadiene- benzene -toluene-xylene.

MODULE III VINYL COMPOUNDS 7

Preparation, properties and uses of vinyl chloride- vinylidine chloride- vinyl fluoride- vinylidine fluoride- vinyl acetate- vinyl alcohol- acrylo nitrile- styrene, tetraflouro ethylene - chloroprene.

MODULE IV CARBONYL AND CARBOXYLIC ACID COMPOUNDS 8

Preparation, properties and uses of formaldehyde- phthalic acid- iso and terephthalic acid- phthalic anhydride - adipic acid –adipic anhydride- acrylic acid-methacrylic acid- methyl methacrylate- ethyl acrylate.

MODULE V HYDROXYL AND NITROGEN CONTAINING COMPOUNDS 9

Preparation, properties and uses of ethylene glycol- propylene glycol- phenol-bisphenol. Urea- Hexamethlyene diamine- Toluene di-isocyanate (TDI) - Hexamethylene di-isocyanate (MDI) - Diphenyl methane di-isocyanate.

MODULE VI SPECTROSCOPY **8**

Theory, instrumentation and applications of Raman, NMR, Mass spectroscopy. Structural elucidation of organic compounds using UV-visible and IR.

Total Hours: 45

TEXT BOOKS:

1. Morrison Boyd, Organic Chemistry, Prentice Hall, New Delhi, 7th Edition, 2009.
2. B.S. Bahl and Arun Bhal, Advanced Organic Chemistry, S. Chand and Co. Ltd., New Delhi. 16th Edition, 2008.

REFERENCES:

1. I.L. Finar, Organic Chemistry, Volume 1, 6th Edition, Longman Higher Education, 1996.
2. I.L. Finar, Organic Chemistry: Stereochemistry and the Chemistry Natural Products, Volume 2, 5th Edition, Longman Higher Education, 1996.
3. Jerry March, Advanced Organic Chemistry, John Wiley and Sons, New York, 1992.
4. Michael B. Smith, Jerry March, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th Edition, John Wiley and Sons, 2007.
5. A. Brydson, Plastic Materials, Butterworth-Heinemann, 1999.
6. Keith J. Saunders, Organic polymer chemistry: an introduction to the organic chemistry of adhesives, fibres, paints, plastics and rubbers, Chapman and Hall, 1973.
7. Joseph B. Lambert, Herbert F. Shurvell, David A. Lightner and R. Graham Cooks, Organic Structural Spectroscopy, 2nd Edition, Prentice Hall, New Jersey, 2011.

OUTCOMES:

At the end of the course, the students will be able to

- demonstrate the understanding of fundamentals of Organic Chemistry
- Illustrate the different types of petroleum and coal products

- demonstrate the understanding of properties of vinyl, carbonyl, amine and carboxylic acid compounds
- learn about the various spectroscopy and structural elucidation of organic compounds

SSB1181 INTRODUCTION TO ECONOMICS L T P C
3 0 0 3

OBJECTIVES:

- Primarily to give an overview of fundamentals of economics to the engineering students
- In particular
  - To introduce the basic concepts of demand, supply and equilibrium.
  - To familiarize on National Income concepts
  - To provide fundamental concepts of money, banking and exchange.
  - To give an idea on industrial sector, markets and trade.
  - To give an overview on five year plans, budget, policies and taxation.
  - To provide an overview of Indian economy and the role of engineers in economic development.

MODULE I INTRODUCTION 8

Classification of economy – open and closed economy – sectors of economy – Basic principles of micro economics – supply ,demand and equilibrium, elasticity of demand- pricing models.

MODULE II NATIONAL INCOME DETERMINATION 7

National Income concepts – GNP, GDP, disposable Income; Aggregate demand and Aggregate supply, macroeconomic equilibrium - concepts of MPS, APS, MPC APC, Inflation – prices indices WPI, CPI and Inflation control.

MODULE III MONEY AND BANKING 7

Monetary system - Role of Central Bank – Monetary policy – Commercial banks, Development banks; Money market – the role of money.

MODULE IV INDUSTRY, MARKET AND TRADE 7

Public and private sectors – Contribution to the national economy, Industrial policy. Markets – labor, capital and debt market. Trade: domestic and International trade.

MODULE V BUDGET, POLICIES AND INDICATORS 8

Economic development – Five year plans, Macro-economic indicators; Central budget: Government revenue-tax and non-tax revenue, government expenditures-plan and non-plan expenditures – Fiscal policy – The impact of the budget on the economy.

MODULE VI ECONOMIC GROWTH AND THE ROLE OF ENGINEERS 8

India Economy – the role of market in the Indian economy – Development in the post independence era – Growth of the economy, Globalization and liberalization – reforms made and their effects, challenges and opportunities, Engineers – Engineers' contributions to the economic growth.

Total Hours : 45

REFERENCES:

1. Vanitha Agarwal, 'Macroeconomics: Theory and Practice', Pearson, (2010).
2. Dwivedi D.N, 'Macroeconomics: Theory and Policies', 3rd edn; McGraw Hill, (2010).
3. Samuelson,Paul A., 'Macroeconomics', 19th edn., TMH, (2009).
4. Gupta G.S, 'Macroeconomics: Theory and Applications', 3rd edn; TMH, (2007).

OUTCOMES:

- Students will have an exposure to the basic concepts of microeconomics and macroeconomics.
- Students will have gained knowledge in government budget, economic planning and its implementation, money, banking and trade.
- They will have learnt about the economic reforms introduced in Indian economy and the role of engineers towards the economic growth and development of the country.

GEB1211 BASIC ENGINEERING MECHANICS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To impart knowledge about the basic laws of statics and dynamics and their applications in problem solving
- To acquaint with scalar and vector approaches for representing forces and moments acting on particles and rigid bodies and their equilibrium
- To give an exposure on inertial properties of surfaces and solids
- To provide an understanding on the concept of work energy principle, friction, kinematics of motion and their relationship

MODULE I VECTOR APPROACH TO MECHANICS 7

Introduction - Units and Dimensions - Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments –Vector Algebra and its Physical relevance in Mechanics -Coplanar Forces – Resolution and Composition of forces- Equilibrium of a particle

MODULE II EQUILIBRIUM OF PARTICLE 6

Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

MODULE III EQUILIBRIUM OF RIGID BODY 6

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples – Scalar components of a moment –Varignon's theorem - Equilibrium of Rigid bodies in two dimensions –Examples

MODULE IV PROPERTIES OF SURFACES 8

Determination of Areas – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Physical relevance - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula –

Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia.

MODULE V LAWS OF MOTION **10**

Review of laws of motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

MODULE VI FRICTION **8**

Introduction to friction- types of friction- Laws of Coloumb friction- Frictional force – simple contact friction – Rolling resistance –ladder friction

Total Hours: 45

REFERENCES:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers, Dynamics & Statics", Third SI Metric Edition, Tata McGraw-Hill International Edition, 2001.
2. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
3. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition Pearson Education Asia Pvt. Ltd., 2003.

OUTCOMES:

On completion of this course students:

- should be able to resolve forces, moments and solve problems using various principles and laws
- should be able to understand the concept of equilibrium, kinetics and kinematics and capable of formulating the governing equations to practical problems and provide solutions for those equations

PEB1211 MATERIALS SCIENCE & ENGINEERING L T P C

3 1 0 4

OBJECTIVES:

- To impart knowledge about the crystal structures and various crystal defects.
- To teach various mechanical tests and plastic deformation of materials.
- To deliver knowledge about thermal and electronic properties of materials.
- To impart knowledge of heat treatment processes to improve the properties of materials.

MODULE I INTRODUCTION 10

Introduction to materials - Metal and alloys, ceramics, polymers and semi conducting materials-introduction and application as engineering materials. Crystal structures - BCC -FCC -HCP -Methods to determine crystal structure - Atomic radius. Defects in solids - Point, line and surface defects. Miller Indices of atomic planes, Crystallographic directions, Measurement of crystals & Bragg's law. structural properties of polymer, thermoplastics, thermosets & elastomers.

MODULE II MECHANICAL PROPERTIES AND TESTING 10

Tensile test - Stress - strain curve for mild steel & brittle material, determination of yield, ultimate stresses, and percentage elongation- Impact tests. Ductile - Brittle transition - fatigue and creep Stress cycle for fatigue testing, endurance limit. Fatigue limit, S-N Curve, Creep Curve.Fracture: Ideal fracture, brittle fracture, Griffith's theory - fracture toughness, ductile failure cup and cone. Type of fracture. Fatigue failure, crack propagation.

MODULE III DEFORMATION OF MATERIALS 10

Deformation of metals: Elastic and plastic deformation, slip, twin, dislocation theory, critical resolved shear stress, deformation in polycrystalline materials; season cracking, Bauschinger's effect, strengthening mechanics; work hardening recovery, crystallization and grain growth, cold and hot working

MODULE IV PHASE DIAGRAM AND HEAT TREATMENT OF STEEL 10

Phase diagrams: Solidification of metals, phase rules, construction of phase

diagram, Fe-c diagram, Cooling Curves of pure Fe, Critical points in Fe-C equilibrium diagrams, Phase changes. Simple calculation of amount of phases.

Plain carbon steels, Effect of alloying elements on steel, Alloy steel, IS designation of steels - classification of cast iron ,Properties and Uses.Non-equilibrium transformation of austenite - Annealing, Normalizing, spheroid zing, T-T-T diagram.

MODULE V THERMAL PROPERTIES OF MATERIALS 10

Thermal properties: High temperature materials; materials for cryogenic application, thermally insulating materials. (Specific heat, thermal conductivity, thermal expansion). Continuous cooling transformation diagram - Hardening and tempering,martempering,austempering - Harden ability and its determination - Surface hardening processes.

MODULE VI ELECTRONIC PROPERTIES OF MATERIALS 10

Electronic properties: Magnetism, diamagnetism, paramagnetism, ferromagnetism, magnetic energy, zone theory of solids, zones in conductors and insulators. Methods of production of metal powder - mixing - blending - compacting - sintering -hot pressing - secondary and finishing operations - Advantages and applications.

Total Hours - 60

TEXT BOOKS:

1. M. Arumugham, Material Science, Anuradha Agencies, 1st Ed., 1987
2. G. E. Dieter, Mechanical metallurgy, McGraw-Hill, 2000.
3. Callister, Jr.Willian.D, Material Science and Engineering -An introduction (5th ed.),John Willey and Sons.2000
4. Raghavan.V, Material Science and Engineering", 5th Edition, Prentice Hall, 2005
5. Khurmi.R.S, Sedha R.S, "Material Science", 4th Edition,S. Chand & Co.,2009

REFERENCES:

1. Ashby,Michel,Hugh Sherallif & David Cebon(2007),Material Science, Processing and Design,1st edition, Butterworth-Heinemann

2. Askeland, Donald R,Pradep.P.Phule,The Science and Engineering of Materials,5th edition(2005),Thomson Engineering.

OUTCOMES:

At the end of the course the student will have the complete knowledge of

- Crystal defects and mechanical properties of materials.
- Carbon content and phase diagram of metals.
- Diffusion process and heat treatment process of materials.
- Students will use these concepts in material characterization and design.

PEB1212 PRINCIPLES OF CHEMICAL ENGINEERING **L T P C**
3 1 0 4

OBJECTIVES:

- To teach the basic concepts of principles of chemical engineering.
- To teach the fundamentals, applications of unit operations with related examples.
- To develop understanding of design principles in the unit operations.
- To develop the ability to analyse the processes and contribute to new designs.

MODULE I CLASSIFICATION OF UNIT OPERATIONS **10**

Unit conversion systems. Heat transfer - Modes of heat transfer, Fourier's law of heat conduction, steady state conduction across composite walls, cylinder and hollow sphere. Convection - Film concept, Heat transfer by natural & forced convection. Radiation. Parallel counter current, and cross flows. Individual and overall heat transfer coefficients. Logarithmic temperatures mean temperature difference (LMTD).

Heat exchange equipments - double pipe and shell and tube heat exchangers, condensers, evaporators. (Equipment description & solution to simple problems)

MODULE II MASS TRANSFER **10**

Mass Transfer - Principles of diffusion, theory of diffusion, Mass transfer coefficients and film theory penetration theory. Distillation - vapor liquid equilibria, Simple distillation, Steam Distillation, Continuous binary distillation. Industrial equipments for distillation. Absorption -Principle and equipment (packed towers and plate Columns). Adsorption - Principle and equipment for absorption.

MODULE III DRYING AND HUMIDIFICATION **10**

Drying - Principles and definitions. Phase equilibria. Cross circulation on drying, through circulation drying. Rate of batch drying. Equipments for drying- dryers of solids and pastes, dryers for solution and slurries.

Humidification - Humidity and saturation, dry bulb and wet bulb temperatures, percentage saturation, dew point, humid volume, humid heat, enthalpy. Equipment - Water - cooling towers, spray chambers, Dehumidification - Principle & application.

MODULE IV MEMBRANE SEPARATION PROCESSES 10

Membrane Separation Processes: Types of Membrane Processes High performance polymers for membrane separation - Types and applications Separation of gases and liquids, dialysis, membrane liquid-liquid extraction, per-evaporation and reverse osmosis.

MODULE V SIZE REDUCTION 10

Size reduction - Laws of crushing, Equipment - classification, Crushers and grinders. Agitation of liquids - Types of impellers. Selection criteria. Power consumption, calculations for agitated vessels.

MODULE VI SEPARATION PROCESSES 10

Screening and screening equipments, Filtration - principle and filtration equipment (filter press, shell and leaf filter, rotary drum filter, centrifugal filter and centrifuges), filter media, filter aids. Gravity settlers, cyclones and hydro cyclones.

Total Hours - 60

TEXT BOOKS:

1. Mc Cabe W L, Smith J C, "Unit Operations of Chemical Engineering", - McGraw Hill, New York (1993).
2. Badger W L, Banchero JT, "Introduction to Chemical Engineering", McGraw Hill, UK, (1997).
3. Richardson and Coulson, "Chemical Engineering" Vol. 1 & Vol. 2, Asian Books Pvt. Ltd, India (1996).

REFERENCES:

1. Robert Perry H, Cecil Chilton H, "Chemical Engineer's Handbook (McGraw-Hill Chemical Engineering Series, McGraw-Hill, 5th edition, (1973).
2. Cengel and Ghajar, "Heat and Mass Transfer", McGraw-Hill, 4th edition, (2011).

OUTCOMES:

At the end of the course, the students are expected to possess knowledge and achieve skills on the following:

- Demonstrate the fundamentals of unit operations and processes in any industry.
- Demonstrate the ability to analyze the processes and contribute to new designs in polymer field with the basic knowledge in chemical engineering.

ENB1282 WRITTEN COMMUNICATION L T P C

0 0 2 1

OBJECTIVES:

- To develop their creative thinking skills and write reviews
- To train them with the nuances of corporate correspondence
- To train them in writing official letters, technical reports and proposals
- To expose them to the writing of Statement of Purpose

MODULE I WRITTEN COMMUNICATION 4

Introduction - process of writing – ABC of academic and professional writing – Writing an article.

MODULE II CREATIVE WRITING 5

Writing stories based on visuals - Preparing an outline for a story - Writing critical reviews on an article / a paper

MODULE III CORPORATE CORRESPONDENCE 3

Tone in formal writing – e-mail writing, memo, fax, agenda and minutes writing.

Lab: viewing e-mail etiquette, format and conventions of writing memo.

MODULE IV OFFICIAL LETTERS 6

Writing Statement of purpose, Letter of Application and Resume – Assessing one's strengths and weaknesses – peer evaluation.

Lab: Resume writing – Viewing different types – Functional, Chronological - Writing one's resume using wiki, Letter calling for interview and seeking promotion.

MODULE V TECHNICAL WRITING I 6

Describing an experiment, writing instructions and recommendations, Feasibility report and progress report, Synopsis – Group assignment – case study.

MODULE VI TECHNICAL WRITING II **6**

Writing a technical proposal – Format – cover page, executive summary, timeline chart, budget estimate, drafting, conclusion,.

Total Hours: 30

REFERENCES:

1. Riordan & Pauley. 'Report Writing Today'. 9th Edition. Wadsworth Cengage Learning, USA. 2005.
2. Gerson, Sharon & Steven M. Gerson, 'Technical Writing: Process and Product' Pearson Education, New Delhi. 2004.
3. M Ashraf Rizvi 'Effective Technical Communication'. Tata McGraw-Hill Education, 2005.
4. Sharma, R.C. & Krishna Mohan, "Business Correspondence and Report Writing". Tata MacGraw – Hill Publishing Company Limited, New Delhi. 2002.
5. Anderson, Durston & Pool. "Thesis and Assignment Writing". 4th Edition. John Wiley & Sons. Australia. 2002.

OUTCOME:

- On completion of the course, the students will have the ability to write all kinds of formal correspondence like letters, reports and proposals.

CHB1290	ORGANIC CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

To impart skill to the students on the following

- Estimation of various organic compounds
- Preparation of various organic compounds
- Separation of binary mixture
- Determination of physical property

Part - A: Organic Estimations

Quantitative Estimation of

1. Phenol
2. Acetone
3. Urea
4. Formaldehyde
5. Acrylonitrile
6. Amine
7. Ester

Part - B: Preparation of Organic Compounds

1. Nitration (Picric acid from phenol)
2. Bromination
3. sulphonation

Part - C: Separation of Components of a Binary Mixture

1. Separation of phenol and toluene
2. Separation of 2-naphthol and toluene

Part - D: Physical Chemistry Experiments

1. Determination of Melting point
2. Determination of degree of polymerization and molecular weight of polymer
3. Determination of critical solution temperature

REFERENCES:

1. A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford and P.W.G. Smith, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Prentice Hall, 1996.

OUTCOMES:

After the completion of the laboratory course the students will gain the ability to

- Estimate the various organic compounds systematically
- Prepare various organic compounds
- Separate the binary mixture
- Determine physical properties of organic compounds.

PEB1213	CHEMICAL ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To impart skill to students in measuring the heat transfer coefficients for different modes of heat transfer.
- To train the students in assessing the flow performance of fluids through different systems.
- To familiarize students with the experimental determination of efficiency of particle size reduction.
- To acquaint the students with the skill of separating a mixture of liquids by using different distillation techniques.

LIST OF EXPERIMENTS:

1. Flow through Rough and Smooth Pipes
2. Performance Study on Centrifugal Pump
3. Calibration of Orifice Meter
4. Performance Test on Two Stage Air Compressor
5. Determination of Emissivity of Given Surface
6. Pressure Drop in Packed Bed Reactor
7. Flow through Fluidized Bed
8 Calibration of Orifice Meter
9. Calibration of Orifice Meter by Variable Head Method
10. Determination of Friction Factor Flow Through a Pipe
11. Thermal Conductivity of Solids
12. Heat transfer in Lagged Pipe
13. Parallel / Counter Flow Heat Exchanger
14. Jaw Crusher
15. Ball Mill
16. Screening Efficiency

17. Simple Distillation

18. Steam Distillation

OUTCOMES:

At the end of the course, the student will have the practical knowledge and skills on the following:

- Evaluating the performance of heat exchangers involved in various systems.
- Finding and rectifying the problems associated with fluid mechanics, heat and mass transfer in various chemical process industries.

SEMESTER III

		L	T	P	C
MAB2181	**TRANSFORMS AND APPLICATIONS (Common to all B.Tech Programmes)**	**3**	**1**	**0**	**4**

OBJECTIVES:

The course aims to

- Develop the skills of the students in the areas of boundary value problems and transform techniques.
- Acquire knowledge on different transforms like Laplace Transform, Fourier Transform and Z-Transform.

MODULE I LAPLACE TRANSFORM **8**

Laplace transform – sufficient condition – Transforms of elementary functions – Properties – Transforms of Derivatives and Integrals – Initial and Final Value Theorem – Transform of Periodic functions – Inverse transforms – Convolution Theorem.

MODULE II FOURIER SERIES **7**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range sine series – Half-range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

MODULE III BOUNDARY VALUE PROBLEMS **8**

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

MODULE IV FOURIER TRANSFORM **7**

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

MODULE V Z -TRANSFORM AND DIFFERENCE EQUATIONS **7**

Z-transform - properties – Inverse Z–transform – Convolution theorem - Formation of difference equations.

MODULE VI APPLICATIONS OF TRANSFORMS **8**

Applications of Laplace Transform in solving linear ordinary differential equations – Second order with constant coefficients, Simultaneous First order equations – Applications of Z–transform in solving difference equations using Z–transform

Total Hours : 60

TEXTBOOKS:

1. Veerarajan.T, "Engineering Mathematics "(5th edition) Tata McGraw Hill Publishing Co. New Delhi, 2012.
2. Grewal B.S, "Higher Engineering Mathematics" (42nd edition), Khanna Publishers, New Delhi, 2012.

REFERENCES:

1. Kreyszig .E. "Advanced Engineering Mathematics" 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics" 4th edition, Jones and Bartlett Publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2006.

OUTCOMES:

At the end of the course, the students will be able to

- Solve Engineering problems in the area of heat conduction, communication systems, electro-optics and electromagnetic theory using different transforms.
- Solve Boundary value problems encountered in engineering practices.

LSB2181 BIOLOGY FOR ENGINEERS L T P C
3 0 0 3

OBJECTIVES:

- To provide an overview of cell structure and function.
- To give basic idea on biochemistry related to biological aspects.
- To introduce genes, their structure, inheritance and about living organisms.
- To give an understanding on metabolism, respiration, etc.
- To inform students of engineering about the interface of biology and engineering.

MODULE I BASICS OF CELL STRUCTURE AND FUNCTION 7

Cells as unit of life – basic chemistry of cell – physical and chemical principles involved in maintenance of life processes, cell structure and functions – Prokaryotic and Eukaryotic cells, cell wall, plasma membrane, endoplasmic reticulum, nucleus, chromosomes- cell division – mitosis, meiosis – molecules controlling cell cycle.

MODULE II BIOCHEMISTRY 8

Biomolecules – introduction – basic principles of organic chemistry, types of functional groups, chemical nature, pH and biological buffers – carbohydrates- mono, di, oligo and polysaccharides, lipids- phospholipids, glycolipids, sphinglipids, cholesterol, steroids, prostaglandms – aminoacids, peptides, proteins – structures- primary, secondary, tertiary and quaternary, glycoproteins, lipoproteins – Nucleic acids – purines, pyrimidines, nucleoside, nucleotide, RNA, DNA.

MODULE III GENETICS 7

Genes – structure and functions – behavior, dominance and epigenetics, evolution – inheritance – reproduction and gene distribution – genome of living organisms – plants – bacteria and viruses – animals – humans, genetic engineering.

MODULE IV MICROBIOLOGY 8

Microbiology – basis of microbial existence – microbial diversity – classification and nomenclature of micro-organisms- impact of microorganisms on industry,

agriculture and health, industrial microbiology – primary and secondary screening of micro-organisms, fermentation processes, bioreactors, microbial ecology – microbial bio-remediation – epidemiology and public health.

MODULE V METABOLISM **7**

Metabolic processes – bio-membranes, diffusion, absorption, osmo-regulation, photosynthesis, respiration, dialysis, nutrition, digestion and excretion.

MODULE VI BIOLOGY AND ENGINEERS **8**

Application of biology in engineering– living things as the solutions (bionics) – living things as models (biometrics) – bio-technology – biomedical engineering – effect of human action on living things – right balance – bioinformatics – bionanotechnology – sensors, biosensors, biochips-ethics in biology.

Total Hours : 45

REFERENCES:

1. Johnson, Arthur T., “Biology for Engineers”, CRC Press, FL, 2011.
2. Campbell and Recee, “Biology”, Pearson, Benjamin Cummins Pub. 8th edition, 2008.
3. Scott Freeman, “Biological Sciences”, Prentice Hall, 2002.

OUTCOMES:

- Able to understand the engineering of life processes.
- Capable of pursuing tissue engineering, biomedical engineering and biotechnology at master level programme.
- Able to apply the knowledge of biology for engineering applications.
- Able to understand the engineering of life processes.

PEB2101 CHEMISTRY OF MACROMOLECULES L T P C

3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of macromolecules.
- To develop an understanding of mechanisms of different polymerisation methods.
- To impart knowledge on characters governing the physical properties of polymers.
- To develop an understanding on various reactions of polymers.

MODULE I INTRODUCTION TO MACROMOLECULES 5

Basic concepts of macromolecules – monomers- functionality – classification and nomenclature of polymers. Polymerisation – addition, condensation and coordination polymerization – thermoplastics – thermosets.

MODULE II ADDITION POLYMERIZATION 9

Addition polymerization – Mechanism and kinetics of free radical – Cationic – Anionic polymerisation – Initiator systems – Chain length and degree of polymerisation – Control of molecular weight – Chain transfer – Inhibition Coordination polymerisation – Mechanism – Kinetics – Ring opening polymerization – diene polymerization.

MODULE III STEP GROWTH POLYMERISATION 6

Step growth polymerization – Mechanism and kinetic of step growth polymerization – Bi-functional systems – Poly functional systems.

MODULE IV COPOLYMERIZATION AND POLYMERISATION TECHNIQUES 8

Copolymerization – Mechanism and Kinetics of free radical – Ionic copolymerization – types of copolymers – Copolymer composition – Determination of Monomer reactivity ratios. Polymerization techniques – Bulk polymerization – Solution polymerization – Suspension polymerization – Emulsion polymerization – Interfacial condensation.

MODULE V PHYSICAL CHARACTERIZATION OF POLYMERS 9

Molecular weight – Molecular weight averages – Molecular weight distribution – Unidispersity, polydispersity, degree of polymerization - Molecular weight determination - Basic concepts of end group analysis, colligative properties, osmometry, light scattering, and gel permeation chromatography - Viscosity of polymers solutions, size of the polymer molecules.

MODULE VI REACTIONS OF POLYMERS 8

Chemical reactions of polymers – Hydrolysis – Acidolysis – Aminolysis – Hydrogenation – Addition and substitution reactions – cross linking reactions. Polymer degradation – Mechanical degradation – Mechano–chemical degradation – Oxidative degradation – Hydrolytic degradation – Photo degradation.

Total Hours : 45

REFERENCES:

1. F.W. Billmeyer, “Textbook of Polymer Science”, Wiley international publishers, 1984.
2. Joel R. Fried, “Polymer Science and Technology”, Prentice Hall, NJ, 1995.
3. JM.G. Cowie, “Polymers: Chemistry and Physics of Modern Materials”, Blackie, and London, 1991.
4. R.J. Young and P.Lovell, “Introduction to Polymers”, 2nd Ed., Chapman & Hall, 1991.
5. Premamoy Ghosh, “Polymer Science and Technology of Plastics and Rubbers”, Tata McGraw - Hill, New Delhi, 1990.

OUTCOMES:

At the end of the course, the students will have the

- Fundamental knowledge of polymers and polymerization reaction mechanisms.
- Ability to select suitable method for the synthesis of polymers.
- Capability to apply the knowledge in synthesizing copolymers.

PEB2102 THERMOPLASTIC MATERIALS ENGINEERING **L T P C**

3 0 0 3

OBJECTIVES:

- To provide fundamental knowledge on the manufacturing process, properties and applications of various thermoplastics.
- To impart knowledge for the comparison and selection of thermoplastic materials for various industrial and high performance applications.

MODULE I COMMODITY POLYMERS I **8**

Industrial manufacturing processes, properties, applications, brief idea about compounding & processing of polyethylene – LDPE – HDPE – LLDPE, HMWHDPE – UHMWHDPE – crosslinked polyethylene – Polypropylene and its Copolymers

MODULE II COMMODITY POLYMERS II **7**

Industrial manufacturing processes, properties, applications, brief idea about compounding & processing of Polypropylene – Copolymers- EPDM – Polystyrene, HIPS, EPS, SAN, ABS.

MODULE III COMMODITY POLYMERS – III **6**

Industrial manufacturing processes, properties, applications, brief idea about compounding & processing of poly (vinyl chloride) – poly (vinylidene chloride) – poly (vinyl alcohol) – poly (vinyl acetate) – chlorinated poly (vinyl chloride) – plastisols.

MODULE IV ENGINEERING POLYMERS I **8**

Industrial manufacturing processes, properties of acrylates – poly (methyl methacrylate) – polyacrylonitrile – aliphatic polyamides: nylon 6- nylon 6, 6 and other types of nylons – aromatic polyamides.

MODULE V ENGINEERING POLYMERS – II **8**

Industrial manufacturing processes, properties of polyethylene terephthalate – polybutylene terephthalate – polyacetals – polycarbonates. Thermoplastic polyurethanes, cellulose nitrate – cellulose acetate – ethyl cellulose – cellulose esters.

MODULE VI HIGH PERFORMANCE POLYMERS **8**

Industrial manufacturing processes, properties of high performance thermoplastics – polytetrafluoroethylene – polychlorofluoroethylene – PS- PPO – polysulphone – polyether slphon – PEEK – polyimides.

Total Hours : 45

TEXT BOOKS :

1. J.A.Brydson, “Plastics Materials”, Butterworth- Heinemann – Oxford Press, 2005.
2. Feldman.D and Barbalata.A, “Synthetic Polymers”, Chapman Hall, 1996.

REFERENCES:

1. Olagoke Olabisi, “Hand Book of Thermoplastics”, Marcel Decker, inc., 1997.
2. K.J. Saunders, “Organic Polymer chemistry”, Chapman & Hall, NY, 1988.
3. Irvin.I.Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY, 1990.
4. S.W. Mayo, “Manufacture of Plastics”, Reinhold Publishing Corporation, Chapman & Hall, Ltd. London, 1964.
5. S.L. Rosen, “Fundamentals Principles of Polymeric Materials”, John Wiley Publisher, 2nd edition, 1993.
6. A.S. Athalye, “Plastics Materials Handbook”, Multi Tech Publisher Mumbai, 3rd edition, 1995.

OUTCOMES:

At the end of the course, the students will be able to possess knowledge in the following:

- Synthesis and properties of polymeric materials.
- Ability to analyze and characterize the thermoplastic materials for new product development.
- Ability to select thermoplastic materials for specific applications.

PEB2103 BASIC MECHANICAL OPERATIONS L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge of heat treatment and metal cutting in mould manufacturing process.
- To provide understanding of machining operations in mould manufacturing.
- To introduce metrology and its applications in mould making.
- To enhance the understanding of electroforming and hobbing process in manufacturing processes.

MODULE I METAL CUTTING AND MACHINING 8

Mechanics of metal cutting – types of chips, cutting tool geometry, types of tools, influence of tool angles, cutting fluids, tool materials used including coated tools. Study of various machining operations: Turning, drilling, shaping, planning.

MODULE II MILLING OPERATIONS 7

Milling – horizontal / copy milling / vertical / ram / tool milling/die sinking /copy milling grinding – surface, cylindrical, tool & cutter, profile and rotary grinding. CNC lathe, machining centers.

MODULE III ADVANCE MACHINING OPERATIONS 7

Electrical discharge machining – characteristics, physical processes, special technological features, design consideration and functions, types of equipment, technological planning. Typical applications.

MODULE IV ELECTROFORMING AND HOBBING 8

Electroforming for mold manufacturing – process, materials, design, machining electroformed blanks for mold cavities, economy and service life. Hobbing for mold making – process & its advantages, elements of hobbing – hobbing punch, shape of hob, materials used for cavity blanks, lubrication, and depth of hobbing, hobbing presses, hobbing operations.

MODULE V POLISHING 7

Polishing technology in mold making: Definition of surface roughness, basis of polishing technology, effect of mold material on polishability, polishing

techniques – lapping, lapping and polishing, ultrasonic finishing, principles of electro deposition in damaged molding surfaces, surface texturing of molds – process description, types of molds, types of patterns and mold shapes, metals that can be etched, mold preparation, limitations of chemical texturing.

MODULE VI METROLOGY **8**

Metrology and inspection: Scope of inspection, procedures, choices of basic measuring instruments, vernier, micrometer, surface plates, angle plates, squares, vernier height gauges, depth gauges, slip gauges, dial gauges, surface roughness measurement, hardness testing, comparators, optical profiles projectors, tool makers microscope, optical flats – types and uses.

Total Hours : 45

TEXT BOOKS :

1. Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters Pvt Ltd., Mumbai, 2007.
2. P.C. Sharma, “A Text Book of Production Technology”, S. Chand and Company, X Edition, 2008.
3. P.N. Rao, “Manufacturing Technology”, Tata McGraw-Hill Publishing Limited, II Edition, 2009.
4. HMT – “Production Technology”, Tata McGraw-Hill, 2001.

REFERENCES:

1. Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 2006.
2. Richerd R. Kibbe, John E. Neely, Roland O. Merges and Warren J. White, “Machine Tool Practices”, Prentice Hall of India, 2003.

OUTCOMES:

At the end of the course, the students will be able to

- Explain the mechanics of metal cutting and machining operations involved in mold manufacturing.
- Compare the milling and hobbing processes for core and cavity manufacturing.
- Describe various polishing techniques involved in mold manufacturing.
- Identify the basic measuring instruments used in machine shop.

EEB1281 INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING **L T P C 3 0 0 3**

OBJECTIVES:

To impart knowledge on

- Basic concepts of electrical circuits and their solutions
- Performance of Electrical machines, speed control and their use as drives.
- Basic knowledge on power system and various methods of power generation through renewable energy sources.
- The concepts of quantum theory of solids and semiconductor materials.
- Basis of understanding the characteristics, operation and limitations of semiconductor devices.

MODULE I DC AND AC CIRCUITS **8**

Circuit Parameters-Sources- Kirchhoff's laws-Solution of simple circuits AC quantities – Phasor representation – Power-Real, Reactive and Apparent Power – Solution of Simple circuits.

Superposition, Thevenin's, Norton's and Maximum power transfer theorem-Network solution by Mesh current and Node Voltage method.

MODULE II ELECTRICAL MACHINES AND DRIVES **8**

DC generator and Motor – Working Principle and Operating Characteristics – Starters for DC motors and speed control – applications.

Transformers - Single phase and three phase transformers- Working Principle – EMF equation - equivalent circuit and performance calculations.

Three phase and single phase induction motors - Working Principle – Torque-Slip characteristics – Starting and speed control – use of induction motor as industrial drives.

MODULE III ELECTRIC POWER SYSTEMS **6**

Structure of Power system – Transmission and Distribution schemes – Power Quality – Indian Electricity Rules and Regulations.

MODULE IV SEMICONDUCTORS **8**

Energy band theory – intrinsic semiconductors- extrinsic semiconductors – Calculation of location of Fermi level and free electron and hole densities in extrinsic semiconductors – N and P type semiconductors- Mobility, drift current and conductivity – Diffusion current – Continuity equation – Hall effect – Calculation of electron and hole densities.

MODULE V PN JUNCTION AND SPECIAL DIODES **7**

Band structure of PN Junction – Current Component in a PN Junction – Derivation of diode equation – switching characteristics of diode – Mechanism of avalanche and Zener breakdown – Zener diode & its applications –Diode as Clipper & Clamper – Varactor diode – Backward diode – Tunneling effect in thin barriers – Tunnel diode – Photo diode – Schottky diodes.

MODULE VI TRANSISTORS AND AMPLIFIERS **7**

Bipolar junction transistor – CB, CE, CC configuration and characteristics – Comparison – Field effect transistor – Configuration and characteristic – SCR, DIAC, TRIAC, UJT – Characteristics and simple applications – MOSFET:PMOS.NMOS – Structure and characteristics.

Total Hours : 45

REFERENCES:

1. William H. Hayt Jr, Jack E. Kemmerly, and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2002.
2. Vedam Subrahmanyam, "Electric Drives", McGraw-Hill Education (India) Pvt Limited, 2010.
3. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 9th Edition, 2007.
4. D.P.Kothari and I.J.Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill Publishing Co Ltd, 2nd Edition, 2002.
5. I.J .Nagrath and D.P.Kothari, ‘Power System Engineering’ , Tata McGraw Hill Publishing Co Ltd, 2nd Edition, 2007.
6. Ewald F.Fuchs and Mohammed A.S.Masoum, Elsevier Academic Press, 2008.
7. Indian Electricity Rules, 1956.

8. Jacob Millman & Christos C.Halkias, “Electronic Devices and Circuits” Tata McGraw–Hill, 1991.

9. Floyd, “Electronic Devices: Conventional Current Version, 7/E” Pearson Education India, 2008.

10. S. Salivahanan, N.Sureshkumar and A.Vallavaraj, “Electronic Devices and Circuits”, Tata McGraw Hill Publishing Co Ltd, 1998.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- The basics of electrical circuits and their solution methods.
- The working of machines and their drives.
- The structure of power system and importance of power quality.
- Various methods of power generation from renewable energy sources.
- Working of PN junction diodes and special purpose diodes.
- Characteristics of transistors both in ideal and non-ideal cases

ENB2181 ORAL COMMUNICATION L T P C

0 0 2 1

OBJECTIVES:

- To help the students acquire efficiency in spoken English with due importance to stress, accent and pronunciation.
- To hone the listening skills and understand native accent.
- To enable them to make presentations effectively.
- To develop their ability to persuade and convince people to accept a point of view.
- To prepare them for placement interviews, group discussions etc.

MODULE I PRESENTATION SKILLS 8

(i) Oral Communication – Implications in real life and work place situations

(ii) One–minute Presentations (JAM) on concrete and abstract topics that test their creative thinking

(iii) Prepared presentations and extempore presentations

(iv) Group project – presentation on any social issue. The group will have to research on the history of the problem, its cause, impact and outcome hoped for and then make a presentation

(v) Recording presentations and feedback - Peer and faculty evaluation

MODULE II LISTENING 4

Listening to ESL Podcast – Viewing Multimedia – Listening to BBC News - Received Pronunciation (RP)/ VOA/ NDTV – exposure to paralinguistic features.

MODULE III DEVELOPING PERSUASIVE SKILLS 6

Selling a product – marketing skills – the topics will be on advertising, convincing someone on social issues such as preservation of water, fuel, protection of environment, gender discrimination.

MODULE IV DEBATES **9**

Debates on pros and cons on topics of relevance like Nuclear Energy, Appropriate Technology, Internet, Social Media. This will be followed by Peer and Faculty feedback.

MODULE V BRAINSTORMING **9**

Think pair and share activity – Discussion etiquette – Assigning different roles in a GD (Note-taker, Manager, Leader and Reporter) Peer and faculty feedback.

MODULE VI INTERVIEW SKILLS **9**

- Assessing one's strengths and weaknesses, SWOC Analysis, Mock interview – Verbal and Non-verbal Communication – Types of Job Interview – Telephone Interview, Stress Interview.

Total Hours : 45

REFERENCES:

1. Hancock,Mark. "English Pronunciation in Use". Cambridge University Press, UK. 2005.
2. Anderson, Kenneth & et.al. "Study Speaking: A Course in Spoken English for Academic Purposes" (Second Edition). Cambridge University Press, UK. 2004.
3. Hurlock, B. Elizabeth. "Personality Development". Tata McGraw Hill, New York. 2004.

OUTCOME:

- On completion of the course, the students will have the ability to speak confidently and effectively in presentations and group discussions.

PEB2104	MACHINING PRACTICE LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To impart practical skills in metal cutting process.
- To impart knowledge of various process parameters affecting the machining operations in mould manufacturing.
- To equip with the fundamental knowledge of metrology and its applications in mould making process.

LIST OF EXPERIMENTS :

1. Exercise on Shaping machine – making square rod from round rod and cutting V- groove.
2. Exercise on Plain Milling.
3. Exercise on Vertical Milling.
4. Exercise on Surface Grinding.
5. Exercise on Slotting Machine.
6. Grinding of Cutting tools.
7. Study of different types of Cutting tools.
8. Study of Micrometer, Vernier calipers, Height gauge and Slip gauge.
9. Measurement of angles and tapers.
10. Checking of straightness using auto collimeter.

Total Hours : 45

OUTCOMES:

At the end of the course, the student will be able to:

- Operate the shaping machines to make square rod from round rod and V groove.
- Manufacture various components by milling operations.
- Polish the machined surface by grinding operations.
- Identify and use the basic measuring instruments used in machine shop

EEB1282	ELECTRICAL AND ELECTRONICS ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To understand, simulate and verify Thevenin's and Norton's theorem.
- To understand and verify the characteristics of various electrical machines
- To understand the three phase power measurement in AC circuits.
- To verify practically, the fundamental characteristics of electron devices.

LIST OF EXPERIMENTS :

1. Verification of Thevenin's theorem and Norton's theorem using MATLAB
2. Open circuit characteristics and Load Characteristics of Self Excited DC Generator
3. Load Test on DC Shunt and DC Series Motor
4. Load Test on Single Phase Transformer
5. Load Test on Three Phase Induction Motor
6. Measurement of 3 phase power using 2 wattmeter method
7. PN Junction Diode characteristics.
8. Zener Diode characteristics.
9. Input and Output characteristics of BJT in CE configuration.
10. Characteristics of JFET.
11. SCR Characteristics.

Total Hours : 45

OUTCOMES:

At the end of the course, the student should be able to:

- Construct and simulate any given simple electric circuits and verify theorems using MATLAB.
- Study and understand the performance of Electrical Machines.
- Measure the three phase power.
- Experimentally understand the characteristics of diodes, BJT's and FET's and SCR.

SEMESTER IV

MAB2283 APPLIED NUMERICAL METHODS L T P C
3 1 0 4

OBJECTIVE:

- This course gives a complete procedure to solve problems in engineering numerically, where analytical method fails to give solution.

MODULE I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 7

Linear interpolation methods (method of false position) – Newton's method – Statement of Fixed Point Theorem – Fixed point iteration: x=g(x) method – Solution of linear system by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods – Inverse of a matrix by Gauss Jordon method – Eigenvalue of a matrix by power method.

MODULE II INTERPOLATION AND APPROXIMATION 7

Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton's forward and backward difference formulas – Relations between operators (E, $\nabla, \mu, \Delta, \Delta$).

MODULE III NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 8

Derivatives from difference tables – Divided differences and finite differences – Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson's rules.

MODULE IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 8

Numerical solution of first and second order ordinary differential equations by Taylor series method – Euler Method – Modified Euler's Method – Runge – Kutta Method of order four.

MODULE V NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8

Millne's Predictor and Corrector Method – Adam's Predictor-Corrector Method

– Finite difference methods for two – point Boundary Value problems for Ordinary Differential Equations.

MODULE VI BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 7

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Total Hours : 60

TEXT BOOKS :

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, “Numerical methods for Scientific and Engineering Computation”, New Age International Publishers, New Delhi, 2003.

REFERENCES:

1. Grewal, B.S., “Numerical methods in Engineering and Science”, 7th edition, Khanna Publishers, 2007.
2. C.F.Gerald, P.O.Wheatley, “Applied Numerical Analysis” Pearson Education, New Delhi 2002.
3. P. Dechaumphai, N. Wansophark,”Numerical Methods in Engineering”, Narosa Publications, 2012.

OUTCOMES:

At the end of the course students will be able to

- Solve system of equations and Eigen value problem of a matrix numerically.
- Use interpolation and find intermediate values for given data.
- Find numerical solution of differential equations in engineering problems.

PEB2211 PHYSICS OF MACROMOLECULES L T P C

3 0 0 3

OBJECTIVES:

- To develop an understanding on the relationship between polymer structure and its properties.
- To equip with the knowledge of polymer chain conformation and configuration on its morphological behavior.
- To introduce the basic principles of thermodynamic transitions in polymers.
- To impart the knowledge of electrical, optical and chemical, properties of polymers.

MODULE I POLYMER CHAIN CONFORMATION AND CONFIGURATION 8

Potential energy and conformational energy of molecules – staggered and eclipsed states – conformations and configurations, isomeric states and isomerism in polymers – tacticity, stereoisomerism, geometric isomerism.

Morphological aspects of polymers – polymer single crystals, lamellae, spherulites, fringed micelle model – degree of crystallinity, factors affecting crystallinity, Chain orientation – concept of chain orientation – orientation in amorphous and crystalline polymers – properties of oriented polymers – birefringence.

MODULE II POLYMER STRUCTURE – VOLUMETRIC PROPERTIES 7

Structure of polymers – linear, branched, cross linked, and network polymers – homochain and hetero atomic chain polymers - copolymers – linear and cyclic arrangement – prediction of polymer properties, group contribution techniques, topological techniques – volumetric properties – molar volume, density, Van der Waals volume – coefficient of linear thermal expansion and volumetric thermal expansion - pressure volume temperature (PVT) relationship.

MODULE III MECHANICAL PROPERTIES OF POLYMERS 7

Mechanical properties – stress-strain properties of polymers – effect of polymer structure on modulus of elasticity, tensile strength, flexural strength, impact

strength, yield strength, fracture toughness – crazing in glassy polymers – ductile brittle transition. Effect of additives on mechanical properties of polymers – creep, stress relaxation, and fatigue.

MODULE IV THERMODYNAMIC TRANSITIONS IN POLYMERS 8

Thermodynamic and transition properties – transition temperature in polymers, glass transition (Tg), melt transition (Tm), relationship between Tg and Tm – other transitions like ß-transitions, upper and lower glass transition temperatures – prediction of Tg and Tm of polymers by group contributions. Calorimetric properties – heat capacity, specific heat, latent heat of crystallization and fusion, enthalpy and entropy – calculation of heat capacities of polymers.

MODULE V ELECTRICAL AND OPTICAL PROPERTIES OF POLYMERS 8

Electrical and optical properties – effect of polymer structure on dielectric constant, power factor, dissipation factor, and loss factor – effect of frequency of voltage and temperature on dielectric properties – prediction of molar polarization and effective dipole moment. Effect of additives on electrical properties of polymers. Optical properties – effect of polymer structure on optical properties – clarity, transparency, haze, transmittance, reflectance, and gloss – prediction of refractive indices of polymers by group contributions.

MODULE VI CHEMICAL PROPERTIES OF POLYMERS 7

Chemical Properties – cohesive energy, cohesive energy density, solubility parameter, determination of solubility parameter of polymers – prediction of solubility parameter – effect of polymer structure on solubility in solvents and oils – influence of structure in prediction of flame retardancy, water repellency – chemical resistance of polymers – polymer toxicity.

Total Hours : 45

TEXT BOOKS :

1. Alfred Rudin, Phillip Choi Ph.D. P.Eng, The Elements of Polymer Science & Engineering, Third Edition, Academic Press; 3 edition December 28, 2012.
2. Gary Patterson, Physical Chemistry of Macromolecules, CRC Press; 1 edition, March 9, 2007.

3. S. F. Sun, Physical Chemistry of Macromolecules: Basic Principles and Issues, Wiley-Interscience; 2nd edition, January 28, 2004.

4. Petr Munk, Tejraj M. Aminabhavi, Introduction to Macromolecular Science, Wiley-Interscience; 2nd editions, March 5, 2002.

5. D.A.Seanor, ed., Electrical properties of polymers, Acadamic press, Newyork, 1982.

6. Jozef.Bicerano, Prediction of Polymer Properties, 2nd Edition, Marcel Dekker Inc. Newyork, 1995.

REFERENCES:

1. Herman F. Mark, “Encyclopedia of Polymer Science and Technology”, Wiley-Interscience; 3rd Edition, 2004.

2. R.J.Samuels, “Structured Polymer Properties”, John Wiley & Sons, New York, 1974.

3. C.C.Ku & R.Liepins , “Electrical Properties of Polymers” , Hanser Publications, Munich, 1987.

OUTCOMES:

At the end of the course, the students will be able to

- Correlate the structure and properties of various polymers.
- Select the specific polymer based on its desired application.
- Predict the properties of newly synthesized polymers.

PEB2212	THERMOSETS AND ADDITIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop an understanding on the limitations aspect of polymeric materials during synthesis, processing, service, etc and emphasize the importance of the additives.
- To provide basic knowledge in selecting the additives based on the performance and property requirements of the targeted polymer.
- To impart knowledge on the chemistry and mechanism involved in incorporation of additives into polymeric materials.
- To develop an understanding on the manufacturing technology, curing characteristics, properties and applications of various thermoset resins.

MODULE I INTRODUCTION TO COMPOUNDING OF POLYMERS 7

Introduction – limitations of polymeric materials – additives for plastics – technological requirements – classification – types – chemistry and mechanisms– general effect on properties –antioxidants – stabilizers – lubricants – plasticizers – fillers.

MODULE II COMPOUNDING ADDITIVES 7

Processing aids – reinforcements – toughening agents – antistatic agents – anti-blocking agents – slip and anti-slip agents – Ultra violet absorbers and stabilizers – fire retardants – blowing agents – colorants– master batch – color matching – miscellaneous additives.

MODULE III PHENOLIC RESINS 8

Industrial manufacturing processes, properties, curing characteristics, applications, of unsaturated polyesters – vinyl ester – phenol formaldehyde resin – urea formaldehyde resin-melamine formaldehyde resin.

MODULE IV SPECIAL PURPOSE THERMOSETS - I 8

Industrial manufacturing processes, properties, curing characteristics, applications, of epoxies-diglycidylether of bisphenol-A resins, epoxy-novalacs, cycloaliphatic epoxies. Thermoset polyimides-silicones - inorganic polymers.

MODULE V SPECIAL PURPOSE THERMOSETS-II 8

Industrial manufacturing processes, properties, curing characteristics, applications of thermoset polyurethanes – cast polyurethane rubber – malleable gums – flexible foams – rigid foams.

MODULE VI COMPOUNDING OF THERMOSETS 7

Compounding of thermosets – dough and sheet moulding compounds – moulding powders – laminates – methods of mixing of additives – compounding and processing of Phenol Formaldehyde resins, unsaturated polyester resin and epoxy resins.

Total Hours : 45

TEXT BOOKS :

1. Gatcher and Muller, “Handbook of Plastics Additives”, Hanser Publishers, New York, 1997.
2. J.A.Brydson, “Plastics materials”, Butterworth- Heinemann – Oxford, 6th Ed., 1995.
3. Feldman.D and Barbalata.A, “Synthetic Polymers”, Chapman & Hall, 1996.

REFERENCES:

1. Irvin. I. Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY, 1990.
2. Manas Chanda and Salil K. Roy, “Plastics Technology Handbook”, Marcel Dekker, New York, 4th Edition, 2006.
3. Mascia; L.,”The Role of Additives in Plastics”, Edward Arnold Publishers Ltd., U. K, 1974.
4. John Murphy, “Additives for Plastics Handbook”, Elsevier Advanced Technology, Oxford, 2nd Edition, 2001.

OUTCOMES:

- Suggest a suitable additive based on the performance and property requirement of the targeted polymer.
- Apply knowledge in compounding of thermoset matrices to enhance proper dispersion for attain the desired performance.
- Demonstrate the synthesis methodology of thermoset resins.
- Examine the curing characteristics of thermosets.

PEB2213 POLYMER RHEOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To provide understanding of the mechanical behavior of polymeric materials.
- To impart knowledge of the rheological behavior of polymer melts.
- To equip with the knowledge of rheometers.

MODULE I MECHANICAL BEHAVIOUR OF POLYMERIC MATERIALS 7

Introduction to Rheology – types of mechanical deformation – Elastic materials – Viscous materials – Viscoelasticity – effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials – creep – stress relaxation – Boltzman principle – time temperature super position principle – WLF equation.

MODULE II MECHANICAL MODELS –VISCOELASTIC BEHAVIOUR 8

Mechanical models – stress strain response of spring and dashpot – viscoelstic models – Maxwell element – Voight kelvin element – response to creep and stress relaxation – four-parameter model – dynamic mechanical properties – behavior of Maxwell element and relaxation spectra.

MODULE III PARAMETERS INFLUENCING POLYMER RHEOLOGY 7

Effect of pressure on viscosity, effect of temperature, activation energy effect of molecular weight and molecular weight distribution on viscosity, molecular at dependence of zero shear viscosity, effect of crosslinking, crystallinity branching, copolymerization, effect of fillers, fiber filled polymer melts, effect of plasticizers, shear rate dependence of viscosity.

MODULE IV FLOW PROPERTIES OF POLYMER MELT 7

Fluid flow – types of fluid flow – time dependant fluids, shear rate dependant fluids, Newtonian and Non Newtonian fluids – viscosity of polymer melts – shear thinning and shear thickening – zero-shear rate viscosity – laminar flow of Newtonian fluids – power law – general treatment of isothermal viscous flow in tubes – entrance and exit effects - elastic effects in polymer melt flow - die- swell and melt fracture – Weissenberg effect – normal stress difference – Elongational viscosity.

MODULE V MEASUREMENT OF RHEOLOGICAL PROPERTIES 8

Measurements of rheological properties – capillary rheometers – melt flow index – cone and plate viscometrer – torque rheometers – Mooney viscometer – curemeters – Rheo – optical methods – birefringence.

MODULE VI APPLICATION OF POLYMER RHEOLOGY TO PROCESSING 8

Rheological behaviour of important thermoplastics (PE, PVC, PS, PP, nylons and PC) – Applications of rheology to polymer processing (injection moulding, extrusion and blow moulding)

Total Hours : 45

TEXT BOOKS :

1. Montgomery T. Shaw, “Introduction to Polymer Rheology”, Wiley; 2012.
2. Chang Dae Han, “Rheology and Processing of Polymeric Materials: Volume 2: Polymer Processing”, Oxford University Press, USA, 2007.
3. Paul C. Painter and M. Michael Coleman, “Fundamentals of Polymer Science”, Technomic Publishing Co. Inc., Lancaster, USA 1994.
4. Richard C. Progelhof and James L. Throne, “Polymer Engineering Principles”, Hanser Publishers, Munich Vienna New York, 1993.
5. R. Griskey, “Polymer Process Engineering”, Springer; 1995.
6. J.A Brydson, “Plastics Materials”, Butterworth-Heinemann; 1999.

REFERENCES:

1. Herman F. Mark, “Encyclopedia of Polymer Science and Technology”, Wiley-Interscience; 3rd Edition, 2004.
2. J. D. Ferry, “Viscoelastic Properties of Polymers”, John Wiley & Sons, New York, 1993.

OUTCOMES:

At the end of the course, the students will be able to

- Construct a model for viscoelastic behavior of polymer melts.
- Demonstrate the rheological behavior of thermoplastic materials.
- Analyze and measure the rheological properties of polymer melts.
- Apply the concept of rheology to polymer processing.

PEB2214 POLYMER ANALYSIS AND CHARACTERIZATION **L T P C**
3 1 0 4

OBJECTIVES:

- To provide understanding of specifications, quality control and processability.
- To impart skill in molecular characterizing of polymers.
- To equip with the knowledge of thermal and physical analysis of polymers.

MODULE I IDENTIFICATION AND ANALYSIS **10**

Identification of rubbers and plastics by simple physical methods & by chemical analysis. Introduction to application of instrumental techniques for identification of polymers and additives. Raw materials characterization.

Thermoplastics - melting point, density, viscosity, melt flow index, K-value.

Thermosets - moisture analysis, particle size, apparent density, spiral flow test, cupflow test, gel time and peak exothermic temperature. Resins – acid value, hydroxyl value, isocyanate index, epoxy equivalent.

MODULE II SPECIFICATIONS, QUALITY CONTROL AND PROCESSABILITY **10**

Rubber latex and dry rubber – cup viscosity, TOTAL alkalinity, TOTAL solids, dry rubber content, volatile matter, KOH number.

MODULE III PROCESSABILITY TESTS **10**

Mechanical stability, Plasticity, plasticity retention index (PRI), scorch time and cure characteristics (plastimeter, Mooney viscometer, oscillating disc rheometer)

MODULE IV MOLECULAR CHARACTERIZATION OF POLYMERS **10**

Determination of molecular weight and its distribution, viscometry, end group analysis, colligative property, osmometry, light scattering technique, gel permeation chromatography.

MODULE V THERMAL ANALYSIS OF POLYMERS **10**

Differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), thermomechanical analysis (TMA), dynamic mechanical analysis (DMA).

MODULE VI PHYSICAL METHODS OF ANALYSIS 10

X-ray diffraction (Wide angle and small angle), Infrared spectroscopy (IR & FTIR), Nuclear magnetic resonance spectrometer (NMR), GC – Mass spectrometer, optical microscopy, scanning electron microscopy, transmission electron microscopy.

Total Hours : 60

TEXT BOOKS :

1. Sabu Thomas, Deepalekshmi Ponnamma, Ajesh K. Zachariah, "Polymer Processing and Characterization: 1 (Advances in Materials Science)", Apple Academic Press; 1st edition, January 31, 2013.
2. Joseph D. Menczel, R. Bruce Prime, "Thermal Analysis of Polymers", Fundamentals and Applications, Wiley; 1st edition, April 20, 2009.
3. Wiley, "Characterization and Analysis of Polymers", Wiley-Interscience; 1st edition February 8, 2008.
4. Chermisinoff, "Polymer Characterization – Laboratory Techniques and Analysis", Chapman and Hall, London, 1993.

REFERENCES:

- Hunt & James, Polymer Characterization, Chapman & Hall, London, 1993
- Kampf, "Characterization of Plastics using physical methods, Experimental techniques and practical applications", Hanser Gardner Publications, 1987.

OUTCOMES:

At the end of the course, the students will be able to

- Identify the plastics and rubbers by simple physical methods & chemical analysis.
- Determine the molecular weight and its distribution by various methods.
- Interpret the test results.

SSB2181	LAW FOR ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize with Indian Constitution and Governance of our country.
- To apprise on human rights, local and International and redressal mechanism.
- To provide important aspect of corporate laws.
- To give an introduction of important industrial and labour laws of our country.
- To provide an exposure on laws on contracting and arbitration.
- To give an overview on intellectual property related laws.

MODULE I INDIAN CONSTITUTION **7**

Constitution – meaning and history – making of constitution – salient features, preamble, Citizenship, Fundamental rights, Fundamental duties, Equality and social justice, Directive principles, Constitutional amendments.

MODULE II GOVERNANCE AND POWERS VESTED **7**

Union executive, Legislature – Union – State and union territories, Union and state relations, powers vested with parliament and state legislature, emergency provisions - People's Representations Act – Election Commission – Election for parliament and state legislature, Judiciary.

MODULE III HUMAN RIGHTS **7**

Human rights – meaning and significance, International law on human rights, Covenant on civil and political rights; Covenant on Economic, social and cultural rights – protocol, UN mechanism and agencies, watch on human rights and enforcement – role of judiciary and commission, Right to information Act 2005 – evolution – concept – practice.

MODULE IV CORPORATE AND LABOUR LAWS **7**

Corporate laws – meaning and scope – laws relating to companies, Companies Act 1956 – collaboration agreement for Technology transfer, Corporate liability – Civil and criminal – Industrial employment (standing orders) Act 1946, Industrial Disputes Act, 1947, Workmen's Compensation Act 1923, The Factories Act, 1948 – Industry related other specific laws.

MODULE V CONTRACTS AND ARBITRATION 9

Types of contract – standard form of contracts - General principles under Indian Contract Act, 1872 – protection against exploitation – judicial approach to contracts, Arbitration and conciliation – meaning, scope and types, model law, judicial intervention, international commercial arbitration – arbitration agreement, arbitration tribunal – powers and jurisdiction, enforcement and revision, Geneva Convention, Awards, Confidentiality.

MODULE VI LAWS RELATED TO IPR 8

IPR – Meaning and scope, International Convention – Berne and Parrys Conventions, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator, Securing of International patents.

Total Hours : 45

REFERENCES:

1. Jain M.P, “Indian Constitutional Law”, Wadhwa & Co., (2005)
2. Subhash G. & Kashyap, “Our Constitution : An introduction to India’s Constitution and Constitutional Law”, 3rd Edition, National Book Trust, India (2001)
3. Agarwal H.D., “International Law and Human Rights”, Central Law Publications, (2008).
4. Meena Rao, “Fundamental Concepts in Law of Contract”, 3rd Edition, Professional offset, (2006).
5. Ramappa, “Intellectual Property Rights Law in India”, Asia Law House (2010)
6. Avtar Singh, “Company Law”, Eastern Book Co., (2007).
7. Rustamji R.F., “Introduction to the Law of Industrial Disputes”, Asia Publishing House.
8. Acts : Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

OUTCOMES:

Students will be

- familiar with Indian Constitution and Governance of our country, local and International redressal mechanism.
- familiar with intellectual property related laws.
- able to apply corporate laws, important industrial and labour laws of our country.
- able to take up managerial, professional, ethical, social and economic responsibilities.

ENB2282 CONFIDENCE BUILDING & BEHAVIORAL SKILL L T P C
(Common to all B.Tech Programmes) 0 0 2 1

OBJECTIVES:

- To enable the students to develop communication skills for verbal communication in the work place.

Topics Outline:

This course is practical oriented one and exercises will be given to the students group users /individually depending upon the aspect considered. The following aspect will form the broad outline content of the syllabi. The exercises will be designed by the faculty member and coordinated by the overall course coordinator.

Lab Activities:

- Introduction: Soft skills definition, examples
- Verbal communication: Case study, communication and discussion
  - Prepared speech
  - Impromptu speech
  - Debate: Case studies - Attitude and Behavior: role play and exploration
  - Ability to ask for help – communication and team work
- Manners and etiquette
  - Organization and Planning
  - Time keeping
  - Conduct in workplace
  - Conscientiousness
  - Work output
  - Professionalism
  - Motivation
- Ownership of tasks
- Adaptability/flexibility

Assessment:

The assessment will be continuous and portfolio based. The students must produce the record of the work done through the course of the semester in the individual classes. The portfolio may consist of a) the individual task outline and activities, b) worked out activities c) Pre-designed sheets which may be provided by the Faculty member. The portfolio will be used by the Faculty member for assessment. The course coordinator in consultation with the course committee shall decide at the beginning of the semester, the number of exercises, method of assessment of each and the weightage for the end semester assessment.

OUTCOMES:

The students should be able to:

- Develop verbal communication skills.
- Debate with other students confidently.
- Communicate effectively their ideas.

PEB2215	POLYMER SYNTHESIS LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To impart practical skills in synthesizing different polymers.
- To provide hands on experience in different polymerization techniques like bulk, emulsion, solution and suspension polymerization.
- To impart skill in identifying suitable method for polymerization.

LIST OF EXPERIMENTS:

1. Preparation of phenol – formaldehyde (Novalac) resin.
2. Preparation of phenol – formaldehyde (Resol) resin.
3. Preparation of Urea formaldehyde resin.
4. Preparation of Bisphenol – A epoxy resin.
5. Preparation of Unsaturated polyester resin.
6. Preparation of a polyester using Diethylene glycol & adipic acid.
7. Bulk polymerization of styrene.
8. Emulsion Polymerisation of styrene.
9. Solution Polymerisation of acrylonitrile.
10. Solution Polymerisation of vinyl acetate.
11. Suspension Polymerisation of Methyl methacrylate.
12. Copolymerisation of styrene and methyl methacrylate

Total hours : 45

OUTCOMES:

At the end of the course, students will be able to

- Synthesize thermoplastics and thermosetting polymers.
- Develop new polymers and chemically modify the existing polymers based on specific property requirements.

PEB2216 POLYMER CHARACTERIZATION LAB – I

L	T	P	C
0	0	3	1

OBJECTIVES:

- To provide skills in identification of plastics and rubbers by simple physical and chemical methods.
- To impart fundamental knowledge in analyzing the basic physical and chemical properties of the polymers.

LIST OF EXPERIMENTS:

PART I

1. Identification of Plastics:

   PE, PP, PS, PVC, PVA, PA6, PA66, PET, PBT, PF, UF and MF.

2. Identification of Rubbers:

   NR, BR, SBR, IR, IIR, CR, NBR and Silicone rubber.

PART II

1. Determination of molecular weight of polymers by viscosity method.
2. Determination of viscosity by Brookfield Viscometer.
3. Determination of epoxy equivalent.
4. Determination of acid value of polyester resin.
5. Determination of hydroxyl value of polyol.
6. Determination of K – value of PVC resin.

Total hours : 45

OUTCOMES:

At the end of the course, students are able to

- Identify the plastics and rubbers by simple physical and chemical methods.
- Segregate different plastics based on density variations.
- Predict the fundamental properties governing the polymers by physical and chemical methods.

SEMESTER V

PEB3101 PLASTICS PROCESS ENGINEERING

L	T	P	C
3	1	0	4

OBJECTIVES:

- To provide fundamental knowledge of the equipment and process of injection molding.
- To enhance the understanding of the significance of different molding process.
- To introduce extrusion and blow moulding machineries and process.
- To impart knowledge of advances in thermoforming and rotational moulding.

MODULE I INJECTION MOLDING **10**

Introduction – Theory of injection moulding – Moulding machine components – Clamp mechanism, hydraulic clamping, Injection unit – Feed system, screw and barrel, check valve and nozzle, screw design, Orientation in injection moulding and its effect, processing parameters and their effect on product quality, process control in injection molding – open loop, close loop and PID control of injection moulding machines. Trouble shooting in injection moulding.

MODULE II FUNDAMENTALS OF EXTRUSION MOLDING **10**

Fundamentals of extrusion process–basic operation of single screw and twin screw extruders, analysis of flow through extruder, drag flow, pressure flow and total flow extruder design, extruder drives: types and selection, screw design– construction and operation, different type of screws, barrier screws. Process control variables, Viscoelastic properties and die swell, effect of process parameters on product.

MODULE III EXTRUSION PROCESSES **10**

Extrusion of Pipes, profile extrusion, extrusion line for cable industries, Film extrusion–blown film, cast film, flat film and sheet film extrusion process. Filament and fiber extrusion process, Coating and lamination, Co–extrusion, effects of machine and process variables on different processes. Process control of extrusion process, trouble shootings for extrusion processes.

MODULE IV COMPRESSION MOULDING 7

Types and procedure of compression molding, moulding materials, bulk factor, effect of preheating, number of cavities based on rate of production, basic principles of compression mould design, advantages and disadvantages of compression moulding.

MODULE V BLOW & TRANSFER MOULDING 11

Basics of blow moulding – process variables–Injection and stretch blow moulding, extrusion blow moulding, process control for blow molding, faults in blow moulding process. Transfer moulding: Basic principle and moulding cycle, Types of transfer moulding, Pot and transfer moulding, molding defects, process parameters and their effect on product quality, moulding defects, causes and remedies, clamping tonnage calculation ,advantages and limitations.

MODULE VI THERMOFORMING & ROTATIONAL MOLDING 12

Thermoforming – Types – Vacuum forming, pressure forming and mechanical forming processes, thermoforming machineries, hot strength, cooling and trimming the parts, trimming operations. Calendaring operations – types of calendar, calendaring faults and their origin.

Rotational moulding – Basic process, materials and products parameters, temperature, speed, cooling, effect on product quality, control system, rotational moulding equipment, drive, batch type and continuous type machines. Rotational moulding process analysis – mould temperature rise, heat and melt flow in rotational moulding, cycle time calculations.

Total Hours : 60

TEXT BOOKS:

1. M.L.Berins “Plastic Engineering Handbook”, Society of Plastic Industries, Chapman & Hall NY 1991.
2. D.V.Rosato,”Injection molding handbook”, Academic Publishers Boston 2nd edition 1995.
3. Stanley Middleman, “Fundamentals of Polymer Processing”, Mcgraw – Hill.1977
4. James F.Carley “Plastics Extrusion Technology Hand book”, Industrial Press Inc.1989.

5. Michaeli.W, “Extrusion Dies for Plastics and Rubbers”, 3rd edition, 2003.

6. Ottamer Baundu and William Andrew “Stretch Blow Molding”, 2nd edition, 2011.

7. M.N.Subramanian, “Basics of Troubleshooting in Plastics Processing: An Introductory Practical Guide”, Willey Scrivener, 1st edition, 2013.

REFERENCES:

1. Chris Rauwendaul, “Polymer Extrusion”, Hanser Publication, Munich,1987.

2. Mcklevy.J, “Polymer Processing”, John Willey, New York, 1962.

3. Lee.N, “Blow Molding Design Guide”, 2nd edition, Hanser Publication, 2008.

OUTCOMES:

At the end of the course, the students will be able to

- Explain the process involved with injection, compression, blow molding processes.
- Demonstrate single and twin screw extruders and their working principle.
- Identify the various process parameters that influence plastic processing.
- Find solutions for various processing faults of plastic processing.

PEB3102 RUBBER SCIENCE AND TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge in chemistry, manufacturing technology, compounding, vulcanization, properties and applications of different elastomers.
- To equip with knowledge of selecting suitable rubber materials for specific engineering applications.

MODULE I THERMODYNAMICS OF RUBBER ELASTICITY 8

Rubber elasticity – basic concepts and behaviors – elasticity of single molecule – elasticity of three dimensional networks – second order stress – elastic behavior under small deformation – Energy driven and entropy driven elasticity – entropic and energetic contributions to the elastic force in rubbers – statistical mechanical theory.

MODULE II GENERAL PURPOSE NATURAL RUBBER 4

Natural rubber – latex tapping – processing – conversion of latex in to dry rubbers – classification based on technical specifications – properties – compounding – applications.

MODULE III GENERAL PURPOSE SYNTHETIC ELASTOMERS 9

Styrene Butadiene Rubber (SBR) – Manufacture and structure properties of different SBR's – compounding – vulcanization – applications. Synthetic polyisoprene, Polybutadiene, EPDM, Butyl rubber – Manufacture – structure influence on properties – compounding – vulcanization and applications.

MODULE IV HIGH VOLUME HIGH PERFORMANCE ELASTOMERS 8

Manufacture – properties, compounding, processing, vulcanization and applications of Chloroprene Rubber (CR) – Acrylonitrile Butadiene (Nitrile) Rubbers – Acrylic Rubbers (ACM) – Chlorinated & Chlorosulphonated Polyethylenes – Ethyl vinyl acetate.

MODULE V LOW VOLUME HIGH PERFORMANCE ELASTOMERS 8

Silicone Elastomers – Manufacture – Structure & Properties – Compounding and applications – Liquid Silicone Rubbers – Room Temperature Vulcanizing Rubbers (RTV).

Fluro elastomers – Manufacture – Structure & Properties – Compounding and applications. Polyurethane elastomers – various types – components for manufacture – polymerization – properties – compounding – processing – applications.

MODULE VI THERMOPLASTIC ELASTOMERS 8

Requirements for thermoplastic elastomeric behavior – Different methods of preparation – SBS and SIS Block copolymers – Thermoplastic Polyurethane elastomers – Thermoplastic – co – polyesters – Thermoplastic elastomers based on Plastics – Rubber Blends – Dynamic Vulcanization.

Total Hours : 45

TEXTBOOKS:

1. James E. Mark, Burak Erman, Mike Roland "Science and technology of rubber", Elsevier Academic Press, 2013.
2. Brendan Rodger, "Rubber Compounding: Chemistry and Applications", CRC Press, 2004.
3. John S. Dick, "Rubber Technology – Compounding and testing for performance", Carl Hanser Verlag, Munich 2001.
4. J.A.Brydson, "Rubber Materials and Their Compounds", Elsevier Applied Science, 1988.
5. Maurice Morton, "Rubber Technology", Van Nostrand Reinhold Co., New York, 1987.
6. C.M.Blow and Hepburn, "Rubber Technology and Manufacture", Butterworths, London, 1971.

OUTCOMES:

At the end of the course, students will be able to

- Describe the chemistry, manufacturing technology, compounding, vulcanization, properties and applications of different elastomers.
- Identify suitable rubber materials for various engineering applications.

PEB3103 POLYMER TESTING TECHNOLOGY

L	T	P	C
3	1	0	4

OBJECTIVES:

- To introduce various test methods followed during testing of polymers.
- To provide knowledge of incoming inspection of various raw materials to conform the test certificate.
- To impart knowledge of testing new products to analyze the failure modes.
- To impart skill in interpreting test results.

MODULE I BASIC CONCPET IN TESTING **8**

Specification and Standards – National and International Standards – Advancement in testing technology – preparation of test specimens – conditioning and test atmospheres.

MODULE II MECHANICAL PROPERTIES **15**

Basic understanding of stress–strain behavior of plastic materials. Short term mechanical properties – tensile strength – compressive properties – impact properties – shear strength – abrasion resistance – fatigue resistance – hardness. Long term mechanical properties – creep – stress relaxation – permanent set.

MODULE III THERMAL PROPERTIES **12**

Vicat softening temperature – heat distortion temperature – coefficient of expansion – thermal conductivity – brittleness temperature – flammability – transition temperature measurements.

MODULE IV ELECTRICAL AND OPTICAL PROPERTIES **12**

Dielectric strength – dielectric constant – dissipation factor – volume and surface resistivity – arc resistance – electromagnetic interference (EMI) – radio frequency interface (RFI) shielding – conductivity measurements.

Refractive index – light transmittance and haze – photo elastic properties – color – gloss.Chloroprene Rubber (CR) – Acrylonitrile Butadiene (Nitrile) Rubbers – Acrylic Rubbers (ACM) – Chlorinated & Chlorosulphonated Polyethylenes – Ethyl vinyl acetate.

MODULE V WEATHERING AND PERMEATION PROPERTIES 8

Major environmental factors affecting plastics – accelerated weathering test – outdoor weathering of plastics – microbiological attack. Water absorption test – chemical resistance – environmental stress cracking resistance – gas permeability – moisture absorption – salt spray and staining resistance.

MODULE VI TESTING OF PRODUCTS 5

Plastic films & sheets – pipes – foams – containers – failure analysis – introduction to nondestructive testing of plastic products.

Total Hours: 60

TEXTBOOKS:

1. Vishu Shah, "Handbook of Plastics Testing and Failure Analysis" — 3rd edition. John Wiley, NY, 2007.
2. Roger.P.Brown, "Hand Book of Polymer Testing", Marcel Dekker inc, New York, 1999
3. Nicholas P.Cheremisinoff, "Product Design and Testing of Polymeric Materials", Marcel Dekker, Inc, New York, 1990
4. Roger P. Brown, "Physical Testing of Rubber", Interscience, New York, 1966.

OUTCOMES:

At the end of the course, students will be able to

- Perform various tests for evaluating the properties of plastic materials.
- Identify the suitable test method for predicting product performance and to analyze the failures.
- Interpret test results for data generation.
- Prepare test reports.

PEB3104 STRENGTH OF MATERIALS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To provide a fundamental knowledge of stress induced in materials due to various loadings.
- To develop the ability to draw shear force and bending moment diagrams for beams.
- To provide understanding of stress analysis of thin and thick cylinders subjected to internal fluid pressure.
- To impart knowledge of deriving and solving problems on deflection of beams and columns.

MODULE I TENSION AND COMPRESSION **10**

Elasticity: Stress and strain, compressive, tensile, shear and bearing stress – Stress – strain diagram, Hooks law, modulus of elasticity, modulus of rigidity, bulk modulus of rigidity, bulk modulus, Poisson's ratio. Relationship between elastic constants and temperature stresses, composite bars.

MODULE II MOMENT OF INERTIA **10**

Properties of section, calculation of areas, centroid, neutral axis, moment of inertia, modulus of section, radius of gyration with reference to structural shapes.

MODULE III SHEAR FORCE AND BENDING MOMENT **10**

Types of beams: Supports and loads, shear force and bending moment – relationship between load shearing forces and bending moment. Bending moment and shear force diagram for cantilever, simple supported and over hanging beams.

MODULE IV STRESSES IN BEAMS AND SHAFTS **10**

Bending and shear stresses. Torsion in solid and hollow shafts – combined bending and torsion.

MODULE V THIN AND THICK CYLINDERS **10**

Biaxial state of stresses – Thin cylinders and spheres and thick cylinders and spheres subjected to internal pressures.

MODULE VI DEFLECTION OF BEAMS **10**

Deflection – deflection of beams in simple cases column and struts – long and short columns – axial loading – effect of end conditions – equivalent length and slenderness ratio – Euler and Rankine formulae.

Total Hours : 60

TEXTBOOKS:

1. R.S. Khurmi, “Applied Mechanics and Strength of Materials”, S.Chand & Co., (6th ed), New Delhi, 1987.
2. R. K. Bansal, “A Textbook of Strength of Materials” Laxmi Publications (P) Ltd, New Delhi, 2010.

REFERENCES:

1. Popov E.P, “Engineering Mechanics of Solids”, Prentice – Hall of India, New Delhi, 1997.
2. Beer F.P and Johnston R, “Mechanics of Materials”, McGraw – Hill Book Co, Third Edition, 2002.

OUTCOMES:

At the end of the course, students will be able to

- Calculate the stresses induced in a material due to different loading conditions.
- Locate the centre of gravity and neutral axis of complicated structural shapes.
- Draws shear force and bending moment diagrams of beams with different loading situations.
- Find the critical load in columns of different end conditions and deflection in beams.

GEB3201 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
(Common for all B.Tech Programmes) 3 0 0 3

OBJECTIVES:

- To impart the basic scientific knowledge on the environment and human impacts on various elements of environment and assessment tools.

MODULE I PHYSICAL ENVIRONMENT 8

Earth's surface – the Interior of Earth – Plate Tectonics – Composition of the Crust: Rocks – formation and types, Soils – formation and components – soil profile.

Atmosphere – structure and composition – weather and climate – tropospheric airflow.

Hydrosphere – water budget – hydrological cycle – Rainwater and precipitation, River Water and solids, Lake Water and stratification, Seawater and solids, soil moisture and groundwater.

Bioelement cycling – The Oxygen cycles – the carbon cycle – the nitrogen cycle – the phosphorous cycle – the sulfur cycle sodium, potassium and magnesium cycles.

MODULE II BIOLOGICAL ENVIRONMENT 7

Cellular basis of life – prokaryotes and eukaryotes – cell respiration – photosynthesis – DNA and RNA – genetically modified life

Population dynamics – population – population growth – survival and growth curves – population regulation – future of human population

Biological communities – Five major interactions: competition, predation, parasitism, mutualism and commensalism – Concepts of habitat and niche – natural selection – species richness and species diversity – ecological succession and climax.

Ecosystem and Biomes – Food Chains and food webs – biomagnifications – ecological pyramids – Trophic levels – Energy flow in ecosystem – ecosystem stability – Terrestrial and aquatic biomes.

MODULE III IMPACTS ON NATURAL RESOURCES AND CONSERVATION 9

Biological resources – nature and importance – direct damage – introduced species – Habitat degradation, loss and fragmentation – Values of biodiversity – hotspots of biodiversity, threats to biodiversity – endangered and endemic species of India – conservation of biodiversity, in – situ and ex – situ conservation

Land Utilization – past patterns of land use – Urban and Industrial development – deforestation, salinisation, soil erosion, and desertification – Modern Agriculture and Impacts

Waste management – types of solid wastes: domestic, municipal, industrial and e – wastes – disposal options – reduce, recovery, reuse – waste minimization, cleaner production technology.

MODULE IV IMPACTS ON WATER AND AIR AND CONSERVATION 8

Water pollution – organic oxygen demanding wastes – anthropogenic phosphate and eutrophication – Ground water contamination – Usage of fertilizer and pesticides– acid rain –acid mine discharges – toxic metals – organochlorines – endocrine disrupting substances – treatment process – Rain water harvesting and watershed management – manmade radionuclide's – thermal pollution

Atmospheric pollution – primary and secondary pollutants – anthropogenic, xenobiotic, synergism, sources and sink, residence time, levels and impacts of major pollutants – processes leading to smog, acid rain, global warming, stratospheric ozone depletion – Noise pollution and abatement.

MODULE V IMPACTS ON ENERGY AND CONSERVATION, ENVIRONMENTAL CRISIS 8

Energy – Renewable and non renewable energy resources – thermal power plants – nuclear fuels, fossil fuels, solar energy, wind energy, wave energy, tidal energy, ocean thermal energy, hydropower, geothermal energy, biomass energy.

Environment crisis – state of environment in developed and developing countries – managing environmental challenges for future – disaster management, floods, earthquake, cyclone and landslides.

MODULE VI ENVIRONMENTAL IMPACT ASSESSMENT AND SUSTAINABILITY **5**

Environmental Impact Assessment – Impacts: magnitude and significance – steps in EIA – methods – precautionary principle and polluter pays principle – role of NGOs and Public – value education –Environment protection act (air, water, wild life) and forest Conservation act

Concept of Sustainability – Sustainable Development – Gaia Hypothesis – Traditional Knowledge for sustainability.

Total Hours : 45

TEXTBOOKS:

1. Andrew R. W. Jackson and Julie M. Jackson, “Environmental Science (The Natural Environment and Human Impact)”, Pearson Education Limited, Harlow, Essex, England, 2000.
2. G Tyler Miller, Jr., “Environmental Science (Working with the Earth)”, Thomson Brooks/Cole 2006.

REFERENCES:

1. David McGeary and Charles C Plummer, “Physical Geology, Earth Revealed”, WCB McGraw Hill, 1998.
2. Bryan G. Norton, “Sustainability: A Philosophy of Adaptive Ecosystem Management”, 2005.
3. Larry W. Canter, “Environmental Impact Assessment”, McGraw – Hill, 1996.
4. James Lovelock, “The Revenge of Gaia: Why the Earth is Fighting Back and How We Can Still Save Humanity”, Penguin UK, 2007.

OUTCOMES:

- Student should have gained basic scientific knowledge on the environment and human impacts on various elements of environment and assessment tools.

ENB3181	CAREER BUILDING & PEOPLE SKILL (Common for all B.Tech Programmes)	L T P C 0 0 2 1

OBJECTIVES:

- To prepare the students for building their competencies and career building skills.

COURSE OUTLINE:

- This course is practical oriented one and exercises will be given to the students group users / individually depending upon the aspect considered. The following aspect will form the broad outline content of the syllabi. The exercises will be designed by the faculty member and coordinated by the overall course coordinator.

LAB ACTIVITIES:

- Preparation for the placement
  - o Group discussions: Do's and Don'ts – handling of Group discussions – What evaluators look for.
  - o Interview – awareness of facing questions – Do's and Don'ts of personal interview.
  - o Selection of appropriate field vis – à – vis personality / interest.
  - o Preparation of Resume–Objectives, profiles vis – à – vis companies requirement.
  - o Enabling students to prepare for different procedures / levels to enter into any company – books / websites to help for further preparation.
  - o Technical interview – how to prepare and face it.
- Workplace skills
  - o Presentation skills
  - o Oral presentations
  - o Technical presentations
  - o Business presentations
  - o Technical writing
  - o Interpersonal relationships – with colleagues – clients – understanding one's own behavior – perception by others.

Total Hours : 45

ASSESSMENT:

- As the course is practical one, it will be assessed using a portfolio based assessment. The students must in consultation with the Faculty member, plan a portfolio of evidence for the above mentioned activities. The students must develop a résumé or résumés that promote own ability to meet specific job requirements and plan their portfolio in a format appropriate to industry they wish to target. The case studies will contain direct observation of the candidate developing career plans, résumés and skills portfolio, reflect written or oral questioning to assess knowledge and problem – solving activities to assess ability to align career aspirations with realistic career goals. The course coordinator in consultation with the course committee will decide the number of exercises and mark to be awarded for each beside the weightage for the end semester assessment.

OUTCOMES:

The course will help the students to

- Develop team work skills.
- Take part effectively in various selection procedures followed by the recruiters.

PEB3105 PLASTICS PROCESSING LAB L T P C
0 0 3 1

OBJECTIVES:

- To impart practical skills in operating hand, semi-automatic and fully automatic injection molding machines, extrusion and blow molding machines.
- To impart knowledge of various process parameters affecting the quality of the product.
- To provide with skills in setting up and optimizing various molding operations.
- To equip with the fundamental knowledge of calculating the output and cycle time of various molding operations.
- To expose to the various process defects of the molding operations.

LIST OF EXPERIMENTS:

1. Hand operated Injection moulding Machine.
2. Semi – automatic injection moulding machine.
3. Automatic Injection moulding machine.
4. Compression moulding operation.
5. Blow moulding – hand operated.
6. Blow moulding semi – automatic.
7. Extrusion moulding processes.
8. Compounding of plastics.
9. Post processing operations.
10. Scrap grinding.

Total Hours : 45

OUTCOMES:

At the end of the course, students will be able to

- Set the process with respect to materials.
- Optimize the process based on the quality of the molded products.
- Calculate the process output and cycle time for different process.
- Identify the defects in the products and suggesting suitable remedial action.

PEB3106 POLYMER CHARACTERIZATION LAB – II

L	T	P	C
0	0	3	1

OBJECTIVES:

- To impart skills in characterizing various physical properties of plastics and rubbers.
- To provide skill for determination of filler content in plastics and rubber products.
- To equip with skill in analyzing the quality of natural rubber latex.

LIST OF EXPERIMENTS:

1. Determination of apparent density and bulk density of polymers.
2. Determination of moisture and volatile content in plastics / rubbers.
3. Determination of water absorption in plastics.
4. Determination gel time and peak exothermic temperature for thermosetting resins.
5. Determination melt flow index.
6. Determination of soluble fraction of phenolics by acetone extraction.
7. Determination carbon black content in plastics / rubber.
8. Determination of non – black filler content in plastics / rubber.
9. Determination of total solid and dry rubber content of NR latex.
10. Determination of total alkalinity of NR latex.

Total Hours : 45

OUTCOMES:

At the end of the course, students will be able to

- Analyze and determine the various physical properties of plastics and rubbers.
- Determine the cure characteristics of the thermosetting resins.
- Characterize the quality of latex and plastic raw materials.

SEMESTER VI

		L	T	P	C
PEB3211	COMPUTER AIDED MODELING AND MANUFACTURING	3	1	0	4

OBJECTIVES:

- To provide understanding of CAD/CAM hardware, computer graphics and geometric modeling.
- To provide a fundamental knowledge of computer aided machining and manufacturing.
- To impart knowledge on integration of computers at various levels during manufacturing.

MODULE I INTRODUCTION **12**

Computers in industrial Manufacturing, Product cycle, CAD/CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices. Computer Graphics: Raster scans graphics coordinate system, database for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

MODULE II GEOMETRIC MODELLING **10**

Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired

MODULE III DRAFTING **8**

Drafting and Modelling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling

MODULE IV COMPUTER AIDED MACHINING **12**

Numerical control, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of machining center, turning center, CNC part programming: fundamentals, manual part programming methods, Computer AIDED part Programming

MODULE V COMPUTER AIDED PRODUCTION PLANNING 8

Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Process Planning, Etrival type and generative type. Material requirement planning, manufacturing resources planning.runner mold.

MODULE VI FLEXIBLE MANUFACTURING SYSTEMS 10

DNC, AGV, ASRS, Flexible manufacturing systems-FMS equipment, system layouts, FMS control, CIM: Integration, CIM implementation, major functions in CIM, Benefits of CIM, Lean manufacturing, Just-in-time.

Total Hours : 60

TEXT BOOKS:

1. P.N.Rao, “CAD/CAM Principles and Applications” - 3rd edition, Tata McGraw Hill, 2010.
2. Ibrahim Zeid/R.Siva Subramanian, “CAD/CAM Theory and Practice” - 2nd edition, Tata McGraw Hill, 2009.
3. J.Y.H.Fuh, “Computer Aided Mold Design and Manufacture”, Marcel Dekker Publication, 2004.

REFERENCES:

1. John. M. Nicholas, “Lean Production Competitive Advantage”, A Productivity Press Book, 2011.
2. P.Radhakrishnan and S.Subramanian, “CAD/CAM/CIM”, 3rd edition. New Age International, 2009.

OUTCOMES:

At the end of the course the students will able to

- Explain the use of CAD/CAM in mold manufacturing.
- Create 3D model and analyze the model.
- Analyze the benefits of CAD/CAM in design and manufacturing.

MSB3181 MANAGEMENT OF BUSINESS ORGANISATION **L T P C**
3 0 0 3

OBJECTIVES:

- To give an exposure to principles of management and organizational structures.
- To introduce concepts of operation and material management.
- To provide an understanding of management of human resources.
- To impart some basic knowledge on marketing, pricing and selling.
- To give an overview of accounting and management of finance.

MODULE I PRINCIPLES OF MANAGEMENT **7**

Functions of management – planning – organizing – staffing – direction – motivation – communication – coordination – control, organizational structures – line – line and staff – matrix type, functional relationships – span of control, Management by Objectives (MBO) – Forms of Industrial ownership

MODULE II OPERATIONS MANAGEMENT **8**

Introduction to operations management – functions of production/operations management – types of production, Overview of facility location – lay out planning, introduction to production planning and control, work study, quality assurance, lean manufacturing and six sigma, plant maintenance and management.

MODULE III MATERIALS MANAGEMENT **8**

Materials Planning - types of inventory, Purchasing function – source selection – negotiation – ordering, Stores management – functions - types of stores – overview of inventory control, Introduction to newer concepts: MRP-I – MRP-II – ERP – JIT.

MODULE IV HUMAN RESOURCE MANAGEMENT **7**

Human Resource Management – objectives – role of Human Resource Manager –manpower planning – selection and placement – training – motivation – performance assessment - Introduction to grievances handling and labour welfare.

MODULE V MARKETING MANAGEMENT 7

Marketing – concept and definition – Elements of marketing mix – PLC - Steps in new product development – Pricing objectives and methods – Advertising types/media – Steps in personal selling – Sales promotion methods - Distribution channels: functions, types.

MODULE VI FINANCIAL MANAGEMENT 8

Financial management functions – introduction to financial accounts, financial performance – profit and loss account statement – balance sheet, budgetary control – meaning – uses – limitations – types of costs – basics of depreciation methods – break-even analysis – meaning – assumption – uses and limitations, working capital – meaning and relevance – Use of operating ratios.

Total Hours : 45

REFERENCES:

1. Bhushan Y.K., "Fundamentals of Business Organisation and Management", Sultan Chand & Co., 2003.
2. Banga & Sharma, "Industrial Engineering & Management", 11th edition, Khanna Publications, 2007.
3. Khanna, O.P., "Industrial Engineering & Management", Dhanpat Rai Publications, 2004.
4. S.N.Maheswari, "Principles of Management Accounting", 16th edition, S.Chand & Company Ltd. 2007.

OUTCOMES:

After doing the course,

- the students would have gained basic knowledge of the concepts of management and the functions of management.
- the students would have learnt fundamentals of the functional areas of management viz., operations management, materials management, marketing management, human resources management and financial management

PEB3212 POLYMER PRODUCT DESIGN L T P C

3 1 0 4

OBJECTIVES:

- To impart knowledge of different international standards used in product design.
- To develop the ability of selecting proper material for plastic products based on the end use.
- To equip with the knowledge of design calculations and optimization techniques in plastic product design.
- To provide understanding of finite element analysis in the design of plastic product design.

MODULE I INTRODUCTION TO PRODUCT DESIGN 6

Introduction to product design, product design methodology, concurrent engineering, product life cycle, voice of customer, technical specification, concept generation, design for X, FMEA

MODULE II PRODUCT FUNCTIONALITY & MATERIAL SELECTION 12

Limits, fits and tolerances – type of fits. Design of ribs and bosses. Design considerations for wall thickness – fillets – sharp corners. Molded threads and their types. Material selection for strength and rigidity – design for stiffness – processing limitations on polymer product design. Mould design for part requirement, stress-strain behavior of polymers, structural design of beams and other structural members. Steps in design, Mohrs circle, BIS standards, theories of failures of biaxial stress system and factor of safety.

MODULE III PLASTIC GEAR & BEARING DESIGN 12

Fatigue loading – type of fatigue loading – S-N curve – simple problems by using fatigue equations – dynamic load response of polymers. Design for cylindrical and spherical pressure vessels by using simple equations. Materials for gears – types – basic terminologies – molded and cut gears – design for strength and durability. Bearings – types of bearings – design consideration – materials – self lubricated plastic materials – p-v rating of bearings.

MODULE IV DESIGN OF SPRINGS & ELASTOMERIC PRODUCTS 10

Design of plastic springs – close coiled – Wahl's equation. Couplings – types. Design of seals and O-rings -flat belts and V-belts. Design of inserts – factors to be considered – mould strength – location of inserts in the part – cracking at the inserts. Design for undercuts – cored out sections in molded parts.

MODULE V DESIGN FOR DAMPING & OPTIMIZATION TECHNIQUES 10

Vibration dampers: Basic vibration damping relations – octave rule for damped systems – under damping – over damping and critical damping, vibration isolation, vibration of single and two rotor systems. Introduction to optimum design – general principles of optimization – problem formulation and their classification.

MODULE VI PRODUCT DESIGN VALIDATION 10

Check for functionality, finite element analysis – introduction – type of analysis –requirement of approximation – weight residual, Ritz and Galerkin method – model building, post processing – simple problems on 2D. Understanding of flow analysis, optimum gate locations, pressure drops across runner, fill analysis, shrinkage and warpage.

Total Hours : 60

TEXT BOOKS:

1. Miller.E, "Plastics Product Design Hand Book, Part A and B", Marcel Dekker, 1982.
2. Robert A. Malloy, "Plastic Part Design for Injection Moulding- An Introduction", Carl Hanser, 1994.
3. R.J.Crawford, Pergamon, "Plastics Extrusion Technology" Hanser, 1997.
4. Kazmer.D, "Injection Mold Design Engineering", Hanser, 2007.
5. James.C.Gerdeen, "Engineering Design with Polymers and Composites", CRC press, 2011.

REFERENCES:

1. M.L. Berins, "Plastics Engineering Handbook", Society of the Plastic Industries, Champman and Hall, NY 1991.

2. Charles A.Harper, “Modern Plastics Handbook”, TataMcGraw-Hill, 1999.

3. Natti S. Rao, Günter Schumacher “Design Formula for Plastic Engineers”, Cincinnati, 2nd Edition, 2004.

OUTCOMES:

At the end of the course, the students will be able to

- Select the plastic materials based on end use applications of products.
- Design plastic products for different working conditions with geometrical and financial considerations.
- Plan the dimensions of plastic gears, bearings and springs.
- Validate a plastic product design by finite element methods.

PEB3213 POLYMER COMPOSITES ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge of materials and matrix systems used in polymer composites.
- To develop understanding of processing, properties and applications of polymer composites.
- To provide knowledge in analyzing and characterizing the composite material for various applications.

MODULE I INTRODUCTION **7**

Introduction – classification- theory of composites – macromolecular behaviour of laminates – stress strain relationships – other mechanical properties.

MODULE II MATERIALS FOR POLYMER COMPOSITES **8**

Various matrix materials used in composites Glass fibres – forms or reinforcements – carbon and Kevlar fibres – inorganic fibres - polyester resins – epoxy resins – phenolic resins – other resins systems- curing of the resins – ingredients in FRP – carbon – carbon composites.

MODULE III PROCESSING METHODS **7**

Hand lay up – spray up – resin injection moulding – bulk moulding compounds – compounding of polyester machines – machinery and equipment – SMC, BMC compression and injection moulding, filament winding – pultrusion – autoclave moulding, matched die moulding – injection moulding and forming of thermoplastic composites.

MODULE IV TESTING OF COMPOSITES - I **7**

Analysis and testing of composites; stress-strain behavior and mechanical properties, durability, factors affecting strength of composites, fracture mechanics, debonding and delamination; thermal behavior, failure analysis.

MODULE V TESTING OF COMPOSITES - II **8**

General test methods for tension, flexural, interlaminate shear stress, compression tests – impact strength -elevated temperature tests – shear modules- determination of void content, resin content and fibre content.

MODULE VI APPLICATIONS OF COMPOSITES **8**

Application in aerospace, automotive industry, marine industry, civil engineering applications, electrical industry etc.

Total Hours : 45

TEXT BOOKS:

1. G Lubin, Hand Book of Composites, 2nd Edition, Van Nostrand Reinhold, New York, 1982.
2. L.holloway Hand Book of Composites for Engineers, Technomic, Lancaster, Pa, 1994.
3. S.M. Lee, Dictionary of Composites Materials Technology, Technomic Lancaster, Pa, 1989.
4. G.Shook, Reinforced Plastic for Commercial Composites, Source Book, Asm, 1986.
5. Kevin Potter, An Introduction to Composites Products, Chapman And Hall Madras India 1997.
6. S.T.Peter, Hand Book of Composites, Chapman And Hall Chennai 1998.
7. Lin/Pearce, High Performance Thermosets, Hanser Publishers, Munich, New York, 1993.

REFERENCES:

1. Burns,R., “Polyester Moulding Compounds”, Marcel Dekker Inc., 1982.
2. Mathews F.L., and Rawlings, “Composite Material Engineering Science”, Chapman and Hall, London, 1994.

OUTCOMES:

At the end of the course, the student will have the

- Fundamental knowledge on various materials used in composites.
- Ability to analyze and characterize polymer composites.
- Knowledge in properties and applications of polymer composites.

PEB3214 PLASTICS PRODUCT DESIGN LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To impart skill with the codes and specifications of BIS.
- To introduce the concepts of limits, fits and tolerances in design.
- To develop skill of assembly drawings of various components using design software.

MODULE I DRAWING STANDARDS **5**

Code of practice for engineering drawing, BIS specifications-Welding symbols, riveted joints, keys and fasteners-Reference to hand book for the selection of standard components like bolts, nuts, screws and keys. Limits, Fits-Tolerance of individual dimensions-Specification of Fits-Screw threads and threaded fasteners.

MODULE II ASSEMBLY DRAWING (USING MODELING PACKAGE PRO-E) **40**

Parts drawing and preparation of assembled views given part details for components using a suitable drafting package. Joints-Cotter joints, Knuckle joints, hooks joints, shaft Couplings: rigid, flexible bearings-journal-foot step thrust or collar bearing, Plummer block. Machine tool components-machine vice, screw jack engine Parts- stuffing box, Connecting rod Valves- Safety valve, relief valve, non-return valve. Generation of part and assembly drawings given in actual polymeric products. Reading of art and assembly drawings.

Total Hours : 45

OUTCOMES:

At the end of the course, the students will be able to

- Use international drawing standards in design.
- Read the part and assembly drawings.
- Develop a solid model which is to be used for stress analysis.
- Provide limits, fits and tolerances in product design.

PEB3215 RUBBER AND COMPOSITE PROCESSING LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To impart skills in developing recipes for rubber products.
- To impart knowledge of identifying the sequence of compounding cycle.
- To equip with the skill of processing rubber products by various molding techniques.
- To introduce the various composite fabrication methods.

LIST OF EXPERIMENTS:

1. Compounding of rubbers
2. Compression molding of rubbers
3. Preparation of latex products
4. Rubber injection molding (TPE's)
5. Compression moulding of thermoset resins
6. Fabrication of FRP laminates by hand lay up
7. RTM operations
8. Post processing operations

Total Hours : 45

OUTCOMES:

At the end of the course, students will able to

- Devise compounding recipes based on the product applications.
- Mould / fabricate different elastomer and composite products.

PEB3216	POLYMER TESTING LAB – I	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To emphasize the importance of testing mechanical and thermal characterization of polymers.
- To provide understanding of the working principle and specifications of the apparatus/equipments used for testing.
- To introduce test procedures of international standards.
- To equip with skill in determining various mechanical and thermal properties of polymers
- To impart skills in interpreting the test results.

LIST OF EXPERIMENTS:

TESTING OF MECHANICAL PROPERTIES OF PLASTICS AND RUBBERS

1. Tensile strength.
2. Compression strength.
3. Flexural strength.
4. Tear strength.
5. Izod and Charpy impact strength.
6. Falling dart impact strength.
7. Hardness – Rockwell and Shore.
8. Abrasion resistance.
9. Rebound resilience.
10. Flex resistance.

TESTING OF THERMAL PROPERTIES of PLSTICS AND RUBBERS

1. Vicat softening point.
2. Heat distortion temperature.
3. Thermal aging property of rubbers

Total Hours : 45

OUTCOMES:

At the end of the course, students will be able to

- Identify the test methods to evaluate the properties of a product/sample.
- Execute various tests to verify the quality of products.
- Interpret the data from the test results.

SEMESTER - VII

PEB4101 MOULD AND DIE DESIGN L T P C
3 1 0 4

OBJECTIVES:

- To impart knowledge of injection mold design calculation procedure.
- To provide understanding of compression and transfer mold design for making plastic products.
- To provide understanding of calculation and design procedure of blow mold and extrusion dies.
- To equip with the knowledge of recent developments in mould and die design.

MODULE I DESIGN OF FEEDING SYSTEM IN INJECTION MOLD 10

Classification of injection molds – number of cavities – selection of injection molding machine – layout of cavities in multi impression moulds. Feed systems – type of runners –design of runners – runner efficiency. Gates – sprue gate, tab gate, overlap gate, fan gate, diaphram gate, ring gate, pin gate, submarine gate, design rules – use of mold flow for gate design.

MODULE II DESIGN OF EJECTION SYSTEMS IN INJECTION MOLD 10

Ejection systems – constructional features of ejector grid, ejector grid lay out, type of ejector elements – pin ejector, valve ejector, D-P – pin ejector, stripper plate ejection techniques, calculation of ejector force, type of sprue pullers. Cooling systems – insert cooling systems, baffle cooling systems, bubbler cooling systems, heat rod and heat pipe systems, cooling time calculation and cooling channel layout.

MODULE III DESIGN OF TWO & THREE PLATE MOLDS 10

Design and construction features of two and three plate molds, mold materials. Actuation techniques – finger cam, dog leg cam, cam track actuation, split movement calculations, Type of locating rings, guide pillars, clamping tonnage and shot weight estimation. Calculation of number of cavities based on clamping tonnage and shot weight.

MODULE IV COMPRESSION & TRANSFER MOLD DESIGN 10

Classification of compression moulds – factors that influence thermo setting

molding – design and construction features of compression molds – mold materials – design of mold cavity. Transfer molding – types, design of pot and plunger, feed system, economic determination of number of cavities, loading chamber design, heat and energy requirement to heat the mold, advantages and disadvantages of compression and transfer molds.

MODULE V BLOW MOLD DESIGN **10**

Blow mold design – material selection, mold cooling, mold venting, pinch-off, parison diameter calculation, wall thickness, blow ratio. Molds for blow molding, molds for injection stretch blow molding, molds for thermo forming and rotational molding. Design and constructional features of different type of parison dies. Design of Hot and Cold runner mold.

MODULE VI EXTRUSION DIE DESIGN **10**

Extrusion die design: Basic consideration in die design, constructional features of rod die, cross head pipe die, offset pipe die, centre fed blown film die, spiral mandrel blown film die, flat film dies, sheet dies, fish tail die, coat hanger die and various type of profile dies.

Total Hours : 60

TEXT BOOKS:

1. R.G.W.PYE, “Injection Mould Design”, SPE Publication, 1986.
2. Menges Mohren, “How to Make Injection Molds” Hanser Publication, New York, Second Edition, 1986.
3. M.V.Joshi, “Dies for Plastic Extrusion” Macmillan India Ltd. First Publication1984.
4. Laszlo Sors and Imre Balazs, “Design of Plastics Moulds and Dies”, Elsevier, 1989.

REFERENCES:

1. J.Harry Dubois, “Plastics Mold Engineering Handbook” Wayne.I.Pribble Publisher, Nergi Bossi.Spa, 1987.
2. Herbert Rees, “Mold Engineering” by Hanser Publishers, Munich Vienna, N.Y1995.
3. Gastrow, Unger.P, “Injection Molds for Engineers”, Hanser Publications, 2006.

OUTCOMES:

At the end of the course the students will be able to

- Select suitable material for making moulds and dies.
- Calculate the dimensions of various components in mould and die.
- Design injection moulds according to the plastic product.
- Design feed systems and ejection systems for any mould.
- Design blow moulds and dies based on product design specifications.

PEB4102 POLYMER REACTION ENGINEERING

L	T	P	C
3	1	0	4

OBJECTIVES:

- To introduce the basic concepts in designing the reactors based on the applicability in polymer industries.
- To equip with the knowledge in optimization methods using genetic algorithm.
- To provide clear understanding of control systems used in the reactors.

MODULE I KINETICS OF REACTIONS 12

Elements of Chemical Reaction Engineering: Introduction to chemical kinetics. Representation of expression for reaction rate, Temperature dependent and concentration dependent. Batch reactor Interpretation of Batch Reactor data for various types of reactions taking place in constant volume and variable volume batch reactors.

MODULE II POLYMER REACTION ENGINEERING CONCEPTS 12

Ideal polymerization reactors: Batch & semi batch reactor, CSTR and PFR. Molecular weight distributions (qualitative and quantitative analysis) in CSTR and PFR for addition and condensation polymerization.

MODULE III OPTIMIZATION OF POLYMERIZATION REACTORS 8

Optimization of polymerization reactors: poly (methylmethacrylate), poly(vinyl chloride), poly(ethylene terephthalate) and Nylon 6 (using Pontrygon maximum principle and Genetic Algorithm).

MODULE IV SUSPENSION POLYMERIZATION 8

Introduction – Surface active agents, Mixing Phenomena, Bead and Powder Suspension Polymerization Process, Population balance modeling – Drop breakage and coalescence process, Numerical solution of PBE, Physical properties and phase equilibrium calculations – physical and transport properties, Effect of operating conditions on PSD, Scale-up of suspension polymerization reactors.

MODULE VEMULSION POLYMERISATION – REACTOR ENGINEERING 10

Emulsion polymerization fundamentals – Description of the process, Mechanisms, thermodynamics and kinetics, Reactor Engineering – Emulsion polymerization reactors, Predicting the performance of emulsion polymerization reactors, Implementation of emulsion polymerization, Residual monomer and VOC removal, Scale-up. Inverse, Mini, Micro and Dispersion polymerization.

MODULE VI CONTROL OF POLYMERIZATION REACTORS 10

Characterization of the control problems. Classical polymerization reaction control problems – Control of reaction rates and of reactor temperature, Control of monomer conversion and polymer production, Control of molecular weight averages and MWDs, Control of copolymer composition, Control of particle size and PSDs, control of other reaction parameters. On-line monitoring – online sensors for monitoring polymer quality, state estimation. Calculation of control action and control schemes – open – loop control, closed – loop control, data handling.

Total Hours : 60

TEXT BOOKS:

1. Octave Levenspiel, “Chemical Reaction Engineering”, Wiley, 3rd edition 1998.
2. Asua J. M, “Polymer Reaction Engineering”, Blackwell Publishing Ltd, UK, 2007.
3. Scott Fogler H, “Elements of Chemical Reaction Engineering”, Prentice Hall International, 1999.
4. Smith J M, “Chemical Engineering Kinetics”, McGraw-Hill, 1981.
5. Kalynmoy Deb, “Optimization: Principle and Practice, Multi-objective Optimization using Evolutionary Algorithms” Prentice Hall of India, 1st edition Wiley, 1995.
6. Schork F J, Deshpande P B and Lefew K W, Marcel Dekker, “Control of Polymerization Reactors”, Taylor & Francis, 1993.

REFERENCES:

1. Anil Kumar and Gupta R P, “Fundamentals of Polymer Science and Engineering”, McGraw Hill, 1998.
2. Ray W.H, Szekeley .I, “Process Optimization”, 1st edition, Wiley, 1973.

OUTCOMES:

At the end of the course, the students will be able to

- Describe the various types of reactors used in polymerization.
- Choose a reactor and determine its size, conversion for a given application.
- Describe the different control systems used in polymerization reactors.

PEB4103 POLYMER BLENDS AND NANOCOMPOSITES

L	T	P	C
3	1	0	4

OBJECTIVES:

- To enhance the understanding of polymer miscibility, blend characteristics and mechanism of toughening.
- To equip with the knowledge of processing, characterization methods, properties and industrial applications of nanocomposites.

MODULE I MISCIBILITY AND MORPHOLOGY **10**

Classification – study of polymer blends and alloys on the basis of miscibility – criteria for selection of polymer. Compatibility of blends: principles of solubility and compatibility, Compatibilizers. Thermodynamics of miscibility – mechanical compatibility – phase morphology, phase separation behavior – morphology of blends and its determination- electron microscopy- domain structure.

MODULE II RHEOLOGY OF POLYMER BLENDS **10**

Principles and methods involved in the preparation of different polymer blends– introduction to rheology of polymer blends – its relevance in processing – rheology – phase morphology relationships and their relevance – micro rheology – rheological models –solution, and suspension models.

MODULE III COMPATIBILIZATION METHODS **10**

Introduction of specific interacting groups-in-situ polymerization compatibilization – Non reactive compatibilization – reactive compatibilization. IPN's – synthesis, Thermodynamics and morphology of blends, properties and applications – enhancement of polymer miscibility – utilization of miscible polymers. Commercial blends, Block Copolymer & Thermoplastic Elastomers. Industrial applications of polymer blends.

MODULE IV TOUGHENED PLASTICS **10**

Toughening of polymers-mechanism of toughening of thermoplastics and thermosets. Specific examples for toughened thermoplastics and thermosets – influence of processing on toughness.

MODULE V NANOCOMPOSITE TECHNOLOGY **10**

Plate-like nanofillers, Nanoparticle fillers, Carbon nanotubes- Inorganic filler –

polymer interfaces – Modification of interfaces- Processing of polymer nanocomposites – Direct Mixing, Melt mixing Solution Mixing, In-Situ Polymerization, In-Situ Particle Processing, Ceramic/Polymer Composites Metal/Polymer Nanocomposites, Natural nanobiocomposites, Biomimetic nanocomposites, and Biologically inspired nanocomposites.

MODULE VI CHARACTERISATION TECHNIQUES AND PROPERTIES 10

X-ray diffraction – WAXD, principle, basal spacing, crystal structure, intercalation and exfoliation, Transmission Electron Microscopy, principle and application, Atomic force microscopy – principle and application, Nuclear magnetic resonance spectroscopy – application to nanocomposites

Properties of nanocomposites – Mechanical properties, modulus and the Load – Carrying Capability, Failure, Stress and strain, Toughness, Glass Transition& Relaxation Behavior, Abrasion and wear resistance, Permeability, Dimensional Stability, Thermal Stability and Flammability Electrical and Optical Properties.

Total Hours : 60

TEXT BOOKS:

1. Lloyd M.Robeson, “Polymer Blends” Hanser Gardner Publications, U.S.A, 2007.
2. Leszek A. Utracki, “Polymer Alloys and Blends: Thermodynamics and Rheology” Hanser Gardner Publications, 1989
3. P. M. Ajayan, L. S. Schadler, P. V. Braun, “Nanocomposite Science and Technology”, WILEY-VCH Verlag GMBH, 2003.

REFERENCES:

1. C.B. Bucknall and D. R. Paul, “Polymer Blends: Volumes I and II”, John Wiley and Sons, New York, 2000
2. D R. Paul and C.B. Newman, “Polymer Blends Vol. I & II”, Academic Press Inc, 1978.
3. Polymer Blends and Alloys, “Gabriel O. Shonaike and George P. Simon”, editors. Marcel Dekker, 1999.

OUTCOMES:

At the end of the course, students will be able to

- Tailor-make the properties by selecting the right choice of polymers and nanofillers as per the need of the requirements.
- Develop novel polymer blend and their nanocomposites to achieve synergistic properties.
- Characterize the various properties of polymer blends and nanocomposites.

PEB4105 MOULD AND DIE DESIGN LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To impart basic knowledge and skill in using design software in mold design.
- To develop proficiency in computer aided design software for die design.
- To develop the ability to analyze the design of a mould.
- To impart skill in using mold flow software for mold design.

MODULE I INJECTION MOULD DESIGN BY USING PRO-E 8

Design Calculations; No. of cavities, Selection of injection moulding machine, Shot capacity, clamping force, Injection pressure and tool strength calculation for Two Plate and Three Plate moulds.

MODULE II COMPRESSION MOULD DESIGN BY USING PRO-E 8

Design calculations: Economic determination of number of cavities, design of mould cavity and loading chamber related to Open type and Semi-Positive type compression moulds.

MODULE III TRANSFER MOULD DESIGN BY USING PRO-E 7

Design Calculations: Pot calculation, runner and gate dimensions, bulk factor and shrinkage allowances for thermo set plastics related to Pot transfer and Plunger transfer mould.

MODULE IV BLOW MOULD DESIGN USING PRO-E 7

Design Calculations: Clamping force, Pinch-off, head die design and Parison diameter calculations related to blow moulds.

MODULE V EXTRUSION DIE DESIGN USING PRO-E 7

Design calculations for pipe and profile dies.

MODULE VI MOULD FLOW ANALYSIS 8

Three dimension modeling using Mould Flow software – Flow analysis, Cooling analysis, Shrink/ Wrap analysis and Stress analysis

Total Hours : 45

REFERENCE:

1. R.G.W.PYE, “Injection Mould Design”, SPE Publications, 2002.

OUTCOMES:

At the end of laboratory course the students will be able to

- Design molds and dies using Pro-E software.
- Identify the failures in mold and die design.
- Analyze flow, cooling provisions, shrinkage and stress level in plastic products using mold flow software.

PEB4106	POLYMER TESTING LAB – II	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To emphasize the importance of testing electrical and optical properties of polymers.
- To impart skill in determining various electrical and optical properties of plastics.
- To equip with the knowledge of different ASTM standards and testing procedures.

LIST OF EXPERIMENTS:

TESTING OF ELECTRICAL PROPERTIES.

1. Volume and surface resistivity.
2. Arc resistance
3. Comparative tracking index.
4. Dielectric strength.
5. Dielectric constant.

TESTING OF OPTICAL PROPERTIES

1. Refractive index.
2. Haze.
3. Gloss

TESTING OF MISCELLANEOUS PROPERTIES

1. Environmental stress crack resistance
2. Chemical resistance.
3. Flammability.

Total Hours : 45

OUTCOMES:

At the end of the course, students will be able to

- Identify the test method to evaluate the properties of the product/sample.
- Execute various tests to verify the quality of products.
- Interpret the data from the test results.

PROFESSIONAL ELECTIVE COURSES

PEBX01 THERMOPLASTIC POLYESTERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To develop an understanding of the manufacturing methods of various thermoplastic polyesters.
- To provide an overview on the fabrication and dying methods of polyester fibers.

MODULE I INTRODUCTION **8**

Introduction: Conformation and crystal structure – PET, PBT, PEN, PTMT, Morphology of the glassy amorphous state and the effect of deformation and annealing. Polymer synthesis-direct esterification, trans-esterification, acylation and allied reactions, ring opening polymerisation and other reactions for polyester synthesis. Industrial manufacturing thermoplastics – polyesters – structure property relationship.

MODULE II LIQUID CRYSTAL AND BIOMEDICAL POLYESTERS **7**

Special Aspects: Chemistry and properties, processing and applications – Liquid crystal polyesters, polyester elastomeric copolyesters (Block copolymer, polyester, graft copolymer) – polyester blends, composites, biomedical polyesters, bio-absorbable polyester, photo cross linkable polyester, polyester amides – Recycling and ecological aspects.

MODULE III POLYETHYLENE TEREPTHALATE - I **7**

Polyethylene Terepthalate: History, development and commercialization, commercial composition, polymer formation, process technologies and new developments, properties of PET, molecular, structural and phase characteristics as they effect the PET use properties (chemical structure and conformation, thermal transition, crystal structures molecular weight crystallisation, mechanical and electrical properties, chemical resistances and weather).

MODULE IV POLYETHYLENE TEREPTHALATE- II **8**

Polyethylene Terepthalate: Polyester blends, alloys and composites and their commercial relevance specialty grades with compositions and use. PET -

Processing - processing parameters-processes mechanieries and other relevant details-injection Moulding, extrusion, blow Moulding, coating products of blends and reinforced compounds. Performance properties and applications.

MODULE V POLYBUTYLENE TEREPTHALATE 7

Polybutylene Terepthalate: Introduction, history, development and commercialization commercial compositions – polymerisation – transerfication -polycondensation, solid polycondensation - process technologies and new developments available grades with compositions and use - properties of PBT blends and compounds - morphology, crystallisation, influence of temperature on properties-modification of properties-blending with mechanical property (stiffness, tensile strength, elongation at break, impact resistance, creep, fatigue), thermal stability, hydrolytic stability, UV stability, stability against chemicals flammability, electrical and rheological properties - processing-production of blends and reinforced compounds injection Moulding, extrusion, blow mulling and coating commercial applications.

MODULE VI POLYESTER FIBRES 8

Polyester Fibres: Introduction-properties (chemical compositions, structural – relationship of structure, property and processing) mechanical properties, chemical, optical of thermal properties. Fibre and yarn manufacturing-spinning process – Rheology, spinning equipment, spinning and drawing, drawing theory, drawing procedure, stable yarn manufacture, lubrication, analysis and testing methods. Polyester films: Introduction –structure properties – manufacture – grades – commercial applications.

Total Hours : 45

TEXT BOOK:

1. Stoyko Fakirov, “Handbook of thermoplastic polyesters”, Volume I & II, Wiley VCH Verlag, 2002.

REFERENCES:

1. Olagoke Olabisi, “Hand book of thermoplastics”, Marcel Dekker NY, 1997.
2. Encyclopedia of Polymer Science and Engineering, John Wiley and Sons N.Y, 1988.

OUTCOMES:

At the end of the course students will be able to,

- Apply knowledge in process methodologies of thermoplastic polyester materials.
- Select the right choice of polyester resin to meet the required performance of innovative polymeric products.
- Characterize and optimize the properties of polyester fibers and films.

PEBX02 NYLON TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge in manufacturing and properties of nylons
- To impart knowledge on fibre spinning process
- To equip with the knowledge of chemical modification and blending of nylons

MODULE I HISTORY AND DEVELOPMENT OF COMMERCIAL NYLONS 8

Polyamidation-Principle of Polyamidation – Process Technologies – hydrolytic polymerization – Ionic Polymerisation, Solid phase polymerisation and other polymerisation techniques. Chemistry – Polymerisation and equilibria, Kinetic molecular mass, deformation of chemical attack.

MODULE II PHYSICAL STRUCTURE AND CHARACTERISATION 7

Structure properties relationship – crystallizing, melting temperature, Tg, solubility, molecular weight, melt viscosity, degradation and stabilization, Electrical and mechanical properties.

Characterisation: Identification, composition/moisture analysis, separation techniques, BGGmolecular mass and distribution, IR, NMR and X-ray diffraction.

MODULE III MELT SPINNING AND FIBRE PROCESSING 7

Fundamentals of Melt Processing: Measurements of viscosity, PVT relationships, importance of moisture, effect of molecular mass, shear, temperature, additives and channel shape. Applications of Rheological data to flow situation.

Processing techniques of melt processing: Processing reagents, material handling and drying, injection moulding, extrusion, blow moulding and monomer processing.

Other processing Techniques: Powder coating, blending and solution coatings. Secondary Treatments: Assembly, Moisture conditioning, mechanical surface clearing, and decorating.

MODULE IV CHEMICAL MODIFICATION 8

Physical change – copolymerization – transparent nylons, filled and reinforced nylons, toughened nylons, fire retardant nylons, plasticized and lubricated nylons, additives for heat stabilization, processing and color and other modifications.

Polymer Blends Alloys And Composites: Properties – factors affecting the properties of nylons, mechanical, thermal electrical and optical properties, moisture absorption, dimensional stability and density, environmental resistances and impact, flammability and failure analysis.

MODULE V COMMERCIAL NYLON BLENDS AND THEIR APPLICATIONS 8

PA6, PA66, PA46, PA6/2,PA11 &PA12Raw materials – preparation – polymerization – Methods of manufacturing, modifications, processing (methods, procedure, processing parameters etc.,)

MODULE VI NYLON PROPERTIES AND STABILITY 7

Properties of materials- tribological, durability, water absorption dimensional stability, immersion resistance, thermal, electrical, optical properties, flammability, resistance to permeation - applications.

Total Hours : 45

REFERENCES:

1. Malvin I. Kohan, “Nylon Plastics Hand Book”, Hanser publisher, 1995.
2. Nicholar P. Chermisinof, “Hand Book of Engineering Polymeric Materials”, Marcel Dekker inc. N.Y. 1997.

OUTCOMES:

At the end of the course the students will have the ability to

- Identify the manufacturing process for the development of nylons for specific applications.
- Select nylon based on the properties for various applications.
- Compare the properties of various types of nylons.
- Analyse the various parameters employed in the fibre spinning process.

PEBX03 BIODEGRADABLE PLASTICS L T P C
3 0 0 3

OBJECTIVES:

- To explain the environmental concern related to polymer degradation.
- To emphasize the need for biodegradable polymers.
- To impart knowledge of biodegradation mechanisms.
- To be make familiar with the synthesis of biodegrable polymers from various sources.
- To introduce the testing methods developed for biodegradation study.
- To provide knowledge of the applications and future prospects of biodegradable polymers.

MODULE I CHEMISTRY AND ENVIROMENT FOR BIODEFGRADATION 8

Plastics & Environment – degradation – bio-degradation of plastics – introduction to enzymes – enzyme nomenclature – enzyme specificity – physical factors affecting the activity of enzymes – enzyme mechanism, chemical degradation initiates biodegradation – hydrolysis of synthetic biodegradable polymers.

MODULE II BIODEGRADABLE POLYMERS FROM DIFFERENT SOURCES 4

Renewable resources – synthetic & natural plastics – Biodegradable starch based polymers – Microbial Polyamino acid – Lignum – Aliginate based cellulose / PLA / PHA Polyester – Polysaccharides – Chitins & chitosan.

MODULE III STARCH BASED PRODUCTS 9

Development of technology – manufacture of master batch – conversion technology – processing precautions – moisture and temperature – rheological considerations, cyclic conversion process, physical properties of products – sample preparation – physical testing methods.

MODULE IV BIOPOLYESTERS 9

Introduction, History, biosynthesis, Isolation – solvent extraction – sodium hypo chloride digestion, enzymatic digestion, Properties – crystal structure – nascent morphology, degradation – Intracellular biodegradation – extra cellular biodegradation – thermal degradation – hydrolytic degradation – environmental degradation – effects of recycling, applications – future prospects.

MODULE V APPLICATIONS OF BIODEGRADABLE POLYMERS 8

Emerging applications areas: Coated Papers, Agricultural Mulch Film, Shopping Bags, Food Waste Film and Bags, Consumer Packing Materials, Landfill Cover Film, Other applications.

MODULE VI TEST METHODS & STANDARDS FOR BIODEGRADABLE PLASTICS 7

Introduction – criteria used in the evaluation of biodegradable polymers – tiered systems for evaluating biodegradability, choice of environment, choosing the most appropriate methodology, description of current test methods – screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, other methods for assessing biodegradability – petri dish screen – environmental chamber method – soil burial tests, Test method developments for the future.

Total Hours : 45

TEXT BOOKS:

1. S.N.Shalaby & K.J.L. Burg, “Absorbabale & Biodegradable Polymers”, CRC Press, 2003.
2. G.J.L. Griffin, “Chemistry and Technology of Biodegradable Polymers”, Blackie Academic Professional, 1994.
3. Gerald Scott & Dan Gilad, “Degradable Polymer – Principles & Applications”, Chapman & Hall, 1995.
4. Y.Doi and K.Fukuda (Eds), “Biodegradable Plastics and Polymers”, Elsevier, 1994.

REFERENCE:

1. Abraham J.Donb “Handbook of Biodegradable Polymers”, Harvard Academic Publishers Australia, 1997.

OUTCOMES:

At the end of the course, students will be able to

- Describe the mechanism of biodegradation process.
- Develop suitable method to synthesis biodegradable polymers from various bacterial sources.
- Conduct test for analyzing the biodegradation process.
- Suggest applications and future prospects of biodegradable polymers.

PEBX04 BIOMEDICAL POLYMERS L T P C

3 0 0 3

OBJECTIVES:

- To provide understanding of the biomedical polymers.
- To equip with the knowledge of polymeric biomaterials for cardio vascular, ophthalmic, dental and orthopedic applications.
- To introduce various polymers having biocompatibility with human body.

MODULE I BIOMATERIALS 7

Biomedical polymers, biomaterials, biocompatibility, different applications, stabilization, inflammation and wound healing, blood clotting system, biological responses to implants, implant design and applications.

MODULE II BIOMEDICAL POLYMERS 8

Criteria for the Selection of Biomedical Polymers, Physicochemical Aspects of the Blood Compatibility of Polymeric Surface. Biomedical Polymers from biological source, Poly hydroxy Alkanoic Acids, Microbial polysaccharides, Silk, Collagen , Microbial Cellulose, Hyaluronic Acid, Synthetic Polymers such as PMMA, Silicon Rubber, Polyethylene, Natural Rubber, Hydrogels.

MODULE III BIOMEDICAL APPLICATIONS OF POLYMERS – I 7

Permanent implants for function – Orthopedics, Cardio Vascular, Respiratory Patches And Tubes, Digestive System, Genitourinary System, Nervous System.

MODULE IV BIOMEDICAL APPLICATIONS OF POLYMERS- II 7

Plastic and Reconstructive, stability of polymers in biological environments, plastics used in surgical applications, Polymer Membranes, Polymer Skin, Polymeric Blood.

MODULE V POLYMERIC LENSES 8

Polymer lenses, contact lenses, hard Lenses, gas Permeable Lenses, flexible Lenses, soft lenses, equilibrium swelling, absorption and desorption, oxygen permeability, types of Soft lenses, manufacture, cleaning and disinfection.

MODULE VI DENTAL POLYMERS **8**

Dental Polymers, dental applications, denture bases, denture reliners, crown and bridge resins, plastic teeth, mouth protectors, maxillotacial prosthetic materials, restorative materials, polyelectrolyte based restoratives, sealants, adhesives, dental impression and duplicating materials.

Total Hours: 45

TEXT BOOKS:

1. Severian Dumitriu, “Polymeric Biomaterials: Structure and Function”, Volume-I, RC Press; 1st edition, 2013.
2. Mike Jenkins, “Biomedical Polymers”, Woodhead Publishing Limited, 2007.
3. Glen S. Kwon, “Polymeric Drug Delivery Systems”, Taylor & Francis Group, 2005.
4. Emo Chiellini, “Biorelated Polymers”, Springer, 2001.

REFERENCES:

1. Toyoichi Tanaka, “Experimental Methods in Polymer Science: Modern Methods in Polymer Research and Technology (Polymers, Interfaces and Biomaterials)”, Academic Press, 1999.

OUTCOMES:

At the end of the course the students will be able to

- Identify polymeric materials for biomedical applications
- Suggest methods of modification of polymers for biomedical applications
- Select polymer for specific biomedical applications.
- Analyze the stability of biopolymers in biological environments.

PEBX05 ELCTROACTIVE POLYMERS L T P C
3 0 0 3

OBJECTIVES:

- To impart t knowledge of electrical conduction mechanism in electro-active polymers.
- To develop understanding of synthesis, properties and applications of conducting polymers.

MODULE I INTRODUCTION 8

Introduction to conducting polymers: Discovery of polyacetylene – concept of doping and n-type – polarons and bipolarons – conduction mechanism – redox type polymers (electro – active polymers).

MODULE II SYNTHESIS TECHNIQUES 7

Synthesis of conducting polymers: Chemical synthesis – electrochemical synthesis – template synthesis – precursor synthesis – soluble polymers (colloids and dispersions) – advantages and disadvantages of various synthesis methods.

MODULE III CHARACTERIZATION METHODS 7

Characterization methods: elemental analysis for dopants – IR – UV (electro chemical), measurement of conductivity- scanning electron microscopy (SEM).

MODULE IV ADVANCED CHARACTERIZATION METHODS 7

Eectrochemical characterization – cyclic voltometry – electrochemical quartz crystal microbalance (EQCM) – probe beam deflection (PBD) – Langmuir – blodgett technique.

MODULE V APPLICATIONS 8

Applications : rechargeable batteries, lights emitting diodes – gas sensors – bio sensors – photo voltaic energy devices – micro electronics (PCB fabrications) electro catalysis – applications – proposed – antistatic coatings – electro chem. Mechanical devices – super capacitors.

MODULE VI RECENT TRENDS IN CONDUCTING POLYMERS 8

Recent trends in conducting polymers: Functionalized conducting polymers (second generation polymers) – super conductors (inorganic – organic hybrid structures) – conducting polymers based on nano composites.

Total Hours : 45

REFERENCES:

1. R. G. Linford, "Electro Chemical Science and Technology of Polymers", Elsevier applied sciences, London,1990.
2. M. Schlvxinger and M. Paunovic, "Modern Electro Plating", John Wiley and sons Inc., New York, 2000.
3. Hari Singh Nalwa (ed.), "Handbook of Organic Conductive Molecules and Polymers", John Wiley & sons, England, 1997.

OUTCOMES:

At the end of the course students will have the ability to

- Demonstrate knowledge of mechanism of electrical conduction in electroactive polymers.
- Analyse the properties of conducting polymers with respect to the structure
- Choose conducting polymers for specific applications

PEBX06 SPECIALTY POLYMERS L T P C
3 0 0 3

OBJECTIVES:

- To develop an understanding on the properties and applications of high temperature resistant specialty polymers.
- To introduce the students with various methods for imparting conductivity in polymers.
- To provide an insight on to the various conducting polymers and ionic polymers.

MODULE I HEAT RESISTANT POLYMERS 7

Temperature and fire resistant polymers, fluoropolymers, aromatic polymers, poly sulphide, polysulphones, polyesters, polyamides, polymides, polyketones, heterocyclic polysiloxanes.

MODULE II IONIC POLYMERS AND LCPS 8

Synthesis, physical properties and applications, ion-exchange hydrophilicity electrometric ionomers based on poly styrene, polyethylene, PTFE and with polyaromatic backbones, polyelectrolytes for ion exchange, based on carboxylates, polymers with integral ions, polyelectroyte complexes, biological and inorganic ionic polymers. Liquid crystalline Polymers, Preparation, structure and properties of various liquid crystalline polymers applications.

MODULE III CONDUCTING POLYMERS 8

Conducting polymers, light sensitive -photo conducting polymers, polymers in non linear optics, polymers with piezoelectric, pyroelectric and ferroelectrics properties, photo resist for semiconductor fabrication, polymer coating in electronics.

MODULE IV CHARACTERISATION OF CONDUCTING POLYMERS 8

Characterization of conducting polymers – electroanalytical techniques – cyclic voltammetry, chronoamperometry and chronocoulometry, spectral methods – use of UV – Raman spectroscopy.

MODULE V APPLICATIONS OF CONDUCTING POLYMERS 7

Conducting polymers in microelectronics – corrosion and ESD protection, EMI shielding and lithography. LED-rechargeable batteries – artificial muscles – electrochromic devices – sensor devices – conductive composites.

MODULE VI POLYMER CONCRETE 7

Polymer impregnated concrete ultra high modulus fibers, polymeric binders for rocket propellants, polymer supported reagents and catalysts.

Total Hours : 45

TEXT BOOKS:

1. Manas Chanda, Salil.K.Roy, "Industrial Polymers, Specialty Polymers, and Their Applications (Plastics Engineering)", CRC Press, 2012.
2. Gordon G. Wallace, Peter R. Teasdale, Geoffrey M. Spinks Leon A. P. Kane-Maguire, "Conductive Electroactive Polymers: Intelligent Materials Systems", 2nd Edition, CRC Press, 2002.
3. Manas Chanda, Salil.K.Roy, "Plastics Technology Handbook", 2nd edition, Marcel Dekker, New York, 1993.
4. Matrin.T.Goosey, "Plastics for Electronics", Elsevier, Applied Science, 1985.
5. R.W. Dyson, "Specialty Polymers", Chapman & Hall, 2nd edition, 1998.

REFERENCES:

1. H.F.Mark, (Ed), "Encyclopedia of Polymer Science & Engineering", John Wiley & Sons, New York, 1989.
2. J A Brydson, "Plastics Materials", Butterworth-Heinemann, 1999.

OUTCOMES:

At the end of the course the students will be able to

- Identify specific method to synthesize polymers for high temperature applications.
- Demonstrate the knowledge of analyzing electrical properties of conducting polymers.
- Select polymeric materials for electrical and electronic applications.

PEBX07 INJECTION MOULDING TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a fundamental knowledge on working principle of an injection molding machine.
- To impart knowledge on components of hydraulic circuit.
- To develop the understanding of hydraulic and electrical locking mechanisms.
- To introduce the advanced injection molding process and use of computer in injection molding operations

MODULE I INJECTION MOLDING OPERATION & PLASTIC MATERIALS **8**

Basics of injection molding-Basic principles of reciprocating machines, plunger type machines, single stage plunger machines, efficiency calculation for plunger machines, plunger-plunger machines, pre-plasticizing machines. Screw drives – hydraulic motor, electric motor, drive characteristics and speed reducers, comparison between hydraulic and electrical drives, horse power requirement. Clamping mechanisms-clamp force rating, toggle clamps, hydraulic clamps, operation of hydraulic clamp, comparison between hydraulic and toggle mechanisms, vertical and horizontal clamping. Machine specification. Molding conditions for PE, PP, PVC, Nylon, ABS, Polycarbonate etc.

MODULE II HYDRAULIC MECHANISMS AND CIRCUITS **8**

Hydraulic mechanisms – Pascal's law, principle hydraulic jack, fluid power symbols, advantages and disadvantages of hydraulic systems. Hydraulic oil requirement – lubricating properties, viscosity, effect of low viscosity, maintenance of hydraulic oil – filtration circuit, connectors – maintenance of connectors, water hammer, packing and seals, fluid power calculations. Hydraulic valves – Two way valves, three way valves, four way valves, check valves, control valves, pressure intensifiers, accumulators. Hydraulic circuits – clamp control, injection control circuits and reciprocating screw circuits.

MODULE III ELECTRICAL MECHANISMS AND CIRCUITS **7**

Basic installation data for electric power, installation cost, rating, power factor.

Protective devices – Fuses and circuit breakers. Control relays – Relay activation, relay failure. Contactors – overload protectors for contactors. Electrical motors – motor failure, mechanical and electrical faults of motor, switch activation. Timers – Types (Mechanical, thermal, dashpot, electronic, solid state, electric motor drive). Electrical heating – Tubular heaters, catridge heaters, band type heaters, temperature controllers. Motor control circuits.

MODULE IV INJECTION MOLD DESIGN AND OPERATION 8

Mold types – flow of plastic melt – cold slug well, melt orientation. Cavity melt flow – Fill rate, melt temperature, mold temperature, packing pressure, mold geometry, number of cavities. Sprue, runner and gate systems. Mold components – Ejector mechanisms, ejector pin strength, sprue pullers, angle pins. Stripper plate ejection, cam actuation, sprue bushing, locating ring, top and bottom ejection, mold venting, cooling, under cuts, strength requirement for molds and deformation of molds.

MODULE V COMPUTER OPERATION AND AUXILLIARY EQUIPMENT 7

Benefits of CAD/CAM/CAE for molding, modeling, mold flow analysis. Computer capabilities for part and mold design, finite element method. Large scale geometry manipulation. Model and drawing modes/associativity. Verification of geometric relationships, automatic dimensioning and tolerance analysis.

Material handling – Basic principles of pneumatic conveying, air movers, hoppers, pneumatic venture conveying. Chilling and cooling – Heat transfer calculation, calculation of cooling load and determination of water loads. Granulators – Auger granulators, granulating and performance. Mold dehumidification – Dew point, mold surface temperature, effect of change in air pollution, air conditioning and Desiccant dehumidification, part handling equipment, Trouble shooting in injection molding process.

MODULE VI SPECIALISED INJECTION MOLDING PROCESSES 7

Co-injection molding, two colour molding. Gas injection molding – basic processes and procedures, advantages and disadvantages, molding aspects. Liquid injection molding, reaction injection molding. Structural foam molding – materials, characteristics, design analysis, blowing agents for foam, methods of processing SF with chemical blowing agents and gas blowing agents. Injection blow molding and injection blow molding with rotation. Tandem molding machine.

Total Hours : 45

TEXT BOOKS:

1. M.L.Berins, “Plastic Engineering Handbook”, Society of Plastic Industries, Chapman & Hall NY, 1991.
2. D.V.Rosato,”Injection Molding Handbook”, Academic Publishers Boston 2nd edition, 1995.
3. Stanley Middleman, “Fundamentals of Polymer Processing”, Mcgraw-Hill, 1977.
4. J.Crawford “Plastics Engineering”, Butterworth-Heinemann, 3rd edition, 2006.

REFERENCES:

1. Chris Rauwendaul, “Polymer Extrusion”, Hanser Publication, Munich, 1987.
2. James F.Carley, “Plastics Extrusion Technology Handbook”, Industrial Press Inc.1989.

OUTCOMES:

At the end of the course the students will have the knowledge on

- Different types of injection molding machines.
- Working of clamping and ejector mechanism.
- Hydraulic and electrical mechanism and circuits.
- Material handling equipment in advanced injection moulding machine.

PEBX08	EXTRUSION AND BLOW MOULDING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart fundamental knowledge of single and twin screw extruder components and design criteria for dies.
- To provide an understanding of advances in blow molding operations and control systems.
- To develop the ability to use CAE in extrusion and blow molding operations.

MODULE I EXTRUSION MACHINES AND LINE 7

Extruder type and construction, features of extruder and production line – single screw and twin screw extruder – extruder components, barrel and feed unit, drive system, auxiliary equipment, melt flow characteristics, melt flow and rheology screw design, barrel screw melting action, venting, processing performance, wear and screw inspection.

MODULE II DIE DESIGN AND PERFORMANCE 8

Die land, manifold & die, die design, co-extrusion dies, special dies, construction materials, maintenance, trouble shooting, process control and computer: sensors, accuracy, intelligent processing, dies for flat film, blown film, sheet, wire and cable, pipe and tubes etc.

MODULE III BLOW MOLDING OPERATION 7

Basics in blow molding – extrusion, Injection, Stretch blow molding, bi-axially oriented PET, PVC, Co-extrusion. Industrial blow molding, multi layer containers via coextrusion, coinjection, coating. Plastic molding material. Interfacing machine performance, start-up and shut down procedures. Blow molding presses – selection of blow molding presses. PET bottle specifications, how to mold heat resistant PET bottles, blow mold temperatures and PET bottle shrinkage, parison temperature, bottle weight, neck design.

MODULE IV CONTROLS FOR BLOW MOLDING 8

Plasticating screw process – metering screw, feed section, transition section, melting, shear rate, pressure holding. Mixing devices – dulmage mixer, mixing pins, union carbide mixer, pulser screw and barrier screw. Machine controls –

temperature, placement of sensors, dual sensors, on/off control, proportional control, automatic reset. Type of sensors – thermocouple, resistance temperature detector, RPM speed regulator, process control – melt temperature control, melt pressure, melt pump, parison programming and length control. Weight and thickness control of blow molded products.

MODULE V CAD/CAM/CAE FOR BLOWN PARTS 8

Basics of CAD/CAM/CAE in design, Basics of CAD/CAM modeling. Flow analysis, cooling analysis, economic plant operation analysis with CIM. Modeling methods – wire frame, surface and solid modeling. Fundamentals of cooling analysis – cooling the melt, conduction in the mold wall, convection cooling in the water line and combining the three.

MODULE VI AUXILLIARY EQUIPMENT FOR BLOW MOLDING 7

Need of material handling equipment, material handling, dryers, chillers, coolers, refrigerated compressed air dryers, heat pump chillers, mold dehumidification, granulation, blow molding automation, detecting leakage in containers, trouble shooting guidelines and troubleshooting guide lines for auxiliary equipment.

Total Hours : 45

TEXT BOOKS:

1. M.L.Berins, “Plastic Engineering Handbook”, Society of Plastic Industries, Chapman & Hall NY, 1991.
2. Stanley Middleman, “Fundamentals of Polymer Processing”, Mcgraw-Hill, 1977.
3. J.Crawford “Plastics Engineering”, Butterworth-Heinemann, 3rd edition, 2006.

REFERENCES:

1. Chris Rauwendaul, “Polymer Extrusion”, Hanser Publication, Munich, 1987.
2. James F.Carley, “Plastics Extrusion Technology Handbook”, Industrial Press Inc.1989.

OUTCOMES:

At the end of the course the students will be able to

- Describe the various types of extrusion machines and screw design.
- Plan the dies for flat film, blown film, pipe and tubes.
- Explain flow and cooling analysis of blow molded parts.
- State the requirement of auxiliary equipment for blow molding.

PEBX09 POLYMER POST PROCESSING OPERATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide understanding of post processing operations.
- To introduce different painting, printing and coating methods.
- To impart knowledge on assembly of plastic parts, plating and painting.

MODULE I MACHINING AND FINISHING **8**

Deflashing, smoothing and polishing, Routing, milling and turning, Filing grinding and sanding, sawing and cutting, drilling, taping and threading, cleaning and annealing.

MODULE II ASSEMBLY OF PLASTIC PARTS **8**

Mechanical fastening, Adhesive bonding, Thermal welding, Solvent cementing, Welding / Sealing: Hot gas, hot bar, high frequency dielectric, ultrasonic, rotations frictions, vibration, electromagnetic radiation, Microwave, infrared, orbital, friction stir, impulse, bond, hotwire, hot knife & contact – self fastening – press fit, snap fit – adhesive bonding.

MODULE III PLATING **8**

Electroplating process on plastics versus on metals, Material selection for plating of plastic, Importance of surface preparation – Electrode less plating – Plating rack building sequence, Processing steps of interior and exterior plating and their operating parameters, Major functions of chrome deposit, Physical vapor deposition and its advantages.

MODULE IV PAINTING **7**

In-mold decorating process, spray painting, vacuum metallizing process, Laser marking, Hot stamping process, Post-molding finishing operations of hard coating, flocking, and data matrix. Plastic finish specifications.

MODULE V PRINTING **7**

Silk printing, Gravure, Graf wave or offset printing, pad transfer printing, letter press printing, And Dry Offset Printing. Flexographic printing, Labels, decal.

MODULE VI COATINGS **7**

Surface preparation, Surface pretreatment-Coating selection, Coating materials- Application methods – Dip coating, Electocoating, Spray coating, Airless coating, Powder coating, Auto-deposition coating and Other coating methods, Curing and baking methods.

Total Hours : 45

TEXT BOOKS:

1. Rodger Talbert, “Paint Technology Handbook”, CRC Press ,September 13, 2012.
2. Arthur A. Tracton ,”Coatings Materials and Surface Coatings”, CRC Press,2006.
3. Arthur A. Tracton,”Coatings Technology: Fundamentals, Testing, and Processing Techniques”, CRC Press, November 7, 2006.
4. Zeno W. Wicks Jr., Frank N. Jones, S. Peter Pappas, Douglas A. Wicks, “Organic Coatings: Science and Technology”, Wiley-Interscience, 3rd edition,1993.
5. Charles A. Harper, “Modern Plastics Handbook”, McGraw-Hill, 1999.
6. Akira Kobayashi, “Machining of Plastics”, McGraw-Hill, 1990.

REFERENCES:

1. Modern Plastic World Encyclopedia – 2000, Modern Plastics International.
2. Walter Michaeli, “Plastic Processing, an Introduction”, Hanser publications – Munich, 2005.

OUTCOMES:

At the end of the course the students will be able to

- Identify machining and finishing operation for different plastic products.
- Select suitable printing and coating methods based on application.
- Design post processing method for polymer products.

PEBX10 RUBBER PRODUCT MANUFACTURING TECHNOLOGY **L T P C 3 0 0 3**

OBJECTIVES:

To provide comprehensive knowledge in

- The techniques used for manufacturing various rubber products.
- Compound design and various vulcanization methods used to cure the rubber products.
- Trouble shooting during rubber products manufacturing.

MODULE I MANUFACTURING TECHNIQUES **7**

Moulding of rubbers – blank preparation – compression molding – transfer molding – injection molding – extrusion molding – types of extruder – vulcanization methods – calendaring.

MODULE II LATEX PRODUCT MANUFACTING **7**

Principle and types of dipping process – Manufacture of gloves, catheters, balloons – formulations – elastomeric tread production – latex sheeting – latex binders and carpet backing – latex fabric – principle and manufacture of foam by Dunlop and Talalay process – Compound design.

MODULE III FOOT WEAR MANUFACTURING **9**

Types of foot wear – plimsolls – build up shoes – all rubber shoes – DVP shoes – dip shoes – plastic foot wear manufacturing by slush molding – injection molded PVC shoes – hand assembled and hand air vulcanized product – rubber boots manufacture by compression moulding – shoe sole / bottom manufacturing by direct molded process – injection molding of sole and heel units – expanded micro cellular soling – methods of manufacturing microcellular soling – trouble shooting.

MODULE IV BELT & HOSE MANUFACTURING **9**

Conveyor belt – raw materials – belt construction – different grades of belts with their properties and applications – belt selection – manufacturing – vulcanization – belt joining process.

V-Belt – raw materials – processing of various components – rubber, cord, canvas – method of processing of various v-belts.

Hose design & construction – different types of hoses and their manufacturing process

MODULE V CABLES AND SPORTS GOODS MANUFACTURING 7

Elements of polymer insulated cables – designation of cables – cable design – compound design – manufacturing techniques – special purpose cables. Golf ball and tennis ball manufacturing.

MODULE VI RUBBER TO METAL BONDED COMPONENTS 6

Introduction to rubber to metal bonding – raw materials – manufacturing methods – moulding – use of various adhesives.

Total Hours : 45

TEXT BOOKS:

1. J.M.Martin, W.K.Smith, “Handbook of Rubber Technology”, CBS Publishers & Distributors, New Delhi, 2004.
2. A.K. Bhowmick, M.M. Hall and H.A. Benaney, “Rubber Products Manufacturing Technology”, Marcel Dekker Inc, New York, 1994.

REFERENCES:

1. Blow. C.M. and Hepburn C, “Rubber Technology and Manufacture”, Butterworths, 1982.
2. C.W. Evans, “Hose Technology”, Elsevier Applied Science Publishers, 1979.
3. D.C. Blackley, “High Polymer Latices, Volume - I & II”, Applied Science Publishers, London, 1966.

OUTCOMES:

At the end of the course, students will be able to

- Describe the rubber product manufacturing process.
- Propose the compound design for various latex products.
- Identify appropriate molding method for rubber product manufacturing.

PEBX11 TYRE MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

To impart knowledge in

- Tyre compounds, tyre design criteria and manufacturing of tyres and tubes.
- Various deformation and failure mechanism encountered during rolling of tyres.
- Tyre retreading process.

MODULE I TYRE COMPOUNDS **8**

Introduction to tyre technology – tyre compound and fundamental properties – compound development – raw materials for rubber compounding – designing the compound matrix for the reinforced composite.

MODULE II TYRE DESIGN **8**

Function of pneumatic tyre – tyre application – tyre construction – classification of tyres – design feature of tyre – selection of materials – specification of number of plies – designing the cord – tyre shape – tread design.

MODULE III TYRE MECHANICS **8**

Mechanics of rubber – cord rubber composite and its properties, failure mechanism of cord reinforced rubbers composites. Inflation pressure – contact area, tyre deflections – design factors and principles. Rolling resistance, friction, mechanical loss on tyre behavior.

MODULE IV TYRE MANUFACTURING **8**

Tyre manufacturing – Tyre building – green tyre – curing methods – post curing inflation – finishing. Tubeless tyres, Aerotyres & ADV tyres, Cycle tyre. Retreading – criteria – methods of retreading.

MODULE V TUBE MANUFACTURING **6**

Tubes: Principles of tube design – manufacturing of tubes by extrusion, valve jamming, inflation & curing in presses, tube testing.

MODULE VI TYRE TESTING **7**

Tyre testing – tyre performance analysis – tyre durability, noise & vibration.

Laboratory test – drum test, pulley wheel test – destructive & non-destructive testing.

Total Hours : 45

TEXT BOOKS:

1. J.M.Martin, W.K.Smith, “Hand book of Rbber Technology”, CBS Publishers & distributors, New Delhi, 2004.
2. Tom French, Tyre Technology, Bristol: Institute of Physics Publishers, 2002.

REFERENCES:

1. Anil K. Bhowmick, “Rubber Products Manufacturing Technology”, Marcel Dekker, 1994.
2. Rebecca Dolbey, “Advances in Tyre Mechanics”, Rapra Technologies Limited, 1997.
3. I Franta, “Elastomers and Rubber Compounding Materials”, Elsevier, 2012.

OUTCOMES:

At the end of the course, students will be able to,

1. Critically analyze the compound design for tyre and tube manufacturing.
2. Provide solutions for the defects occurred during moulding.
3. Demonstrate the tyre retreading process.

PEBX12	POLYMER RECYCLING AND WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To inform the importance of recycling of plastics waste.
- To impart knowledge of basic methodologies involved in identification and separation of plastic wastes.
- To provide knowledge of recycling of packaging and municipal solid wastes, engineering plastics and thermoset waste materials.

MODULE I IDENTIFICATION AND SEPERATION 8

Plastics production and consumption – Plastic wastes generation source and types – Plastic waste composition , quantities – Plastics identification methods physical , chemical and instrumental – sorting and separation technologies – disposal alternatives – Recycling methods – Primary , Secondary and tertiary recycling of plastics.

MODULE II METHODS OF RECYCLING 7

Size reduction of recycled plastics – cutting / shredding, densification, pulverization and chemical size reduction processes – municipal solid waste and composition – recycling of plastics from urban solid wastes – household waste.

MODULE III RECYCLING OF PACKAGING WASTES 8

Recycling of polyolefins – polyethylene films – Polypropylene battery recycling – Recycling of HDPE fuel tanks – PET recycling methods – PET film recycling – Applications of polyolefin and PET recycling – PVC recycling.

MODULE IV RECYCLING OF ENGINEERING PLASTICS 7

Engineering thermoplastics and their major areas where engineering polymers are recycled – major recyclers of engineering plastics – GE/ Bayer/ MRC Polymers – PC, PBT, Nylon, PPO, ABS and polyacetals and their blends.

MODULE V RECYCLING OF THERMOSETS 8

Recycling of Polymer thermoset composites – regrind processes – SMC scrap – pyrolysis and energy recovery –Types of rubber products – rubber grinding

methods – tyre grinding – rubber crumb applications – Reclaiming and de-vulcanization processes – tyre derived fuel and energy recovery – Pyrolysis of scrap tyres

MODULE VI PROCESSING OF RECYCLED PLASTICS 7

Industrial sector – rheology, density and mechanical properties of recyclable plastics and need for compatibilization – Processing of commingled / mixed plastic waste – super wood, plastic lumber.

Total Hours : 45

REFERENCES:

1. John Scheirs, “Polymer Recycling, Science, Technology and Applications”, John Wiley & Sons, England 1988.
2. Francesco Paolo La Mantia, “Recycling of Plastic Materials” Rapra Technologies, 2002.
3. Ann – Christine Albertson and Samuel J.Huang, “Degradable Polymers, Recycling and Plastic Waste Management”, Taylor & Francis, 1995.
4. Nabil Mustafa, “Plastics Waste Management”, Marcel Dekker, 1993.

OUTCOMES:

At the end of the course students will be able to

- Select suitable recycling method for various plastics waste.
- Identify and analyse the various forms of plastic wastes.
- Demonstrate the knowledge of various recycling processes for plastics and elastomeric wastes.

PEBX13 FIBRE REINFORCED PLASTICS L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge of

- Constituent materials of composites and their functions.
- Different processing, post processing techniques and testing methods.
- Advance applications of Fiber reinforced plastics.

MODULE I MATRIX SYSTEM AND REINFORCEMENT MATERIALS 8

Matrix System and Reinforcement Materials: Basic Materials – Polymeric Matrix System – Polyester And Vinyl Ester Resins – Epoxy Resins – High Temperature Resins – Bismaleimides – Cyanide Esters – Benzyl Cyclo Butene – Acetylene Terminated – Bisnodimide – Aryethynyl Resins – Thermoplastic Resins. Fibre Reinforcements – Glass, carbon, aramide, natural fibres, Boron, Ceramic Fibers – Particulate Fillers.

MODULE II PROCESSING METHODS 7

Processing Methods of Composites: Prepregs, SMC, DMC etc. – Hand Lay-Up; Spray- Up; Bag Molding; Compression Molding, Injection molding, Resin Transfer Molding (RTM); Filament Winding; Pultrusion, Auto Clave Molding; Processing Of Thermoplastic Composites.

MODULE III POST PROCESSING METHODS 7

Post Processing Methods: Cutting, Trimming, Machining, Water Jet Cutting, Abrasive Jet Cutting, Laser Cutting, Joining, Mechanical Fastening And Adhesive Bonding, Painting And Coating.

MODULE IV NONDESTRUCTIVE TESTING OF COMPOSITES 8

Testing of Composites: Non- Destructive Evaluation Methods For Composites Visual, Tap Test, Ultrasonic Methods, X-Ray Imaging, Thermography, Neutron Radiography.

MODULE V TESTING OF COMPOSITES 7

Infrared Thermal Testing, Laser Shear -O- Graphy, Holography and Micro Wave Testing. Mechanical Property Tests: Tension And Compression Testing, Shear, Torsion, Bending –Special Test Methods.

MODULE VI APPLICATION OF COMPOSITES 8

Application of Composites: Land Transportation – Marine Application – Air Craft Applications – Aero Space Applications – Composites in Sports Goods – Composite Bio Materials – Composites In Scientific, Industrial And Commercial Applications. Composites in Construction.

REFERENCES:

1. G Lubin, “Handbook of Composites”, 2nd Ed, Van Nostrand Reinhold, New York, 1982.
2. L.Holloway, “Handbook of Composites for Engineers”, Technomic, Lancaster, Pa, 1994.
3. G.Shook, “Reinforced Plastic for Commercial Composites”, Source Book, ASM, 1986.
4. Kevin Potter,” An Introduction to Composites Products”, Chapman and Hall, 1997.
5. S.T.Peter, “Hand Book of Composites”, Chapman and Hall, 1998.
6. Lin Pearce, “High Performance Thermosets”, Hanser Publishers, 1993.

OUTCOMES:

The students will be able to

- Select reinforcement and matrix materials for the manufacturing of composites for specific applications.
- Select specific manufacturing techniques for various composite products.
- Analyze and identify the property requirements of composites for various applications.

PEBX14 MECHANICS OF COMPOSITES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the basics of macro and micromechanical behavior of a lamina.
- To impart knowledge about failure mechanism in composites.
- To enhance the knowledge in design and testing procedures of composites.

MODULE I MACRO MECHANICAL BEHAVIOUR OF LAMINA 8

Stress-strain relations for anisotropic materials, stiffness, compliances and engineering constants for orthotropic materials, elastic constants of isotropic and orthotropic material, stress-strain relations for plane stress in an orthotropic material,

MODULE II MICRO MECHANICAL BEHAVIOUR OF LAMINA 7

Mechanics of material approach to stiffness i.e. determination of engineering constants for the lamina, Halpin-Tsai equations, elasticity approach to stiffness, mechanics of materials approach to strength, tensile and compressive strength in fiber direction.

MODULE III MACRO MECHANICAL BEHAVIOUR OF LAMINATE 8

Classical lamination theory, laminate code, symmetric laminates, theoretical and experimental angle – ply laminate stiffness, anti symmetric laminates, non symmetric laminates, balanced laminates, quasi-isotropic laminates.

MODULE IV FAILURE THEORIES 7

Biaxial strength criteria for an orthotropic lamina; maximum stress failure criteria, maximum strain failure criteria, Tsai-Hill failure criteria,Hoffman Failure Criteria,Tsai-Wu tensor failure criteria, hygrothermal stresses and strains in unidirectional and angle lamina.

MODULE V TESTING OF COMPOSITES 8

Various tests for compressive and tensile properties – fixtures and methods, three point and four point bending, flexural test methods, in-plane shear test methods, two rail and three rail test methods, inter-laminar shear strength, fatigue tests, pin bearing properties, damage identification using non destructive

evaluation techniques: ultrasonic, acoustic emission, X-radiography, thermography, laser shearography.

MODULE VI DESIGN EXAMPLES AND VIBRATION 7

Design of sandwich structures, design of tension members, compression members, torsional member, beam design, laminate joint – bonded and mechanical, design of composite bolted joints, analysis of laminated plates and beams – bending, buckling and free vibrations: first order shear deformation, higher order shear deformation theory, governing vibration equations for laminated beam.

Total Hours : 45

TEXT BOOKS:

1. Robert Jones, ”Mechanics of Composite Materials”, McGraw Hill Company, 1998.
2. P.K.Mallick, “Fiber Reinforced Composite”, Marcel Deckar,1988
3. Autar K.Kaw, “Mechanics of Composite Materials”, CRC Press, 2005.
4. Bhagwan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, “Analysis and Performance of Fiber Composites, 3rd edition, John Wiley & Sons, 2006.

REFERENCE:

1. M.Mukhopadhyay, “Mechanics of Composite Materials and Structures”, Universities Press, 2005.

OUTCOMES:

At the end of the course, students will be able to

- Analyze the stress - strain relationships of macro and micromechanical behavior of composites.
- Analyze and predict various failure modes of composites.
- Design composite structures based on different loading conditions.

PEBX15 DESIGN OF COMPOSITE STRUCTURE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the various materials for composite structure.
- To equip with the knowledge of sandwich structure technology.
- To provide knowledge in fracture mechanics of composites.
- To impart knowledge in fatigue and damping capacity of composite materials.
- To provide understanding of various manufacturing/fabricating techniques for composite structures.

MODULE I INTRODUCTION **7**

Definition and classification – materials for composite structure – metals, ceramics, glasses, polymers, elastomers and composites.

MODULE II SANDWICH AND CORE STRUCTURE TECHNOLOGY **8**

Applications – wind energy, oilfield, marine, transportation, corrosion, pressure vessels, aircraft, space technology, etc.

MODULE III MECHANICAL PROPERTIES **8**

Strength – tensile, impact, flexural – Hardness – Fatigue- toughness, damping capacity, creep – thermal shock resistance – wear- corrosion. Prediction of mechanical properties.

MODULE IV REINFORCEMENT **7**

Reinforcement materials – type and nature – inorganic and organic – glass fiber, silicon carbide, rock fiber, aramid, boron fiber- matrix interface – metal matrix composites – ceramic matrix Composites – polymer matrix composites.

MODULE V MECHANICS **8**

Fracture Mechanics And Toughening Mechanisms: Energy analysis, Local stresses, Fracture initiation, Impact, Toughening mechanisms.

MODULE VI MANUFACTURING **7**

Fabrication/Moulding – filament winding, fiber placement, hand layup, vacuum bagging, tape laying, pultrusion, resin infusion processes, SMC/BMC machining – Joining - tooling aspects.

Total Hours : 45

REFERENCES:

1. Ever J. Barbero, “Introduction to Composite Materials Design, Second edition Taylor & Francis Group LLC, 2011.
2. Composites Materials: Engineering and Science by F.L. Mattews and R.D. Rawlings, Published by CRC Woodhead Publishing Limited, 2002.
3. Material Selection in Mechanical Design” by M.F. Ash, Pergamon Press, 1992

OUTCOMES:

At the end of the course, the students will be able to

- Select various materials for designing composite structures.
- Apply knowledge of fracture mechanics of composites during designing of composite structures.
- Analyze critically the damping capacity of composite materials.
- Correlate various manufacturing/fabricating techniques for composite structures based on design.

PEBX16 POLYMER BLENDS AND ALLOYS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide understanding on the miscibility of polymers, phase morphology, characteristics of blends and mechanism of toughening.
- To impart knowledge on the properties and applications of polymer blends and alloys.

MODULE I INTRODUCTION **6**

Definition for blends, alloys and copolymers, Reason for blending, classification of polymer blends, and methods of blending, selection criteria of blending; Design of polymer blends.

MODULE II POLYMER MISCIBILITY **9**

Introduction, miscible blends and immiscible blends, difference between miscible and immiscible blends, properties of miscible and immiscible blends, Phase equilibria calculation, Huggins-Flory theory.

Factors affecting miscibility: Thermodynamics, compatibility, solubility parameter, interaction parameter, composition, molecular weight, transition temperature.

MODULE III COMMERCIAL BLENDS AND ALLOYS **7**

Blends of engineering and commodity plastics like PVC/ABS, PVC/SAN, PVC/NBR, PC/PET, PC/PBT, PC/ABS; PPO/HIPS etc. study in detail along with properties and applications.

Interpenetrating Polymer Networks (IPNs): Introduction, classification, method of formation of IPNs, properties and uses, role of cross links, and their importance.

MODULE IV MORPHOLOGY **8**

Introduction, mechanism of phase separation (nucleation and growth and spinodal decomposition), semi-crystalline polymer blends, polymer crystallization, crystallization in miscible polymer blends, influence of liquid/liquid phase separation on the crystallization and morphology.

MODULE V BLEND PREPARATION EQUIPMENTS 8

Mixers' and their various types like banbury, hot and cold mixers, twin screw compounders, and two- roll mills, etc. Design features of these equipments like rotor types, screws and their various types; flow behavior of the plastic material in the mixing equipments, theory of mixing etc.

MODULE VI CHARACTERISATION TECHNIQUES 7

Characterization techniques like differential scanning Calorimetry, UVIR, FTIR, scanning electron micrographs, etc.

Determination of polymer/polymer miscibility – phase equilibria methods, measurement of polymer/polymer interaction parameter, indirect methods, methods of measurements-refractive index, ultrasonic velocity, thermal and optical methods.

Total Hours : 45

TEXTBOOKS:

1. LloydM.Robeson, "Polymer Blends", Hanser gardner publications, U.S.A, 2007.
2. Leszek A. Utracki, "Polymer Alloys and Blends: Thermodynamics and Rheology", Hanser Gardner Publications, 1989.
3. M.J .Folkes and P.S.Hope, Blackiebn, "Polymer blends and alloys", Academic and Professional, Glasgow, 1993.

REFERENCES:

1. C.B. Bucknall and D. R. Paul, "Polymer Blends: Volumes I and II", John Wiley and Sons, New York, 2000.
2. Gabriel O. Shonaike and George P. Simon, "Polymer Blends and Alloys", Marcel Dekker, 1999.

OUTCOMES:

At the end of the course students will have the

- Prospective to select the appropriate combination of polymers to have required synergistic property in the polymer blend.
- Ability to perform rheological studies on the polymer blends.
- Ability to analyse and characterize the morphological behavior of polymer blends.

PEBX17 ADHESIVES AND SURFACE COATINGS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge of various types of adhesives.
- To provide basic concepts of adhesive joint designs.
- To introduce the surface preparation methods for adhesive joints.

MODULE I CONCEPTS AND TERMINOLOGY **7**

Adhesives – concepts and terminology : functions of adhesives, advantages and disadvantages of adhesive bonding, theories of adhesion – mechanical theory, adsorption theory, electrostatic theory, diffusion theory, weak-boundary layer theory, Requirements for a good bond, criteria for selection of adhesives.

MODULE II ADHESIVES TYPES **8**

Adhesives types: Structural adhesives, Urethane structured adhesives, Modified acrylic structural adhesives, phenolic adhesives and modifiers, anaerobic adhesives, cyanoacrylate adhesives, Hot melt adhesives, pressure sensitive adhesives, RTV Silicone adhesives, sealants, water based adhesives. Specialty adhesives, adhesives in aerospace, adhesive in automobile industry, conductive adhesives, adhesives in building construction, adhesive in electrical industry.

MODULE III JOINT DESIGN **7**

Joint design: Stress, types of joints, selection of joint detail, joint criteria, surface preparation of adherents – metals, plastics and rubbers. Adhesive bonding process – methods for adhesives application and bonding equipment, adhesives for specific substrates, testing of adhesives, adhesive specifications and quality control.

MODULE IV INTRODUCTION TO SURFACE COATINGS **8**

Introduction to surface coatings: Components of paints, Pigments, pigment properties, different types, extenders, solvents, oils, driers, diluents, lacquers, varnishes, paint preparation, formulation, factors affecting pigment dispersion, preparation of pigment dispersion.

MODULE V SURFACE COATING METHODS **7**

Different types of paints – classification based on polymeric resin, emulsion, oil and alkyd paints, acrylic paints, epoxy coatings, polyurethane, silicones, formaldehyde based resins, chlorinated rubbers, hydrocarbon resins. Classification based on application, fluropolymers, vinyl resins, appliance furnishes, automotive finishes, coil coatings, can coatings, marine coatings, aircraft coatings.

MODULE VI SURFACE PREPARATION **8**

Surface preparation and paint application: Paint properties and their evaluation – mechanism of film formation, factors affecting coating properties, methods used for film preparation – barrier properties, optical properties, ageing properties, rheological properties and adhesion properties of coatings.

Total Hours : 45

REFERENCES:

1. Gerald L. Schreberger, “Adhesive in manufacturing”, Marcel Dekker Inc., New York, 1983.
2. W.C. Wake, “Adhesion and the formulation of adhesives” Applied Science Publishers, London, 1976.
3. Swaraj Paul, “Surface Coatings”, John Wiley & Sons, NY, 1985.
4. George Mathews, “Polymer Mixing Technology”, Applied Science Publishers. London, 1982.
5. Sheilds, “Hand book of adhesives”, Butterworth’s, 1984.

OUTCOMES:

At the end of the course, students will be able to

- Suggest suitable adhesives and joint design for specific applications
- Select appropriate coatings for specific applications
- Identify the defect in coatings and suggest suitable solutions
- Identify relevant surface preparation method and application techniques based on the coatings selected.

PEBX18 PAINTS AND SURFACE COATINGS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge in manufacturing of paints.
- To develop understanding of properties of paints and coatings.
- To introduce methods of characterizing paints and coatings.

MODULE I MANUFACTURE OF PAINTS **8**

Introduction: Components of paints - paint preparation, formulation - factors affecting- pigment dispersion - preparation of pigment dispersion –manufacture – pigments- pigment properties, different types, selection - dispersion and color matching of pigments, extenders – solvents - solvent properties- oil, driers, resins, diluents, additives, factors affecting: viscosity interfacial tensions, chemical reaction, living micro-organisms.

MODULE II PROPERTIES OF PAINT FILM **7**

Light: reflection, refraction, diffraction, colour science, additive color mixing, subtractive color mixing, gloss, specular gloss, bloom gloss, surface uniformity, chromaticity diagrams for color measurement.

MODULE III POLYMER BASED COATINGS **7**

Types: classification based on polymeric resin, emulsion, oil and alkyd paints, acrylic paints, epoxy coatings, polyurethanes, silicones, formaldehyde based resins, chlorinated rubbers, acrylics, and hydrocarbon resins. Classification based on application. fluoropolymers, vinyl resins, appliance finishes, automotive finishes, coil coatings, can coatings, marine coatings, aircraft finishes.

MODULE IV SURFACE PREPARATION AND PAINTING **8**

Surface cleaning methods, chemical conversion treatments, paint application, brushing, dip coating, flow coating, roller coating, spray painting, electro deposition, chemiphoretic deposition.

MODULE V PROPERTIES OF PAINT FILM **8**

Paint properties: mechanism of film formation, physical drying, oxidation drying,

chemical drying, factors affecting coating properties, film thickness, film density, internal stresses, pigment volume concentration (PVC).

MODULE VI CHARACTERISATION TECHNIQUES 7

Film preparation, barrier properties, mechanical properties and optical properties of coatings - color, gloss, hiding power, ageing properties -factors affecting viscosity of paints - effect of rheological behavior on paint performance. Adhesion properties of coatings - factors affecting adhesive bond - thermodynamics of adhesion - destructive methods - non destructive methods - properties such as floating, silking, cratering, foaming, skinning, flame retardancy, slip resistance and storage stability.

Total Hours : 45

TEXT BOOKS:

1. Swaraj Paul, “Surface Coatings: Science and Technology”, Wiley – Interscience 1985.
2. R.Lambourne. “Paint and Surface Coatings – Theory and Practice”, Ellis Horwood Chichester 1987.

REFERENCE:

1. Arthur A. Tracton, Coating Technology Handbook, Third Edition, Taylor and Francis, 2005.

OUTCOMES:

At the end of the course students will be able to

- Demonstrate knowledge in manufacturing technology of paints.
- Identify various characterization methods to assess the quality of paints and coatings.
- Select suitable type of paints and coating methods for specific applications.

GENERAL ELECTIVES

GEBX01 DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give an exposure to various environmental hazards and disasters: and various concepts and principles to manage disaster.
- To give exposure to various environmental policies & programs in India for disaster management.

MODULE I ENVIRONMENTAL HAZARDS **7**

Environmental hazards, Environmental Disasters and Environmental stress-Meaning and concepts. Vulnerability and disaster preparedness.

MODULE II NATURAL DISASTERS **7**

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

MODULE III MAN-MADE DISASTERS **7**

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion.

MODULE IV DISASTER MANAGEMENT **8**

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT **8**

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards.

MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

Total Hours: 45

REFERENCES:

1. Satender, "Disaster Management in Hills", Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), "Environmental Geography", Heritage Publishers, New Delhi,1990.
3. Savinder Singh, "Environmental Geography", Prayag Pustak Bhawan,1997.
4. Kates, B.I. and White, G.F., "The Environment as Hazards", Oxford University Press, New York, 1978.
5. Gupta, H.K., (Ed), "Disaster Management", University Press, India, 2003.
6. Singh, R.B.,"Space Technology for Disaster Mitigation in India (INCED)", University of Tokyo, 1994.
7. Bhandani, R.K., "An overview on Natural & Manmade Disaster & their Reduction", IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., "Manuals on Natural Disaster management in India", National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

OUTCOMES:

At the end of the course, the students will

- achieve sufficient knowledge on the disaster prevention strategy, early warning system, disaster preparedness, response and human resource development.
- be familiar with the National Policy on Disaster Management.

GEBX02 NANO TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II TYPES OF NANOMATERIALS 9

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES 7

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS 6

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS 7

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI CHARACTERISATION TECHNIQUES 7

Basic principles of scanning Electron Microscopy (SEM), Atomic force

microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

Total Hours: 45

TEXTBOOKS:

1. Hari Singh Nalwa, "Handbook of Nanostructured Materials and Nanotechnology", Academic Press, 2000.
2. Guozhong Cao, "Nanostructures and Nano materials-Synthesis, Properties and Applications", Imperial College Press (2011).
3. Zhong Lin Wang, "Handbook of Nanophase and Nanomaterials (Vol 1 and II)", Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, 2005.

REFERENCES:

1. A. Nabok, "Organic and Inorganic Nanostructures", Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, "Nano Technology – Basic Science and Emerging Technologies", 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, "Nanoscience and Nanotechnology: Fundamentals to Frontiers", Wiley, 2013.

OUTCOMES:

At the end of this course, the students will be able to:

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GEBX03 CONTROL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of Control systems.

MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

MODULE IV STABILITY 8

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

MODULE V COMPENSATOR DESIGN 8

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

MODULE VI CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS 6

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

Total Hours : 45

REFERENCES:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Proper understanding of basics of Control Systems.
- Ability and skill to carry-out time domain and frequency domain analysis.
- Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- Ability to design lag, lead and lag lead compensator networks.

GEBX04 GREEN DESIGN AND SUSTAINABILITY

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart knowledge to face challenges, the technology poses for water, energy, and climate change by implementing sustainable design.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT **7**

Objectives of Sustainable Development - Need for sustainable development- Environment and development linkages - Globalisation and environment- Population, poverty and pollution- global, regional and local environment issues- Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS **8**

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth- Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY **7**

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS **8**

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY **7**

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation- Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN **8**

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

Total Hours: 45

TEXT BOOK:

1. Kirby, J., Okeefe, P., and Timber lake, “Sustainable Development”, Earthscan Publication, London, 1995.

REFERENCE:

1. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, John Wiley and sons, 2007.

OUTCOMES:

At the end of the course, the students will be able to

- explain the relationship between sustainability and emergence of green building practices.
- address the economic, environmental, and social concerns.

GEBX05 KNOWLEDGE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification - Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery - Content management tools - Knowledge sharing and dissemination tools - Group ware and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION 6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels - Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT 6

KM return on investment and metrics - Benchmarking method - Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

Total Hours:45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, “Knowledge Management”, Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, “Handbooks on Knowledge Management”, 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, ”Knowledge Management: Systems and Processes”, 2010.

OUTCOMES:

Students who complete this course will be able to

- describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- critically evaluate current trends in knowledge management and apply it for e-learning

GEBX06 APPROPRIATE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

MODULE I BASICS CONCEPTS 9

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis-discounted cash flow, and energy fundamentals.

MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN 9

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 9

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

MODULE IV WASTE MANAGEMENT 9

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

MODULE V ENERGY EFFICIENT TECHNIQUES 9

Green building concepts-renewable energy sources- Solar – Steam and wind-Biofuels - Biogas – Electricity.

MODULE VI TECHNOLOGY POLICY 9

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

Total Hours: 45

TEXT BOOKS:

1. Barrett Hazeltine and Christopher Bull, “Appropriate Technology: Tools Choices and Implications”, Academic Press, Orlando, USA, 1998.

2. Ken Darrow and Mike Saxenian, “Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology”, Stanford, 1986.

REFERENCES:

1. Richard Heeks, “Technology and Developing Countries: Practical Applications Theoretical Issues”, 1995.

2. John Pickford, “The Worth of Water : Technical Briefs on Health, Water and Sanitation”, Intermediate Technology Publications, 1998.

OUTCOME:

- At the end of the course, the students will be able to use suitable technologies for various conditions for sustainable development.

GEBX07 SYSTEM ANALYSIS AND DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic principles of systems engineering
- To understand the systems engineering methodology
- To provide a systems viewpoint

MODULE I INTERDICTION TO SYSTEMS ENGINEERING 8

Concept of Systems Engineering – Origin – Systems Approach – Advantages of systems approach – Examples.

The building blocks of modern systems – Systems and environment – Interfaces – Complexity of Modern Systems.

MODULE II SYSTEM DEVELOPMENT PROCESS AND MANAGEMENT 8

System life cycle – the systems engineering method – Role of Testing – Management of system development – Risk Management – Organisation.

MODULE III CONCEPT DEVELOPMENT 8

Need Analysis – Concept Exploration – Performance requirement and validation - Concept selection and validation – systems architecture – Decision making.

MODULE IV ESTABLISHING ENGINEERING SYSTEMS 8

Risk Analysis – Risk Mitigation –System performance Analysis – Simulation Techniques in System Analysis – Validation Methods..

MODULE V DECISION SUPPORT TOOLS IN SYSTEMS ENGINEERING 7

Analytical decision support – Statistical influences on system design – System performance analysis – System Reliability, Availability and Maintainability (RAM) – Analysis of Alternatives.

MODULE VI CASE STUDIES 6

Case studies in Software Systems Engineering – Systems for Product Design - Manufacturing Systems.

Total Hours: 45

REFERENCES:

1. Charles S. Wasson, “System Analysis, Design, and Development: Concepts, Principles, and Practices”, Wiley Series in Systems Engineering and Management, 2006.
2. Kossiakoff Alexander and William N. Sweet A, “Systems Engineering: Principles And Practice”, Wiley Student Edition, 2009.

OUTCOMES:

At the end of the course the student will have the

- ability to have systems of view of problems and issues at hand.
- ability to comprehend systems in their totality and specific.
- ability to design, build and evaluate simple systems for industrial requirement.
- ability to analyze systems and strengthen them for performance enhancement.

GEBX08 VALUE ANALYSIS AND ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

MODULE I VALUE ENGINEERING BASICS 8

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS 6

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

MODULE III ORIENTATION AND INFORMATION PHASES 8

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES 9

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagraming - Cost Modelling.

Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

MODULE V EVALUATION, INVESTIGATION AND RECOMMENDATION 6

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

Total Hours: 45

TEXTBOOKS:

1. Mudge, Arthur E. “Value Engineering- A systematic approach”, McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), “Value Engineering”, Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, “Value Engineering: A Plan for Invention”, St.Lucie Press, New York, 1999.
2. Lawrence, D.M., “Techniques of Value Analysis and Engineering”, McGraw Hill 1988.
3. George, E.D., “Engineering Design: a Material and Processing Approach”, McGraw Hill, 1991.
4. Heller, D.E., “Value Management, Value Engineering and Cost Reduction”, Addison Wesley, 1988.

OUTCOME:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

GEBX09 OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods.
- The goal is to maintain a balance between theory, numerical computation, problem setup for solution by optimization techniques, and applications to engineering systems.

MODULE I INTRODUCTION 7

Overview of Optimization techniques for Civil Engineering Problems - Introduction to methods of optimization - Classification of Optimization problems - optimality and convexity - General optimization algorithm - necessary and sufficient conditions for optimality.

MODULE II LINEAR PROGRAMMING 8

Introduction to linear programming - a geometric perspective - Standard form in linear programming; basic solutions; fundamental theorem of linear programming - Simplex Algorithm for Solving Linear Programs - Duality; complementary slackness; economic interpretation of the dual;

MODULE III DYNAMIC PROGRAMMING 8

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality; Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP); Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP.

MODULE IV APPLICATIONS 8

Regression modeling in engineering; industrial blending problems; dynamic optimal control of engineering systems; optimal estimation in environmental engineering - Water resources; production planning in industrial engineering; transportation problem - Heuristic optimization methods: genetic algorithms;

ecological engineering application; Minimum cost network flow algorithms; out-of-kilter method; primal-dual methods; Dynamic Programming Applications - Water allocation as a sequential process - Capacity expansion and Reservoir operation.

MODULE V INTEGER PROGRAMMING 8

Integer programming - applications in optimal irrigation scheduling in agricultural engineering - Interior point optimization methods - affine scaling method.

MODULE VI NON-LINEAR PROGRAMMING 6

Non-linear programming - Kuhn-Tucker conditions for constrained nonlinear programming problems; necessary and sufficient conditions; quadratic programming; applications.

Total Hours: 45

REFERENCES:

1. Taha, H.A., “Operations Research - An Introduction", 9th Edition, Pearson Prentice Hall, 2011.
2. Winston.W.L. “Operations Research”, 4th Edition, Thomson – Brooks/Cole, 2003.
3. Kreyszig .E., “Advanced Engineering Mathematics“,10th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.

OUTCOMES:

At the end of the course, the students will be able to understand

- basic theoretical principles in optimization.
- formulation of optimization models.
- solution methods in optimization.
- methods of sensitivity analysis and post processing of results.
- applications to a wide range of engineering problems.

GEBX10	ENGINEERING SYSTEM MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

MODULE I INTRODUCTION **6**

Systems – Modelling – types – systems components – Steps in model building- Simulation Algorithms and Heuristics; Simulation Languages.

MODULE II RANDOM NUMBERS / VARIATES **7**

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

MODULE III MODELLING PROCESS **7**

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

MODULE IV DESIGN OF SIMULATION EXPERIMENTS **9**

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

MODULE V SIMULATION LANGUAGES **10**

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

MODULE VI CASE STUDIES USING SIMULATION LANGUAGES **6**

Total Hours: 45

REFERENCES:

1. Law, A.M., & W.D. Kelton, “Simulation Modelling and Analysis”, McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., “System Improvement Using Simulation”, 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, “Simulation Made Easy, A Manager’s Guide”, IIE Press, 1995.
4. Geoffrey Gordon, “Systems Simulation”, Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, “Simulation with Arena”, Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

GEBX11 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN 9

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 9

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY 9

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV SOURCING AND TRANSPORTATION 9

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE V INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 9

Information technology in a supply chain – CRM, ISCM, SRM in supply chain - Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

Total Hours: 45

REFERENCES:

1. Sunil Chopra and Peter Meindl, “Supply Chain Management-Strategy Planning and Operation”, Pearson Education, 4th Indian Reprint, 2010.
2. Jananth Shah “Supply Chain Management – Text and Cases“ Pearson Education, 2008.
3. Altekar Rahul V, “Supply Chain Management-Concept and Cases”, Prentice Hall India, 2005.
4. Monczka et al., “Purchasing and Supply Chain Management”, Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GEBX12 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

MODULE I INTRODUCTION 8

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

MODULE II TQM PRINCIPLES 7

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

MODULE III TQM IMPROVEMENT PROCESS 8

Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

MODULE IV STATISTICAL PROCESS CONTROL (SPC) 8

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

MODULE V TQM TOOLS 7

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality

Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI QUALITY SYSTEMS **7**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits.

Total Hours: 45

TEXT BOOK:

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2003.

REFERENCES:

1. James R.Evans & William M.Lidsay, "The Management and Control of Quality", 5th Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S., "Total Quality Management", Butterworth Hcinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan. N.S., "Quality Management – Concepts and Tasks", New Age International, 1996.
5. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.

OUTCOMES:

The student should be able to

- apply the various statistical tools and approaches for Quality control.
- achieve continuous process improvement through TQM.

GEBX13 ENERGY STUDIES L T P C
3 0 0 3

OBJECTIVES:

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

MODULE II SOLAR ENERGY 8

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

MODULE IV COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS 8

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipments. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENRGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

Total Hours: 45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, “Energy Technology”, 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. “Principles of Energy Conservation”, McGraw Hill, 1991.
3. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
4. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GEBX14 ROBOTICS L T P C
3 0 0 3

OBJECTIVE:

- To learn about the robots, various components, of Robots, programming and their applications.

MODULE I INTRODUCTION 8

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

MODULE II ROBOT DRIVES AND CONTROL 8

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

MODULE III ROBOT SENSORS 8

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES 7

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS 7

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

MODULE VI ROBOT KINEMATICS AND DYNAMICS 7

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity

of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

Total Hours: 45

REFERENCES:

1. Yoram Koren," Robotics for Engineers", Mc Graw-Hill, 1987.
2. Kozyrey, Yu, "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int. 1986.
6. Timothy Jordanides et al,"Expert Systems and Robotics", Springer –Verlag, New York, May 1991.

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GEBX15	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Laws.
- To know the legal, ethical and professional issues in Cyber security.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.

MODULE I FUNDAMENTALS OF CYBER SECURITY 8

Security problem in computing – Cryptography Basics – History of Encryption – Modern Methods – Legitimate versus Fraudulent Encryption methods – Encryption used in Internet.

MODULE II TYPES OF THREATS AND SECURITY MEASURES 8

Security Programs – Non-malicious program Errors – Virus and other Malicious Code – Targeted Malicious Code – Control against program threats – Web Attacks – DOS – Online Security Resources.

MODULE III APPLICATION SECURITY 8

Introduction to Databases - Database Security Requirements – Reliability & Integrity – Multilevel Databases - E-Mail and Internet Security – SQL Injection – Cross Site Scripting – Local File Inclusion – Intrusion Detection Software"s.

MODULE IV PHYSICAL SECURITY AND FORENSICS 7

Firewalls – Benefits and Limitations – Firewall Types - Components – Server Room Design and Temperature Maintenance – Cyber Terrorism and Military Operation Attacks- Introduction to Forensics – Finding evidence on PC and Evidence on System Logs – Windows and Linux logs.

MODULE V CYBER STALKING & FRAUD 7

Introduction – Internet Frauds – Auction Frauds – Identity theft – Phishing – Pharming- Cyber Stalking – Laws about Internet Fraud – Protecting against Cyber Crime – Secure Browser settings – Industry Espionage.

MODULE VI CYBER SECURITY STANDARDS AND POLICIES 7

Introduction– ISO 27001– ISO 27002 - PCI DSS – Compliance - IT ACT – Copyright ACT, Patents. Definition of Policy – Types- User Policies- Administrative Policies – Access control – Developmental Policies.

Total Hours: 45

TEXT BOOK:

1. Chuck Easttom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education, 2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, 3rd Edition, Pearson Education, 2003.
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3rd Edition, Pearson Education, 2003.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2000.

OUTCOMES:

Upon completion of this course, attendees should be able to satisfy the critical need for ensuring Cyber Security in Organizations.

- The students attending this course will be able to analyse the attacks and threats.
- They can also provide solutions with Intrusion Detection systems and Softwares.
- They will have knowledge about Cyber Frauds and Cyber Laws.

GEBX16 USABILITY ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION **6**

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES **8**

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN **8**

Process of Interaction Design - Establishing Requirements – Design, Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING **8**

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS **8**

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual

Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards

MODULE VI USER INTERFACES **7**

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

Total Hours : 45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, "Interaction Design: Beyond Human - Computer Interaction", John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, "Usability Engineering", Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, "Designing the User Interface: Strategies for Effective Human Interaction", Pearson Education, 5th Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, "Usability Engineering: Process, Products, and Examples", Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GEBX17	INDUSTRIAL SAFETY	L	T	P	C
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OBJECTIVE:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT **7**

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING **7**

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION **8**

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY **8**

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING **8**

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

Total Hours: 45

REFERENCES:

1. Krishnan N.V, “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. Blake R.B., “Industrial Safety”, Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., “Construction Safety, Security, and Loss Prevention”, John Wiley and Sons, 1979.
4. Fordham Cooper W., “Electrical Safety Engineering”, Butterworths, London, 1986.
5. Alexandrov M.P., “Material Handling Equipment”, Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.