# 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 ELECTRICAL AND ELECTRONICS ENGINEERING

## VISION

To achieve excellence in the programs offered by the Department of Electrical and Electronics Engineering through quality teaching, holistic learning, innovative research and extension.

## MISSION

- To offer Under Graduate, Post Graduate & Research programs of industrial and societal relevance.
- To provide knowledge and skill in the Design and realization of Electrical and Electronic circuits and systems.
- To impart necessary managerial and soft skills to face the industrial challenges.
- To pursue academic and collaborative research with industry and research institutions in India and abroad.
- To disseminate the outcome of research and projects through publications, seminars and workshops.
- To provide conducive ambience for higher education, teaching and research.

# PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES
# B.Tech. (Electrical and Electronics Engineering)

## PROGRAMME EDUCATIONAL OBJECTIVES

- To provide fundamental knowledge of Mathematics and Science to understand the basic concepts of Electrical and Electronics Engineering
- To impart theoretical and practical knowledge in the broad areas of Power Generation, Transmission, Distribution and Utilization
- To provide knowledge and skill in using Electrical and Electronic components, circuits and systems
- To develop skills for devising and evaluating solutions including design of components systems and their analysis using appropriate tools.
- To enhance the spirit of enquiry through projects and internships to develop creativity, self confidence and team spirit
- To inculcate self learning capability to enable the students to constantly update themselves with the technological developments.
- To impart necessary managerial and soft skills to face the challenges in core industries and software companies

## PROGRAMME OUTCOMES

On completion of the Programme the graduates will

- Demonstrate analytical skills in solving electrical engineering problems, acquired through fundamental knowledge of mathematics and basic sciences
- Have ability to self learn any new concept or technology depending on the need
- Have capacity to design, simulate, fabricate and develop electrical systems
- Evolve engineering solutions in global, economic and societal context with professional and ethical responsibility.
- Exhibit professional approach, team work and demonstrate their soft skills capability for the benefit of any organization.

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

# 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

## 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 internship

**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 (2nd to 8th 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

During 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) Coordinator for the first semester 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 and the invited 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. If the course is common to more than one branch of study, grades for such courses shall be finalized in the course committee meetings in consultation with the Dean (Academic Affairs).

## 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 with the approval of Dean (Academic Affairs) 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 and enrolled 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

**12.3** However, a student who has secured "I" grade (due to shortage of attendance) in all the courses of a particular semester is not eligible to move to the next higher 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 | 1 to 18 (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 or admission to a hospital due to illness, etc. by a committee constituted by the Dean of School for that purpose.

**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 shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the University in approved events etc.) to become eligible to appear for the semester-end examination in that course, failing which the student shall be awarded "I" grade in that course. If the course is a core course, the candidate should register for and repeat the course when it is offered next.

**15.2** The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the class advisor. The class advisor will consolidate and furnish the list of students who have earned less that 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department. Thereupon, the Dean (Academic Affairs) shall announce, course-wise, the names of such students prevented from writing the semester end examination in each course.

**15.3** A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded, "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

**15.4** A student who is awarded "U" or “AB” 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 during summer term / regular semester. 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 during summer term course, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

**15.5** If a student with "U" or “AB” grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will be awarded "I" grade in that course.

## 16.0 SUMMER TERM COURSES

**16.1** A student can register for a maximum of three courses during summer term, if such courses are offered by the concerned department during the summer term. Students may also opt to redo such courses during regular semesters.

**16.2** The Head of the Department, in consultation with the department consultative committee may arrange for the conduct of a few courses during the summer term, depending on the availability of faculty members during summer and subject to a specified minimum number of students registering for each of such courses.

**16.3** However, in the case of students who have completed eighth semester, but having arrears in the earlier semesters in a maximum of two courses, summer courses may be offered, even if less than minimum students are registering for the course.

**16.4** The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters except that there is no provision either for withdrawal from a summer term course or for substitute examination.

## 17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

**17.1** All assessments of a course will be made on absolute marks basis. However, the Class Committee without the student members and the invited 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 Grades | Grade Points |
|---|---|
| S | 10 |
| A | 9 |
| B | 8 |
| C | 7 |
| D | 6 |
| E | 5 |
| U | 0 |
| I | -- |
| W | -- |
| AB | -- |

**"W"** denotes withdrawal from the course

**"I"** denotes inadequate attendance in the course and hence prevented from writing semester-end examination.

**"U"** denotes unsuccessful performance in the course.

**"AB"** denotes Absent for the semester end examination

**17.2** 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.

**17.3** 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.

**17.4** 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 fees, through proper application to Dean (Academic Affairs). The concerned HOD 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.

**17.5** 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 summer term 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, including summer courses, if any.

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.

**"I"** and **"W"** grades will be excluded for calculating GPA .

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

**17.6** 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 the 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 or I 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.

## 18.0 ELECTIVE CHOICE: OPTION TO DO PROJECT ALONE IN FINAL SEMESTER

**18.1** 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.

**18.2** 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 including the summer, preceding or succeeding the project work, if offered.

## 19.0 PERSONALITY AND CHARACTER DEVELOPMENT

**19.1** 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.

## 20.0 DISCIPLINE

**20.1** 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.

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

## 21.0 ELIGIBILITY FOR THE AWARD OF DEGREE

**21.1** 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 disciplinary action pending against him/her.

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

## 22.0 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. ELECTRICAL & ELECTRONICS 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<br>FRB1181<br>ISB1181 | English*<br>French*<br>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 | SSB1181 | Introduction to Economics | 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 | PHB1283 | Physics of Engineering Materials | 3 | 0 | 0 | 3 |
| 3. | HS | SSB1182 | Sociology, Ethics & Human Values | 3 | 0 | 0 | 3 |
| 4. | ESF | GEB1211 | Basic Engineering Mechanics | 3 | 1 | 0 | 4 |
| 5. | EC | EEB1211 | Electric Circuit Analysis | 3 | 1 | 0 | 4 |
| 6. | ESF | ITB1281 | C++ Programming | 3 | 0 | 2 | 4 |
| 7. | HS | ENB1282 | Written Communication | 0 | 0 | 2 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8. | EC | EEB1212 | Electric Circuits Lab | 0 | 0 | 3 | 1 |
| 9. | BS | PHB1284 | Physics of Engineering Materials Laboratory | 0 | 0 | 2 | 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. | HS | SSB2181 | Law for Engineers | 3 | 0 | 0 | 3 |
| 3. | EC | EEB2101 | Network Analysis & Synthesis | 3 | 0 | 0 | 3 |
| 4. | EC | EEB2102 | Electronic Devices & Circuits | 3 | 0 | 0 | 3 |
| 5. | EC | EEB2103 | DC Machines & Transformers | 3 | 0 | 0 | 3 |
| 6. | ESF | MEB2181 | Fluid Mechanics & Thermodynamics | 3 | 0 | 0 | 3 |
| 7. | HS | ENB2181 | Oral Communication | 0 | 0 | 2 | 1 |
| 8. | EC | EEB2104 | Electronic Devices & Circuits Lab | 0 | 0 | 3 | 1 |
| 9. | EC | EEB2105 | Machines Lab I | 0 | 0 | 3 | 1 |
| 10. | ESF | MEB2182 | Fluid Mechanics & Thermal Lab | 0 | 0 | 3 | 1 |
| | | | | | | | **23** |

**SEMESTER IV**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | BS | MAB2282 | Optimization Techniques & Numerical Methods | 3 | 1 | 0 | 4 |
| 2. | EC | EEB2211 | Transmission & Distribution | 3 | 0 | 0 | 3 |
| 3. | EC | EEB2212 | Electro Magnetic Theory | 3 | 0 | 0 | 3 |
| 4. | EC | EEB2213 | AC Machines | 3 | 0 | 0 | 3 |
| 5. | EC | EEB2214 | Control Systems | 3 | 0 | 0 | 3 |
| 6. | BS | LSB2181 | Biology for Engineers | 3 | 0 | 0 | 3 |
| 7. | HS | ENB2282 | Confidence Building & Behavioral Skill | 0 | 0 | 2 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8. | EC | EEB2215 | Machines Lab II | 0 | 0 | 3 | 1 |
| 9. | EC | EEB2216 | Control Systems Lab | 0 | 0 | 3 | 1 |
| 10. | EC | EEB2217 | Basic Simulation Lab | 0 | 0 | 3 | 1 |
| | | | | | | | **23** |

**SEMESTER V**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | EC | EEB3101 | Digital Systems and Integrated Circuits | 3 | 0 | 0 | 3 |
| 2. | EC | EEB3102 | Power System Analysis | 3 | 0 | 0 | 3 |
| 3. | EC | EEB3103 | Microprocessor & Micro controllers | 3 | 0 | 0 | 3 |
| 4. | EC | EEB3104 | Measurements & Instrumentation | 3 | 0 | 0 | 3 |
| 5. | HS | MSB3181 | Management of Business Organization | 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 | EEB3105 | Digital Systems & Integrated Circuits Lab | 0 | 0 | 3 | 1 |
| 9. | EC | EEB3106 | Microprocessor & Microcontroller Lab | 0 | 0 | 3 | 1 |
| 10. | EC | EEB3107 | Measurements & Instrumentation Lab | 0 | 0 | 3 | 1 |
| | | | | | | | **22** |

**SEMESTER VI**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | EC | EEB3211 | Power Electronics & Drives | 3 | 1 | 0 | 4 |
| 2. | EC | EEB3212 | Protection & Switch Gear | 3 | 0 | 0 | 3 |
| 3. | EC | EIB3283 | PLC SCADA & DCS | 3 | 0 | 0 | 3 |
| 4. | BS | GEB3201 | Environmental Science & 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 | EEB3213 | Self Learning | 0 | 2 | 0 | 2 |
| 8. | EC | EEB3214 | Power Electronics & Drives Lab | 0 | 0 | 3 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9. | EC | EIB3284 | PLC SCADA & DCS Lab | 0 | 0 | 3 | 1 |
| 10. | EC | EEB3215 | Industrial Internship | 0 | 0 | * | ** |
| | | | | | | | **23** |

* 30 days

** Industrial training will be undertaken during third year summer vacation. The credit will be awarded in the 7th semester.

**SEMESTER VII**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | EC | EEB4101 | Power System Operation & Control | 3 | 0 | 0 | 3 |
| 2. | EC | EEB4102 | High Voltage Engineering | 3 | 0 | 0 | 3 |
| 3. | EC | EEB4103 | Evolutionary Computing | 3 | 0 | 0 | 3 |
| 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 | EEB4104 | Mini Project | 0 | 0 | 6 | 3 |
| 8. | EC | EEB4105 | Power System Simulation Lab | 0 | 0 | 3 | 1 |
| 9. | EC | EEB4106 | Comprehension | 0 | 0 | 3 | 1 |
| 10. | EC | EEB4107 | CAD for Electrical Apparatus Lab | 0 | 0 | 3 | 1 |
| 11. | EC | EEB3215 | Industrial Internship | 0 | 0 | * | 2 |
| | | | | | | | **26** |

* 30 days

**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 | EEB4211 | Project | 0 | 0 | 18 | 9 |
| | | | | | | | **15** |

**Total Credits: 182**

## PROFESSIONAL ELECTIVES

| Sl. No. | Course Group | Course Code | Course Title |
|---|---|---|---|
| | | | **POWER SYSTEM** |
| 1. | PE | EEBX01 | Power Distribution System |
| 2. | PE | EEBX02 | Power System Planning & Reliability |
| 3. | PE | EEBX03 | EHV AC & DC Transmission Engineering |
| 4. | PE | EEBX04 | Power System Dynamics |
| 5. | PE | EEBX05 | Power System Transients |
| 6. | PE | EEBX06 | Smart Power Grid |
| 7. | PE | EEBX07 | Wind Energy Conversion systems |
| 8. | PE | EEBX08 | Flexible AC Transmission Systems |
| 9. | PE | EEBX09 | Industrial Power System Analysis & Design |
| | | | **POWER ELECTRONICS & DRIVES** |
| 1. | PE | EEBX10 | Special Electrical Machines |
| 2. | PE | EEBX11 | CAD for Electrical Apparatus |
| 3. | PE | EEBX12 | Software for Circuit Simulation |
| 4. | PE | EEBX13 | FEA for Electrical Engineers |
| 5. | PE | EEBX14 | Chopper Controller DC Drives |
| 6. | PE | EEBX15 | Solid State AC & DC Drives |
| 7. | PE | EEBX16 | Converter, Application & Design |
| 8. | PE | EEBX17 | Power Electronics Application to Renewable Energy Systems |
| 9. | PE | EEBX18 | Embedded Control of Electric Drives |
| 10. | PE | EEBX19 | Electric Vehicles Technology |
| | | | **HIGH VOLTAGE ENGINEERING** |
| 1. | PE | EEBX20 | Bio-Electrics |
| 2. | PE | EEBX21 | Micro-grid Protection |
| 3. | PE | EEBX22 | High Voltage DC Transmission |

| | | | |
|---|---|---|---|
| 4. | PE | EEBX23 | Power Quality |
| 5. | PE | EEBX24 | Electromagnetic Interference and Electromagnetic Compatibility |
| 6. | PE | EEBX25 | Outdoor Insulators |
| 7. | PE | EEBX26 | High Voltage Generation and Measurement |
| 8. | PE | EEBX27 | Insulation Technology |
| 9. | PE | EEBX28 | Electromagnetic Field Computation and Modeling |
| 10. | PE | EEBX29 | Pulsed Electric Field and Food Preservation |

## COMPUTER SCIENCE & INFORMATION TECHNOLOGY

| | | | |
|---|---|---|---|
| 1. | PE | ITB3103 | Database Management Systems |
| 2. | PE | ITBX21 | Web Collaboration & Technology |
| 3. | PE | ITB2101 | Data Structures |
| 4. | PE | ITB2104 | Computer Networks |
| 5. | PE | ITBX82 | Java Programming |
| 6. | PE | CSBX53 | Computer Hardware and Interfacing |
| 7. | PE | CSBX47 | Cyber Security |
| 8. | PE | CSBX08 | Cloud Computing |
| 9. | PE | CSBX51 | Operating systems |

## ELECTRONICS, COMMUNICATION & INSTRUMENTATION

| | | | |
|---|---|---|---|
| 1. | PE | EIBX81 | Bio Instrumentation and Signal Analysis |
| 2. | PE | ECBX81 | Introduction to Computer and Image Processing |
| 3. | PE | EIBX82 | Sensors for Bio-Medical Application |
| 4. | PE | ECBX82 | VLSI Design |
| 5. | PE | ECBX83 | Integrated Circuits and System Design |
| 6. | PE | ECBX84 | Communication System Security |
| 7. | PE | ECBX85 | Embedded Hardware & Software System Design |
| 8. | PE | ECBX86 | Speech Processing |
| 9. | PE | EIBX83 | Intelligent Control |

## GENERAL ELECTIVES (GE)

| 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

**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.

| 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.

**PHB1283 PHYSICS OF ENGINEERING MATERIALS L T P C**
**(Common to ECE, EEE, AERO, CSE & IT Branches) 3 0 0 3**

**OBJECTIVE:**

- To familiarize the physical, chemical, electrical and mechanical properties of different Engineering materials.

**MODULE I CONDUCTING MATERIALS 10**

Electron ballistics : charged particle, force on charged particles in an electric field, force on charged particles in Magnetic field - Parallel electric and magnetic field - Perpendicular electric and magnetic field - Classical free electron theory of metals – Derivation for electrical conductivity – Merits and drawbacks of classical theory – Quantum free electron theory of metals and its importance (qualitative) – Energy distribution of electrons in metals – Fermi distribution function – Density of energy states and carrier concentration in metals (derivation) – Fermi energy – Classification of solids into conductors, semiconductors and insulators on the basis of band theory.

**MODULE II SEMICONDUCTING MATERIALS 9**

Elemental and compound semiconductors – Drift and diffusion current - Intrinsic semiconductors –Carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

**MODULE III DIELECTRIC MATERIALS 7**

Dielectric constant – Electric Susceptibility – Types of dielectric polarization – Frequency and temperature dependence of polarization – Internal field and deduction of Clausius-Mosotti's equation(derivation) – Dielectric loss – Types of dielectric breakdown – Uses of dielectric materials (capacitor & transformer).

**MODULE IV MAGNETIC MATERIALS 6**

Origin of magnetic moment –Types of magnetic materials and their properties –Ferromagnetism – Domain theory of ferromagnetism, hysteresis, soft and

hard magnetic materials – Anti ferromagnetic materials (qualitative) – Ferrites – Applications-Magnetic memory – Tapes & magnetic disk drives.

**MODULE V SUPERCONDUCTING MATERIALS 6**

Superconductivity - BCS theory - Meissner effect - Critical magnetic field - Type I and Type II superconductors - High temperature superconductors - Applications of superconductors: SQUID and magnetic levitation.

**MODULE VI OPTICAL AND NEW ENGINEERING MATERIALS 7**

Optical properties of semiconductors – Direct and indirect bandgap semiconductors – Color centers, exciton – Luminescence – Fluorescence – Phosphorescence – Liquid crystal display, Solar cell – Electro optic effect-Pockel's effect - Kerr effect – Faraday effect. Metallic glasses – Preparation, properties and applications - Shape Memory Alloys – Preparation, properties and applications, Nano phase materials – Synthesis, properties and applications.

**Total Hours: 45**

**TEXT BOOKS:**

1. Palanisamy P.K., Physics II, Material Science for ECE, Scitech Publications (India) Pvt Ltd., 2006.
2. Safa O. Kasap, Principles of Electronic materials and devices, McGraw Hill Publishers, 3rd Edition, 2006.

**REFERENCES:**

1. Arumugam.M, Physics II, Material Science for ECE, Anuradha Publishers, 5th Edition, 2005.
2. Jacob Millman, Christos C.Halkais, Electronic Devices and Circuits, Tata McGraw-Hill, New Delhi, 1991.
3. Charles Kittel, Introduction to solid state physics, 7th Edition, John Wiley & sons (ASIA) Pvt. Ltd.
4. Sze. S.M., Semiconductor Devices – Physics and Technology, 2nd edn. John Wiley, 2002.

5. Nandita Das Gupta and Amitava Das Gupta, Semiconductor Devices – Modelling and Technology, Prentice Hall of India, 2004.

6. Donald A. Neamen, “Semiconductor Physics and Devices” 3rd Ed., Tata McGraw Hill, 2002.

**OUTCOMES:**

On completion of this course, the student will be able to

- choose the correct semi-conductors for electronic devices and display.
- use dielectric materials for transformers and capacitors
- use ferromagnetic materials for solid state devices
- apply the concept of super conductivity for Engineering applications.

**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.

**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

| EEB1211 | ELECTRIC CIRCUIT ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- To learn circuit laws, theorems and circuit solution methods
- To be able to analyze DC circuits, 1F and 3 F AC circuits
- To be able to analyze magnetic circuits and magnetically coupled electric circuits

**MODULE I DC CIRCUITS** **8**

Circuit elements : R, L and C - sources : Independent (ideal and practical), and dependent voltage and current sources - ohm's and kirchoff's laws - power and energy - solution of DC circuits - use of source transformations - network reduction by Y-? transformations.

**MODULE II AC FUNDAMENTALS** **7**

Sinusoidal voltages and currents : Average and RMS Values, peak and form factors - concept of phasor and its use in representing sinusoidal voltages and currents - impedance and admittance - Real, reactive and apparent power - Analysis of simple series and parallel circuits.

**MODULE III AC NETWORK ANALYSIS** **7**

Solution of series-parallel AC circuits - Resonance : RLC series and parallel resonance, resonant frequency, half-power frequencies, Q-factor - Node voltage and mesh current method of analysis - concept of super nodes and super meshes.

**MODULE IV NETWORK THEOREMS** **8**

Network Theorems : Superposition theorem, Millman's Theorem, Thevenin's Theorem, Norton's Theorem and Maximum power transfer theorem - Application to DC and AC networks

**MODULE V MAGNETIC CIRCUITS** **8**

Magnetic circuits : Definition of magnetic quantities i.e., permeability, flux, flux density, field intensity and their units and relationships - magnetic curves of ferromagnetic materials - magnetic circuit concept and analogies - magnetic circuit computations - Hysteresis and eddy current losses.

**MODULE VI COUPLED AND THREE PHASE CIRCUITS 7**

Magnetically coupled circuits : self and mutual inductances, Dot rule for coupled circuits, coupled circuits analysis - Three phase circuits: generation of 3 - phase voltages - star and delta connection - relation between phase and line quantities - balanced and unbalanced 3 - phase loads - power measurement by 2 - wattmeter method.

**L – 45; T – 15; Total Hours– 60**

**REFERENCES:**


1. Electrical and Electronic Technology, Edward Hughes, PH (UK) 9th edition (2004), 11th revised edition (2012)
2. Vincent Del Toro, “Principles of Electrical Engineering”, 2nd Edition, Prentice - Hall of India, 1984
3. William H.Hayt, Jr.Jack E.Kemmerly, Steven M.Durbin, “Engineering Circuit Analysis”, 6th Edition, Tata McGraw - Hill Edition, 2002.
4. Joseph A.Edminister, Mahmood Nahvi, ‘Electric Circuits’, Schaum’s Series, Tata McGraw Hill publishing Co. Ltd., New Delhi 2001.
5. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, 2007.
6. R.C. Dorf, ‘Introduction to Electric Circuits’, John Wiley & Sons Inc, New York, 2nd Edition, 2003.


**OUTCOMES:**

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

- Familiarity with circuit laws, theorems and solution methods
- Analysis of 1F and 3F circuits.
- Analysis of magnetic circuits
- Basic concepts for future advanced courses

| ITB1281 | C++ PROGRAMMING (Object Oriented Programming) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- To understand the concepts of object-oriented programming and master OOP using C++
- To acquire knowledge and skills in OO design and program development
- Certain skills in Internet and windows programming and using graphical user interface

**MODULE I OVERVIEW OF C++** **8**

Introduction - Object oriented programming concepts; Object oriented programming languages; Origins of C++; C++ fundamentals; OO concepts; ADT, Classes and objects, Inheritance, abstract classes, Polymorphism; Classes and objects in C++ ; Arrays, Pointers, References.

**MODULE II CONSTRUCTOR AND OVERLOADING** **8**

Constructors-default constructor-parameterized constructor-constructor with dynamic allocation-copy constructor-destructors; Introduction - Function and Operator overloading; Function overloading; Operator overloading-fundamentals, restrictions; operator overloading using a friend function, overloading special operators.

**MODULE III TEMPLATES AND EXCEPTION** **7**

Function and class templates; Exception handling, try-catch-throw paradigm, exception specification, terminate and unexpected functions, Uncaught exception.

**MODULE IV INHERITANCE AND POLYMORPHISM** **7**

Base class, Member accessibility; Multiple Inheritance; Virtual base class; Runtime polymorphism, Virtual functions- pure virtual functions, dynamic binding.

**MODULE V INPUT / OUTPUT FUNCTIONS AND FILE PROCESSING** **7**

Unformatted I/O, Formatted I/O; I/O Manipulators; File handling, Random access, object serialization, standard namespaces; File processing-Opening and closing a file-Reading and writing a file.

**MODULE VI RTTI AND STANDARD TEMPLATE LIBRARY 8**

RTTI - Application of RTTI; STL - Overview; Container classes: Vector, Lists and Maps; Algorithms: Counting, removing, replacing, reversing and transforming elements.

**L – 45; T – 15; Total Hours : 60**

**REFERENCES:**

1. Deitel and Deitel, 'C++ HOW TO PROGRAM', Pearson Education, 4th Edition, 2001
2. Herbert Schildt, 'The Complete Reference C++', TataMcgraw Hill, 2001, 3rd Edition
3. Balaguruswamy E., 'Programming in C++', Tata McGraw Hill, 2nd Edition, 2001
4. Bruce Eckel, 'THINKING IN C++', Pearson Education, 2nd Edition, 2001.
5. James P. Cohoon, Jack W. Davidson, 'C++ PROGRAM DESIGN', An Introduction to Programming & Object Oriented Design, TataMcgrawHill, 2nd Edition, 2000.
6. Yashwant Kanetkar, 'LET US C++', BPB Publication, First Edition, 1999

**OUTCOMES:**

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

- Experience in basic concepts of object oriented programming
- Know practical knowledge in OO design concepts
- Design a small-scale object-oriented program.

**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.

| EEB1212 | ELECTRIC CIRCUITS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVE:**

- To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and simulation of time response.

**LIST OF EXPERIMENTS:**

1. Verification of Kirchoff's voltage and current laws.
2. Verification of Thevenin's and Norton's Theorems.
3. Verification of Superposition theorem.
4. Verification of Maximum Power Transfer Theorem.
5. Study of oscilloscope and measurement of sinusoidal voltage, frequency and power factor.
6. Transient response of RC, RL and RLC circuits.
7. Study of the effect of Q on frequency response of series and parallel resonant circuits.
8. Measurement of real power, reactive power, power factor and impedance of RC, RL and RLC circuits using 3 voltmeters and 3 ammeters.
9. Power measurement in a three phase circuit by using two Wattmeter method.

**Total Hours: 45**

**OUTCOME:**

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

- Complement the knowledge acquired in the theory class.

| PHB1284 | PHYSICS OF ENGINEERING MATERIALS LABORATORY (Common to ECE, EEE, AERO, CSE & IT Branches) | L | T | P | C |
|---|---|---|---|---|---|
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**OBJECTIVES:**

- To study the characteristics of conducting, semiconducting, dielectric, magnetic and optical materials.

**LIST OF EXPERIMENTS:**

1. Determination of magnetic field along the axis of a circular coil – Stewart and Gees experiment.
2. Determination of electrical conductivity of a given metal by four point probe method.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of band gap of a semiconductor diode.
5. Determination of dielectric loss of a dielectric material using LCR bridge method.
6. Determination of time constant of an RC circuit by charging and discharging of a capacitor.
7. Determination of magnetic susceptibility of a paramagnetic material using Quincke's method.
8. Determination of energy loss of a given transformer coil using Hysteresis – B-H curve.
9. Determination of Verdet constant of a material using Faraday Effect.
10. Determination of Kerr constant using electro optic modulators.

**OUTCOMES:**

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

- Know the properties of conducting, semiconducting, dielectric and magnetic materials.
- Know the principle and working of Kerr modulator and Faraday rotator.

## SEMESTER III

| MAB2181 | TRANSFORMS AND APPLICATIONS (Common to All Branches) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- 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 TRANSFORMS 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**

**REFERENCES:**

1. Grewal, B.S., "Higher Engineering Mathematics", 36th Edition, Khanna Publishers, Delhi, 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, 2007.
6. Veerarajan.T., "Engineering Mathematics", 5th edition Tata Mc Graw Hill Publishing Co. New Delhi, 2012.

**OUTCOMES:**

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

- Solve enginering 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.

| 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.

**MODULEVI 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, National Book Trust, 3rd edition., 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.

**EEB2101 NETWORK ANALYSIS AND SYNTHESIS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To impart basic knowledge on s domain analysis using Laplace transforms.
- To introduce network transients, network topology and two port networks.
- To introduce basic theory about the design of filters and attenuators.

**MODULE I S-DOMAIN ANALYSIS** **6**

S - domain network – driving point and transfer impedances and their properties – transform network analysis – poles and zeros of network functions – time response from pole – zero plots.

**MODULE II TRANSIENT ANALYSIS** **6**

Transient response of RL, RC and RLC circuits using Laplace transform using DC input and AC input.

**MODULE III NETWORK TOPOLOGY** **7**

Network graphs, tree and cutsets – tie set and cutset schedules – V shift and I shift – primitive impedance and admittance matrices – application to network solutions.

**MODULE IV TWO PORT NETWORK** **9**

Characterization of two port networks in terms of Z, Y, h and ABCD parameters – network equivalents – relation between network parameters – T and p representation - Analysis of Ladder, Bridged T and lattice networks – transfer function of terminated two port networks.

**MODULE V ELEMENTS OF NETWORK SYNTHESIS** **9**

Reliability of one port network – Hurwitz polynomials and properties – Positive Real functions and properties – Synthesis of RL, RC and LC one port networks using Foster and Cauer methods.

**MODULE VI FILTERS AND ATTENUATORS** **8**

Classification of filters: Classification of Pass Band and Stop Band – Characteristic impedance in the pass and stop bands- Design of constant K

low pass and high pass filters - M derived filters – Band pass filters – Band elimination filter- Types of Attuenuators .

**Total Hours: 45**

**REFERENCES:**

1. Kuo F.F., “Network Analysis and Synthesis”, Wiley International Edition, 2nd Edition, 1966.
2. Paranjothi S.R., “Electric Circuit Analysis”, New age International Publishers, 2nd Edition, 2000.
3. Van Valkenburg, M.E., “Network Analysis”, Prentice – Hall of India Private Ltd., New Delhi, 3rd Edition, 1974.
4. Sudhakar. A., and Shyammohan, “Circuits and Networks Analysis and Synthesis”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.

**OUTCOMES:**

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

- Capable of analyzing s domain analysis and transient analysis.
- Ability to obtain network solutions through network topology.
- Capable of determining Z,Y, h and ABCD parameters.
- Ability to realize RL,RC and LC networks.
- Better understanding of design of different types of filters and attenuators.

**EEB2102 ELECTRONIC DEVICES AND CIRCUITS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- To familiarize the student with the principle of operation, capabilities and limitation of various electronic devices and their applications.

**MODULE I P-N JUNCTION DIODE** **8**

Semi Conductors- Charge carriers, electrons and holes in intrinsic and extrinsic semi conductors-Hall Effect. Diodes-PN junction-current equation, junction capacitance, breakdown characteristics, V-I characteristics, PN junction diode ratings. Diode Applications- Clippers, clampers and Rectifiers (Half wave and Full wave). Zener diode-VI Characteristics, applications. Elementary Physics of Opto electric Devices – LED and Photo-Diode.

**MODULE II BIPOLAR JUNCTION TRANSISTOR (BJT)** **7**

Physical behaviour of a BJT – Ebers – Moll model, large signal current gains, Modes of transistor operation - Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, Thermal runaway. AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed bias, collector to base bias, self bias. Transistor switching times, Transistor as a switch and an amplifier, High frequency effects, BJT ratings. Introduction to photo transistors.

**MODULE III FILTERS AND REGULATORS** **7**

Harmonic component in rectifiers-ripple factor- inductor filter, Capacitor filter, PI section filter. Comparision of filter in terms of ripple factor. Regulators- series and shunt. UPS – Principle of operation- types.

**MODULE IV FIELD EFFECT TRANSISTOR** **8**

JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal JFET model, JFET as a switch, Voltage variable resistor and an amplifier.

MOSFET- Constructional details- Operation of Enhancement and Depletion type MOSFETs, V-I characteristics, Transfer characteristics, analytic expression for drain current, Comparison of PMOS and NMOS devices -

MOSFET biasing, MOSFET as a switch, resistor and amplifier, Introduction to CMOS devices.

**MODULE V FEEDBACK AMPLIFIERS AND OSCILLATOR 8**

Amplifier classification - Feedback concept - Characteristics of negative feedback- effect of feedback on input and output characteristics.

Oscillator-Principle, condition for oscillator, RC oscillator- Wien bridge oscillator and Phase shift oscillator, LC oscillator - Hartley and Colpitts, Crystal oscillator.

**MODULE VI ANALYSIS OF SMALL SIGNAL AMPLIFIERS 7**

Two port devices and hybrid model, Transistor hybrid model- Analysis of transistor amplifier using h parameter – CE, CB and CC (actual and approximate model) - Comparison. Small signal analysis of –CE and CC amplifier, JFET amplifier.

**Total Hours : 45**

**REFERENCES:**

1. Boylestead L.R., Nashelsky L.,"Electronic Devices and Circuit Theory", Pearson Education India Series, New Delhi, 10th Edition, 2009.
2. Gupta.J.B. "Electronic Devices and Circuits", 3rd Edition, S.K.Kataria & Sons, New Delhi, 2010.
3. Millman J., C.C.Halkias, Sathyabaratha Jit, "Electronic Devices and Circuits", Tata McGraw-Hill Publishing company limited, 2nd Edition, 2007.
4. Thomas L. Floyd, "Electronic Devices", Pearson Education India Series, New Delhi, 7th Edition, 2007.

**OUTCOMES:**

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

- An overview of various semiconductor devices.
- Ability to analyze amplifier circuits, oscillators and filter circuits.

**EEB2103 DC MACHINES & TRANSFORMERS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- Construction, principle of operation, performance and characteristics of DC generators.
- Construction, principle of operation, performance, characteristics, speed control and applications of DC motors.
- Design Concepts in DC machines.
- Construction, principle of operation, performance, analysis and parallel operation of 1-phase transformers.
- Design Concepts in transformers.

**MODULE I DC GENERATORS** **8**

Construction – Principle of Operation – Types – EMF equation – OCC – Generator on Load – Power Flow diagram – Losses and efficiency – Armature reaction – Commutation.

**MODULE II DC MOTORS** **9**

Construction – Principle of operation – Torque – Types and characteristics – Power Flow diagram – Starters – Speed Control – Solid state DC drives (Introduction) – Testing.

**MODULE III SINGLE PHASE TRANSFORMERS** **9**

Construction and principle of operation – EMF equation – Transformer on no load and load – Phasor diagram – OC and SC tests – Equivalent circuit – Voltage regulation – Losses – Efficiency.

**MODULE IV PARALLEL OPERATION** **4**

Parallel Operation of transformers – Auto Transformer – 3-phase transformer connections.

**MODULE V DESIGN OF DC MACHINES** **9**

Specific loadings – Output equation – Main dimensions – Armature Design – Field system design.

**MODULE VI TRANSFORMER DESIGN** **6**

Core design and Windings Design for single phase and 3 phase transformers – Cooling System – Performance prediction.

**Total Hours: 45**

**REFERENCES :**

1. Edward Hughes, “Electrical Technology”, 2001.
2. H. Cotton, “Electrical Technology”, 2001.
3. M.G. Say, “Performance and Design of AC machines”, 1999.
4. Clayton and Hancock, “Performance and Design of DC machines”, 1995.

**OUTCOMES:**

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

- Ability to understand the rudiments of DC machines and Transformers.
- Ability to design and analyze DC machines and Transformers.

**MEB2181 FLUID MECHANICS AND THERMODYNAMICS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce basic properties of fluids and the laws of fluid mechanics.
- To introduce the laws governing the fluid flow.
- To introduce the concepts and laws of thermodynamics and their application in analyzing cyclic process.
- To introduce the working of various thermal systems like engines and turbines.

**MODULE I BASIC CONCEPTS AND PROPERTIES** **7**

Fluids-Definition, Units and Dimensions, Properties of fluid - Density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension, Fluid pressure, pressure measurement.

**MODULE II FLUID MECHANICS** **8**

Fluid flow, classification of flows in terms of variation of flow parameters in time and space, the concepts of streamline and stream tube, the principles of continuity, energy and momentum, Bernoulli's Equation, turbulent flow, flow measurement by orifice, Venturi, Pitot tube, rotameter.

**MODULE III FLUID MACHINES** **7**

Classification and working principle, basic calculations of head, flow rate and power of hydraulic turbines and pumps.

**MODULE IV BASIC CONCEPTS AND LAWS OF THERMODYNAMICS** **8**

Concepts of heat and work, properties of pure substances, representation of properties, change of phase, steam and air tables and vapour, equation of state, ideal gases, ideal non-flow and flow processes, laws of thermodynamics, Carnot's principle, Clausius inequality.

**MODULE V POWER GENERATING MACHINES** **8**

Air standard Cycles for IC engines - Otto cycle; plot on P-V, T-S planes; Thermal efficiency and working of SI engines. Diesel cycle; plot on P-V, T-S planes; Thermal efficiency and working of CI engines.

Rankine cycle of steam h-s chart of steam (Mollier's Chart). Simple Rankine cycle plot on P-V, T-S, h-s planes. Rankine cycle efficiency with & without ump work. Layout of thermal power station.

**MODULE VI COMPRESSORS, REFRIGERATION AND AIR CONDITIONING 7**

Working of Reciprocating, rotary, centrifugal and scroll compressors. Simple vapour compression refrigeration systems. Air conditioning systems.

Introduction to Heat Transfer, Introduction to Hydraulic and Pneumatic Systems.

**Total Hours : 45**

**REFERENCES :**

1. White, F.M., Fluid Mechanics", Tata Mc Graw hill, 5th Edition, New Delhi.-2003.
2. Bansal R.K "Fluid Mechanics and hydraulics Machines ", 5th Edition , Laxmi Publications (P) Ltd, New delhi, 1995.
3. Streeter Wylie and Bedford, "Fluid Mechanics", McGraw- Hill Publishing Company Limited, New York, 1998.
4. Cengel Y Al and Boles M A "Thermodynamics, An Engineering Approach" Tata McGraw Hill, 2003.
5. Nag P K, "Engineering Thermodynamics", Tata McGraw Hill, Delhi, 2004.
6. Holman J P, "Thermodynamics", Tata McGraw Hill, 1998.
7. Holman J P, "Heat Transfer", 9th edition, Tata McGraw Hill Inc., New York, 2008.

**OUTCOMES:**

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

- Ability to conceptualize the behavior of fluids and fluid flows found in the real time applications.
- Exposure to various hydraulic turbines and pumps.
- Knowledge on the basic laws of thermodynamics.
- Exposure to various thermal systems like IC Engines, Stream turbines, Compressors, Refrigeration and Air Conditioning systems

**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** **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** **2**

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

**MODULE III** **4**

Developing persuasive skills - Selling a product – Marketing skills – The topics will be on advertising, convincing some one on social issues such as preservation of water, fuel, protection of environment, gender discrimination.

**MODULE IV** **4**

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** **6**

Brainstorming – 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** **6**

Interview Skills - 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 : 30**

**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:**

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

- Ability to speak confidently and effectively in Presentations and Group Discussions.

| EEB2104 | ELECTRONIC DEVICES & CIRCUITS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To get a practical exposure of the various electronic devices and its application circuitry.
- To design and implement waveform generators and amplifiers.

**LIST OF EXPERIMENTS:**

1. Study of CRO.
2. VI characteristics of PN diode and Zener diode.
3. Characteristics of BJT.
4. Characteristics of photodiode and photo transistor.
5. Transfer characteristics of JFET and MOSFET.
6. Characteristics of FET amplifier.
7. Design and fabrication of Transistor amplifier.
8. Bridge Rectifier.
9. RC Phase shift oscillator and Wein Bridge oscillator.
10. Hartley and Colpitt oscillator.
11. Design and fabrication of voltage regulators-series and shunt.

**Total Hours: 45**

**OUTCOME:**

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

- Ability to enhance the skills to use modern engineering tools to design electronic circuits.

| EEB2105 | MACHINES LAB I | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVE:**

- To experimentally verify the performance and characteristics of DC machines and 1-phase transformers.

**LIST OF EXPERIMENTS**

1. Study of symbols and starters.
2. OCC and Load characteristics of a separately excited DC generator.
3. OCC and Load characteristics of a self excited DC shunt generator.
4. Load characteristics of a DC shunt motor.
5. Load characteristics of a DC series motor.
6. Load characteristics of a DC compound motor.
7. Speed control of DC shunt motor.
8. Swinburne's test.
9. Load test on a 1-phase transformer.
10. OC and SC tests on a 1-phase transformer.
11. Sumpner's test.
12. 3-phase transformer connections.

**Total Hours : 45**

**OUTCOMES:**

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

- Ability to test DC machines and Transformers for suitable applications.
- Ability to troubleshoot DC machines and transformers.

**MEB2182 FLUID MECHANICS AND THERMAL LAB**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To know the various measuring devices for fluid properties.
- To study the performance characteristics of various kinds of pumps and turbines
- To Study the various performance characteristics of SI and CI engines.
- To study the performance characteristics of Air Compressor, VCRS and convective heat transfer.

**FLUID MECHANIC AND MACHINERY LAB**

1. Calibration of Venturimeter.
2. Calibration of Orifice meter.
3. Performance Study on Centrifugal Pump.
4. Performance Study of Jet Pump.
5. Performance Study on Pelton Wheel.
6. Performance Study on Reciprocating Pump.
7. Performance Study on Francis Turbine.

**THERMODYNAMICS LAB**

1. Valve Timing and Port timing diagram.
2. Performance test on 4 stroke petrol / diesel engine.
3. Heat balance test on 4 stroke diesel engine.
4. Performance test on air compressor.
5. Performance test on Vapour Compression Refrigeration system.
6. Determination of connective heat transfer coefficient in (a) natural convection and (b) forced convection.

**Total Hours : 45**

**OUTCOMES:**

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

- Students will be having hands on experience in discharge measurement devices and working of pumps and turbines.
- Students will have exposure to various thermal systems like IC Engines, Air Compressors, Refrigeration systems.

## SEMESTER IV

| | | L | T | P | C |
|---|---|---|---|---|---|
| MAB2282 | OPTIMIZATION TECHNIQUES AND NUMERICAL METHODS | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- Provide tools in optimization of resources for industries.
- Provide solution to different kinds of problems occurring in engineering, numerically.

**MODULE I LINEAR PROGRAMMING 8**

Linear Programming - Definition - Formulation - Solutions - Graphical - Simplex method, Duality in LPP - Dual simplex method – Two Phase simplex method.

**MODULE II TRANSPORTATION AND ASSIGNMENT MODELS 7**

Formation and Solutions of Transportation problems, Assignment problems and Travelling salesman problems.

**MODULE III SOLUTION OF SYSTEM OF EQUATIONS AND EIGENVALUE PROBLEMS 8**

Gauss elimination method – Pivoting strategy 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 IV INTERPOLATION 6**

Lagrange's and Newton's divided difference interpolation - Newton's forward and backward difference interpolation.

**MODULE V NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 8**

Numerical differentiation by finite differences – Trapezoidal, Romberg's method, Simpson's 1/3 and Gaussian Quadrature formula.

**MODULE VI NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8**

Numerical solution of first and second order ordinary differential equations by Taylor's series method – Euler's Method - Modified Euler's Method - Runge – Kutta Method of fourth order - Millne's Predictor and Corrector Method – Finite difference methods for two – point Boundary Value problems.

**Total Hours : 60**

**REFERENCES:**

1. Hamdy ATaha, "Operations Research an introduction", 8th Edition, Phil Pearson, 2007. (For Modules I and II).
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.
3. Wayne.L.Winston, "Operations Research applications and algorithms", 4th edition, Thomson learning. 2007. (For Modules I and II).
4. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" Pearson Education, New Delhi, 2002.
5. P. Dechaumphai, N. Wansophark,"Numerical Methods in Engineering", Narosa Publications, 2012.

**OUTCOMES:**

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

- Solve system of linear equations and eigenvalue problem of a matrix numerically.
- Solve transportation and assignment problems.
- Use numerical differentiation and integration techniques to solve engineering problems.

**EEB2211 TRANSMISSION AND DISTRIBUTION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To derive expressions for the computation of transmission line parameters.
- To model transmission lines for determining voltage regulation and efficiency.
- To analyze the voltage distribution in insulator strings /underground cables.
- To understand the operation of the different distribution schemes.

**MODULE I INTRODUCTION** **6**

Structure of electric power system - Generation, transmission and distribution EHV AC and HVDC transmission - Comparison of economics of transmission, technical performance and reliability, application of HVDC transmission system. FACTS (qualitative treatment only) - TCSC, SVC, STATCOM, UPFC.

**MODULE II TRANSMISSION LINE PARAMETERS** **8**

Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors - Symmetrical and unsymmetrical spacing and transposition; application of self and mutual GMD; skin and proximity effects; interference with neighboring communication circuits.

**MODULE III MODELLING AND PERFORMANCE OF TRANSMISSION LINES** **8**

Classification of lines - Short, medium and long lines; equivalent circuits, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation; real and reactive power flow in lines - Power-angle diagram; surge-impedance loading, shunt and series compensation; Ferranti effect and corona loss.

**MODULE IV INSULATORS AND CABLES** **8**

Insulators - Types, voltage distribution in insulator string, improvement of string efficiency. Underground cables - Constructional features of LT and HT cables, capacitance, dielectric stress and grading, thermal characteristics.

**MODULE V MECHANICAL DESIGN OF OVERHEAD LINES 7**

Sag in overhead lines- calculation of sag and tension – supports at equal heights-supports at unequal heights- effect of ice – combined effect of wind and ice loading – Statutory rules and Indian Electricity rules.

**MODULE VI SUBSTATION, AND DISTRIBUTION SYSTEM 8**

Types of substations; bus-bar arrangements; substation bus schemes: single bus scheme, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker-and-a-half with two main buses, double bus-bar with bypass isolators.

Radial and ring-main distributors; interconnectors; AC distribution: AC distributor with concentrated load; three-phase, four-wire distribution system; sub-mains; stepped and tapered mains.

**Total Hours : 45**

**REFERENCES:**

1. B.R.Gupta, “Power System Analysis and Design”, S.Chand, New Delhi, 2003.
2. S.N. Singh, “Electric Power Generation, Transmission and Distribution”, Prentice Hall of India Pvt. Ltd, New Delhi, 2002.
3. Luces M.Fualkenberry, Walter Coffer, “Electrical Power Distribution and Transmission”, Pearson Education, 1996.
4. Hadi Saadat, “Power System Analysis”, “Tata McGraw Hill Publishing Company”, 2003.

**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 transmission and distribution.
- Capable of determining voltage regulation and efficiency for short, medium and long lines.
- Ability to determine string efficiency of insulators.
- Better understanding of different types of substation and distribution systems.

**EEB2212 ELECTROMAGNETIC THEORY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- Concepts of electrostatics, electrical potential, energy density and their applications.
- Concepts of magneto statics and its applications.
- Faraday's laws, induced emf and their applications.
- Concepts of electromagnetic waves.

**MODULE I VECTOR ANALYSIS 6**

Scalars and vectors- Cartesian Coordinate System-Vector components and unit vector- vector field-other coordinate systems-cylindrical coordinate system, spherical coordinate system.

**MODULE II ELECTRIC FIELD 6**

Coulomb's Law-Electric field intensity-Electric field due to point charge, line charge, surface charge and volume charge distributions-Electric flux density-Gauss law-Application of Gauss law-Work done in moving a point charge-Electric potential-Potential Gradient-Dipole-Energy density in electrostatic field-Del Operator-Divergence-Divergence theorem-Maxwell's First equation (electrostatic) - Poission's and Laplace Equations.

**MODULE III CONDUCTOR, DIELECTRICS AND CAPACITANCE 7**

Charges in motion- current density - Conduction current - Displacement current - Equation of continuity -Conductor properties and boundary conditions – methods of images-nature of dielectric material-Boundary Condition for perfect dielectric –Capacitance - Energy stored in a capacitor-Electrostatic potential energy associated with different charge distributions-Energy density –Force between charges in motion.

**MODULE IV MAGNETIC FIELDS 9**

Force on current element- Biot-Savart's Law- Ampere's Circuital Law-Curl-Stokes Theorem-Magnetic Flux and Magnetic Flux density-Force between current carrying conductors-Torque on closed conductor-Boundary conditions at the magnetic surfaces.

**MODULE V INDUCTANCE AND MAGNETIC CIRCUIT 9**

Faraday's Law of Electromagnetic induction-Inductance of solenoids, toroids, transmission lines and cables- Mutual inductance of series and parallel circuits-Energy stored in magnetic fields-Magnetic circuits.

**MODULE VI MAXWELL'S EQUATION AND ELECTROMAGNETIC WAVES 8**

Modified Ampere circuital law-Maxwell equation in point and integral forms-Wave equation- Wave equations in phasor form-Electromagnetic wave in perfect dielectric – Electromagnetic wave in good conductor-Skin depth-Reflection of uniform plane waves-Poynting's Theorem.

**Total Hours : 45**

**REFERENCES:**

1. William Hayt , "Engineering Electromagnetics", McGraw Hills, New York,1989.
2. John D.Kraus, "Electromagnetisc", McGraw Hills, 1999.
3. Joseph A.Edminister M.S.E, "Schaum's Outline of Theory and Properties of Electromagnetics", McGraw Hill Book Company,1998.

**OUTCOMES:**

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

- Acquire the knowledge about electrostatics, magneto statics and its applications.
- Understand the concepts of Faraday's laws, induced emf and their applications.
- Understanding the concepts of electromagnetic waves.

**EEB2213 AC MACHINES L T P C**
**3 0 0 3**

**OBJECTIVES:**

- Construction, principle of operation, performance, analysis and speed control of 3-phase induction motors.
- Construction, principle of operation, performance, analysis and parallel operation of 3-phase synchronous generators and synchronous motors.
- Construction, principle of operation and performance analysis of 1-phase induction motors and certain special machines.

**MODULE I SYNCHRONOUS GENERATOR 7**

Construction – Principle of Operation – EMF equation – Synchronous impedance – Voltage Regulation.

**MODULE II PERFORMANCE STUDY OF SYNCHRONOUS GENERATOR 7**

Armature Reaction – Parallel operation – Synchronizing current and torque – Effect of change of excitation and mechanical input – Two reaction theory – Slip test.

**MODULE III SYNCHRONOUS MOTOR 9**

Principle of Operation – Starters – Power developed and torque – Power stages and efficiency – Motor on load with varying excitations and varying loads – V and inverted V curves.

**MODULE IV THREE PHASE INDUCTION MOTORS 8**

Construction – Types – Principle of operation – Slip and torque – slip-torque characteristics - Various torques - Tst, Tmax etc., – Their conditions and values – Losses and efficiency – Equivalent circuit – Circle diagram – Speed Control.

**MODULE V DESIGN OF ALTERNATORS 7**

Output equation – main dimensions – field design – salient pole design.

**MODULE VI INDUCTION MOTOR DESIGN** **7**

Main dimensions – stator design – Cage rotor design – Slip ring rotor design – Determination of equivalent circuit parameters.

**Total Hours : 45**

**REFERENCES:**

1. Edward Hughes, Electrical Technology, , Tata McGraw Hill Publication, 2001.
2. H. Cotton, Electrical Technology, Tata McGraw Hill Publication, 1999.
3. A.E. Fitzgerald et.al. Electrical Machinery, Tata McGraw Hill Publications, 2003.

**OUTCOMES:**

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

- Ability to understand the rudiments of rotating AC machines.
- Ability to analyze problems on rotating AC machines.

**EEB2214 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**

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-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.

**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 low priced 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, 1995 (MATLAB Reference).

**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.

**LSB2181 BIOLOGY FOR ENGINEERS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- The aim of the course is to introduce basic biological concepts to the engineering students to promote cross-breeding of ideas. In particular,
- 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 AND SENSORS** **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 Publications 8th Edition, 2008.
3. Scott Freeman, “Biological Sciences”, Printice Hall, 2002.

**OUTCOMES:**

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

- 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.

| ENB2282 | CONFIDENCE BUILDING AND BEHAVIORAL SKILLS (Common to all Branches) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**OBJECTIVE:**

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

**LAB ACTIVITIES**

**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.

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

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

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

| EEB2215 | MACHINES LAB II | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVE:**

- To experimentally verify the performance and characteristics of Alternator, Synchronous motor and 3-phase induction motor.

**LIST OF EXPERIMENTS:**

1. Regulation of alternators by EMF method.
2. Regulation of alternators by MMF method.
3. Regulation of alternators by Potier Triangle method.
4. Load test on a 3-phase alternator.
5. Regulation of a salient pole alternator by Slip test.
6. V and inverted V curves of a synchronous motor.
7. Load test on a 3-phase squirrel cage induction motor.
8. Load test on a 3-phase slip ring induction motor.
9. No load and blocked rotor tests on a 3-phase induction motor to draw the equivalent circuit and circle diagram.
10. Load test on single phase induction motor.
11. No load and blocked rotor tests on a 1-phase induction motor.
12. Performance study of induction generator.

**Total Hours : 45**

**OUTCOME:**

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

- Ability to conduct experiments on induction and synchronous machines.

| EEB2216 | CONTROL SYSTEMS LAB | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVE:**

- To provide a platform for understanding the basic concepts of linear control theory and its application to practical systems.

**LIST OF EXPERIMENTS**

1. Transfer function of DC Servomotor.
2. Transfer function of AC Servomotor.
3. Transfer function of separately excited DC Generator.
4. Transfer function of Armature controlled and field controlled DC Motor.
5. Digital simulation of type-0 and type-1 system.
6. Digital simulation of linear systems.
7. Stability analysis of linear systems using Bode plot.
8. Stability analysis of linear systems using Root locus/Nyquist plot.
9. Digital control of first order plant (P, PI and PID).
10. Design and implementation of compensators.
11. Study of synchro.
12. Study of stepper motor.

**Total Hours : 45**

**OUTCOMES:**

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

- Ability to determine the transfer function of d.c generator, d.c motor, d.c and a.c servomotors.
- Obtain the stability of the system using Bode, Root locus and Nyquist plot.
- Design lag, lead and lag-lead compensators.

| EEB2217 | BASIC SIMULATION LAB | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVE:**

- The aim of this course is to make the students to understand the modeling of basis electrical and electronic circuits, the transient response of RLC circuits and behavior of transistors, amplifiers and logic gates in PSPICE and MATLAB simulation software.

**LIST OF EXPERIMENTS**

Experiments in PSPICE simulation

1. Study of various commands of PSPICE.
2. To obtain Thevenin's equivalent circuit of a resistive network.
3. To obtain transient response of a series R-L-C circuit for step voltage input.
4. To obtain transient response of a parallel R-L-C circuit for step current input
5. To obtain the characteristics of PN junction diode, Zener diode.
6. To obtain output characteristics of CE NPN transistor.
7. To obtain frequency response of a R-C coupled CE amplifier

**Experiments in MATLAB simulation**

1. Study of various basic tools of MATLAB.
2. Verification of KVL and KCL
3. To obtain Norton's equivalent circuit of a resistive network.
4. Three phase power measurement by two wattmeter method.
5. To analysis the operation of phase shift and wein bridge oscillators.
6. To analysis the operation of Hartley and Colpit oscillators.
7. Designing of different waveform generators.

**Total Hours : 45**

## REFERENCES:

1. Irvine, Calif, “PSPICE Manual”, Microsim Corporation, 1992.
2. Paul W. Tuinenga, “SPICE : A guide to circuit Simulation and Analysis Using PSpice”, Prentice Hall, 1992.
3. M.H. Rashid, “SPICE for Circuits and Electronics Using PSPICE”, Prentice Hall of India, 2000.

## OUTCOMES:

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

- To simulate various electric circuits and electronic circuits using PSPICE and MATLAB simulation.
- Apply modern simulation tools such as PSPICE – MATLAB design, analyses, and performance evaluations of electrical and electronics circuits and systems.

## SEMESTER VI

**EEB3211 POWER ELECTRONICS AND DRIVES**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- To make the students learn the fundamentals of power electronic components, circuit analysis techniques and design skills.
- To acquire basic understanding of various power converter modules.
- To acquire the knowledge and applications of modern devices.

**MODULE I POWER SEMI CONDUCTOR DEVICES** **8**

Study of Switching devices - Construction, Theory of operation and switching characteristics of SCR, TRIAC, MOSFET and IGBT- snubbers-Gate Drive Circuitry for Power Converters – Case study - IR 21XX series MOSFET / IGBT drivers and MOC 30XX series SCR /TRIAC drivers.

**MODULE II PHASE CONTROLLED CONVERTERS** **8**

AC–DC Converters - Single phase and Three phase controlled converters - Inverter operation - Effect of source impedance on Current Commutation Dual Converters- AC-AC Converters - AC–AC Voltage Controller Cycloconverters - Matrix Converters.

**MODULE III INVERTERS** **7**

Single phase and Three phase (both 120°and 180°Modes) Inverters - synthesizing sinusoidal output - Sine-PWM - Space Vector PWM - Multilevel inverters - Matrix converters (Direct Link System)- Uninterruptible power supplies

**MODULE IV DC-DC CONVERTERS** **6**

Switching Analysis in steady state – Buck, Boost and Buck- Boost converters- Voltage Regulation by PWM- Bi-directional Switching - Feedback controller design using Bode plot- Flyback converters - Forward converters-soft-switching – ZVS – ZCS- Synchronous Buck Converter- PWM and Phase-Shift Modulated converters.

**MODULE V SOLID STATE DC DRIVES** **10**

Drive Classifications-Load Profiles - Characteristics- DC Moto representation Four Quadrant Operation - Thyristor Converter Drive – Buck Converter fed DC Motor– Closed – loop Systems –Steady state analysis-Importance of loop gain- Integral controller- Stability-Disturbance Rejection.

**MODULE VI SOLID STATE AC DRIVES** **6**

Inverter - fed induction motor drive - general arrangement - Importance of Achieving full flux -Torque–speed characteristics with constant–v/f operation - open loop and closed loop Speed control – vector control - synchronous motor drives - open loop and self - synchronous operation - Electric and Hybrid Electric Vehicles.

**Total Hours : 45**

**REFERENCES:**

1. Ned Mohan,Undeland and Robbin, "Power Electronics - converters, Application and design", John Wiley and sons.Inc, New York,1995.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, New Delhi, 1995.
3. Austin Hughes, "Electric Motors and Drives- Fundamentals, Types and Applications", Newnes 2006.
4. Rashid M.H., "Power Electronics Hand Book", Academic Press, USA 2007.
5. Ned Mohan, "Power Electronics: A First Course", John Wiley and sons.Inc,New York, 2012.
6. P.C Sen., "Modern Power Electronics", Wheeler publishing Co, 1st Edition, New Delhi, 1998.
7. P.S.Bimbra, "Power Electronics", Khanna Publishers, 11th Edition, 2003.

**OUTCOMES:**

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

- Technical information on the design of Circuits and Converters based on modern Power Electronics devices.
- Analysis and design of efficient Electrical Drives.

**EEB3212 PROTECTION AND SWITCHGEAR**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To understand the characteristics and functions of relays and protection schemes.
- To understand the problems associated with circuit interruption by a circuit breaker.

**MODULE I INTRODUCTION** **6**

Importance of Protective schemes for electrical apparatus and power system- Qualitative review of faults and fault currents – relay terminology - definitions – essential qualities of protection - CT's and PT's and their applications in protective schemes.

**MODULE II PROTECTION AGAINST OVER VOLTAGES AND NEUTRAL GROUNDING** **7**

Generation of Over Voltages in Power Systems - Protection against Lightning Over Voltages –Shielding – Non metallic shielding methods - Valve type and Zinc-Oxide Lighting Arresters – Impulse Ratio -Standard Impulse Test Wave - Volt-Time Characteristics - BIL - Insulation Coordination.

**MODULE III OPERATING PRINCIPLES AND RELAY CHARACTERISTICS** **8**

Electromagnetic relays – overcurrent, directional and non-directional, distance, negative sequence, differential and under frequency relays – Introduction to static relays.

**MODULE IV APPARATUS PROTECTION** **8**

Main considerations in apparatus protection – transformer, generator and motor protection – protection of bus bars. Transmission line protection – zones of protection.

**MODULE V THEORY OF CIRCUIT INTERRUPTION 8**

Physics of arc phenomena and arc interruption – DC and AC circuit breaking – restriking voltage and recovery voltage – rate of rise of recovery voltage – resistance switching – current chopping – interruption of capacitive current

**MODULE VI CIRCUIT BREAKERS 8**

Types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breakers – comparative merits of different circuit breakers – testing of circuit breakers.

**Total Hours : 45**

**REFERENCES:**

1. Ravinranath.B and Chander.N, "PowerSystem Protection and Switchgear", New Age International (P) Publishers,1977 (2005 Reprint).
2. Chakrabarti.A.Soni.M.L Gupta, P.V. "A Text book on Power System Engineering", Dhanpat Co. Pvt. Ltd., 2008.
3. C.L.Wadhwa; "Electrical Power Systems", New Age International Pvt. Ltd., 2006.
4. Patra S.Basu S.K & Choudary.S, "Power System Protection", Oxford and IBH Publishing Co. Ltd.,1983.
5. Sunil S.Rao, "Switch Gear and Protection", Khanna Publishers, New Delhi, 1986.

**OUTCOMES:**

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

- Analyse the fault level and accordingly design the protective devices in a power system for power frequency voltages and currents.
- Ability to design insulation co – ordination between protected equipments and protective devices so that major equipment are protected against surges.

| EIB3283 | PLC, SCADA & DCS (Programmable Logic Controllers (PLC), Supervisory Control and Data Acquisition System (SCADA) and Distributed Control System (DCS)) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide fundamental knowledge about the computer networks.
- To give an introductory knowledge about PLC and the programming languages.
- To give adequate knowledge about the applications of PLC and SCADA.
- To give basic knowledge in the architecture and local control unit of distributed control system.
- To give adequate information in the interfaces used in DCS.

**MODULE I PROGRAMMABLE LOGIC CONTROLLER 8**

Evolution of PLCs — Sequential and programmable controllers — PLC Architecture - Programming of PLC — relay logic — Ladder logic — Functional blocks programming, sequential function chart.

**MODULE II COMMUNICATION IN PLCS 8**

Requirement of communication networks for PLC — connecting PLC to computer — Use of Embedded PC as PLC - PLC applications in Industrial Automation.

**MODULE III INTRODUCTION TO SCADA 7**

SCADA - Data acquisition system, evaluation of SCADA, communication technologies, monitoring and supervisory functions. Interfacing of PLC with SCADA. SCADA system components.

**MODULE IV SCADA ARCHITECTURE 7**

Various SCADA Architectures, advantages and disadvantages of each system, SCADA Communication - wired and wireless methods and fiber optics, open standard communication protocols.

**MODULE V DISTRIBUTED CONTROL SYSTEM 8**

Introduction to DCS-Evolution, Architectures-Hybrid, centralized computer control, Generalized DCS. Architectures-Comparison, Local control unit, LCU-

Configurations, Comparison, Process interfacing issues, Communication facilities.

**MODULE VI INTERFACES IN DCS** **7**

Operator interfaces-Low level and High level operator interfaces, Operator displays, Engineering interfacing- Low level and High level engineering interfaces, Factors to be considered in selecting DCS.

**Total Hours : 45**

**REFERENCES:**

1. G.K.Mc-Millan, “Process / Industrial Instrument and controls and handbook”, Mc Graw Hill, New York, 1999.
2. Hughes T, “Programmable Logic Controllers”, ISA Press, 1989.
3. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes, 1st Edition, 2004.
4. Petrezeulla, “Programmable Controllers”, Mc-Graw Hill, 1989.
5. Michael P.Lucas, “Distributed Control System”, Van Nastrand Reinhold Company, New York, 1986.

**OUTCOME:**

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

- Basics of Computer networks, Ladder logic programming and SCADA.

**GEB3201 ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
**3 0 0 3**

**OBJECTIVE:**

- 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 & types, Soils – formation & components – soil profile.

Atmosphere – structure & composition – weather & climate – tropospheric airflow Hydrosphere – water budget – hydrological cycle – Rainwater & precipitation, River Water & solids, Lake Water & stratification, Seawater & solids, soil moisture & groundwater.

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

**MODULE II BIOLOGICAL ENVIRONMENT** **7**

Cellular basis of life – prokaryotes & eukaryotes – cell respiration – photosynthesis – DNA & RNA – genetically modified life Population dynamics – population – population growth – survival & growth curves – population regulation – future of human population Biological communities - Five major interactions - competition, predation, parasitism, mutualism and commensalism – Concepts of habitat & niche – natural selection – species richness & species diversity – ecological succession & climax.

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

**MODULE III IMPACTS ON NATURAL RESOURCES & CONSERVATION** **9**

Biological resources – nature & 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 & Industrial development – deforestation, salinisation, soil erosion, and desertification – Modern Agriculture & Impacts Major extractive industries – metals & ores – building materials – peat – fossil fuels (coal, oil, natural gas)

Waste management – types of solid wastes – disposal options –reduce, recovery & reuse – waste minimization, cleaner production technology.

**MODULE IV IMPACTS ON WATER & AIR AND CONSERVATION 8**

Water pollution – organic oxygen demanding wastes – anthropogenic phosphate & 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 & secondary pollutants – anthropogenic, xenobiotic, synergism, sources & sink, residence time, levels & 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 & significance – steps in EIA – methods – precautionary principle & polluter pays principle – role of NGOs & 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**

**REFERENCES:**

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. James Lovelock, "The Revenge of Gaia: Why the Earth is Fighting Back and How We Can Still Save Humanity", Penguin UK, 2007.
3. Larry W. Canter, "Environmental Impact Assessment", McGraw-Hill, 1996.
4. Bryan G. Norton, Sustainability: "A Philosophy of Adaptive Ecosystem Management", 2005.
5. David McGeary & Charles C Plummer, "Physical Geology, Earth Revealed", WCB McGraw Hill, 1998.
6. G Tyler Miller, Jr., Thomson, "Environmental Science (Working with the Earth)", Brooks/Cole, 2006.

**OUTCOME:**

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

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

| EEB3213 | SELF LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 2 | 0 | 2 |

**OBJECTIVES:**

- A student is expected to do the self learning course on his own, relating to the area of Project work.
- For discussion and interaction with the project supervisor, one hour per Week is allocated.
- The credit for the EEB3213 Self Learning Course IS "TWO".
- A "Self Learning Course-EEB3213" on the topic of student's choice has been introduced during VI Semester.
- The course for "Self Learning" shall be relevant to the student's project work.
- The course content and the materials for self learning course shall be decided by the respective supervisor and the Head of the Department and it will be approved by the Dean (Academic).
- A broader choice will be given to the student so that a student is permitted to choose a course in the areas of his/her interest.
- The Self Learning Course shall be introduced as a "Core Course".

**EEB3214 POWER ELECTRONICS & DRIVES LAB**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To acquire knowledge on design and operation of several common circuits relevant to the field of power electronics.
- To expose the students to the Micro Controller based controlling techniques.

**LIST OF EXPERIMENTS:**

1. Designing and fabrication of zero crossing detector circuit for SCR and TRIAC triggering.
2. Designing and fabrication of SCR and TRIAC triggering circuits using MOC 30XX series
3. Designing and fabrication of gate driver circuits for MOSFETs and IGBTs using self oscillating driver ICs (IR 215X series)
4. Designing and fabrication of gate driver circuits for MOSFETs and IGBTs using high voltage driver ICs (IR 21XX series)
5. Study of interfacing PIC microcontrollers with PC.
6. Gate pulse generation using PIC Controllers (Frequency modulation and Pulse Width Modulation techniques).
7. Fabrication of TRIAC based lighting control using PIC microcontroller.
8. Fabrication of SCR based converters (open loop).
9. Fabrication of converter with closed loop using PIC microcontroller based PI and PID controllers.
10. Fabrication of inverters using MOSFET and IGBT (open loop).
11. Fabrication of inverters with closed loop using PIC microcontroller based PI and PID controllers.
12. Fabrication of Chopper with closed loop using PIC microcontroller based PI and PID controllers.

**Total Hours : 45**

**OUTCOMES:**

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

- Ability to design switching power converters and inverters.
- This course gives a "running start," that can lead to a useful understanding of the PIC Controller based Converters.

| EIB3284 | PLC, SCADA & DCS LAB | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To know fundamentals of PLC and DCS and its Programming.
- To provide hands on experience with industrial PLC and DCS.
- To know Hardware structure of PLC and DCS.
- To have an exposure to basics concepts of SCADA.

**LIST OF EXPERIMENTS:**

1. Development of Ladder program for simple on-off applications.
2. Development of Ladder program for Timing and counting applications.
3. Configuring Screens and Graphics (DCS).
4. Programming of HMI interfacing with PLC.
5. Develop simulate programming using FBD in Delta –V.
6. Tag Assignments to Field Devices in DCS.
7. DCS based PID control for temperature loop.
8. DCS based PID control for level loop.
9. DCS based PID control for pressure loop.
10. Communicate PLC with SCADA & DCS.

**Total Hours : 45**

**OUTCOMES:**

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

- Appropriate knowledge and skills in Industrial automation systems with the use of DCS, PLCs, and SCADA.
- An appropriate mastery of knowledge, techniques, skills and modern tools of their disciplines.
- An ability to apply current knowledge and adapt to engineering applications of mathematics, science, engineering and technology.

- An ability to conduct, analyze and interpret experiments and apply experimental results to improve processes,
- An ability to apply creativity in design of systems, components or processes appropriate to program objectives.

| EEB3215 | INDUSTRIAL INTERNSHIP | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | * | ** |

* Minimum 30 days of Industrial Training, in a single slot, is required.

** The credit to be awarded for "EEB3215 Industrial Training course is "one"

*** The credit for the successful completion of "EEB3215 Industrial Training" course will be awarded in the seventh semester, while a student can complete the course in a single slot between 6th and 8th semester Vacation.

- The students of EEE will be allowed to undergo training only in reputed Companies/research labs/design centres.
- For the same, a student needs to get an approval from the Head of the Department, before applying for the industrial training.
- The evaluation for the industrial training programme shall be done by the company /research labs/design centres.
- The evaluation format will be prepared by the Department and it will be sent to the Company/research labs/design centres offering industrial training.
- After the successful completion of “EEB3215 Industrial Training”, the student will be awarded "ONE CREDIT” and the same will be accounted in the 7th Semester [Grade Point Average(GPA)].
- A report as the industrial training along with the industry certificate needs to be submitted to the department.

## SEMESTER VII

**EEB4101 POWER SYSTEM OPERATION & CONTOL**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide knowledge about economics of power generation.
- To provide knowledge about real power frequency control and voltage control.
- To acquire knowledge about excitation system.
- To provide basic knowledge about the economic dispatch and unit commitment.

**MODULE I INTRODUCTION** **7**

Types of load – load Characteristics – load curves and load duration curves – economics of generation - generation reserves – overview of system operation and control

**MODULE II REAL POWER FREQUENCY CONTROL** **8**

Fundamentals of Speed Governing mechanism and its modeling – Speed load characteristics – Load sharing between two synchronous generators in parallel – concept of control area Need for frequency control -Load frequency control of single area power system – modeling- static and dynamic analysis of uncontrolled and controlled cases –Two area power system-modeling, static and dynamic analyze controlled and uncontrolled cases.

**MODULE III EXCITATION SYSTEM** **7**

Types of excitation system - Modeling – static and dynamic analysis root loci of AVR – Stability compensation

**MODULE IV REACTIVE POWER AND VOLTAGE CONTROL** **8**

Requirements of voltage and reactive power control – relation between node voltage, power and reactive power at a nodes – generation and absorption of reactive power – analysis of reactive power absorbed and generated by the transmission line – methods of voltage control-reactive power compensation-tap changing transformers.

**MODULE V UNIT COMMITMENT AND ECONOMIC DISPATCH 8**

Unit commitment - Need – constraints, solution methods, priority listing scheme – numerical problems.

Incremental cost curve – co- ordination equation without and with losses – analytical solution for - computer approach to iteration method-flow chart – transmission loss formula by B coefficient method.

**MODULE VI COMPUTER CONTROL OF POWER SYSTEMS 7**

Energy control centre – functions – monitoring, data acquisition and control-system hardware configuration – SCADA and EMS functions – power system security –various operation states.

**Total Hours : 45**

**REFERENCES:**

1. Olle. I. Elgerd, “Electric Energy Systems Theory – An Introduction”, Tata Mc Graw Hill Publishing company Ltd,New Delhi, Second Edition, 2003.
2. Allen J.Green Wood and Bruce F.Wollenberg, “Power Generation, operation and control”, John Wiley and spons, Inc.,2003.
3. P.Kundur, “Power System Stability and Control”, Mc.Graw Hill Publications, USA,1994.34.D.P.Kothari and I.J.Nagrath”, Modern Power System Analysis”, Third edition, Tata Mc Graw Hill Publishing company limited, New Delhi, 2003.
4. N.V.Ramana, “Power System Operation and control”, Pearson Education India, 2010.
5. Abhijit chakrabarti and Sunita Halder, “Power System analysis –Operation and control” Prentice Hall of India Learning private limited, 2010.

**OUTCOMES:**

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

- Ability to understand the basic economic concepts of power system operation.
- Ability to use his knowledge to operate the power system under most economic conditions.
- Work with power system planning, design and operation companies.

**EEB4102 HIGH VOLTAGE ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

This course Imparts a detailed knowledge on:

- Breakdown in gaseous, liquids and solid dielectrics.
- Generation and measurement of High voltages and currents.
- Different High voltage testing methods.

**MODULE I OVER VOLTAGE PHENOMENON AND INSULATION CO-ORDINATION 8**

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

**MODULE II BREAK DOWN IN GASEOUS AND LIQUID DIELECTRICS 7**

Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law - Streamer theory-Breakdown in non uniform fields and corona discharges. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids.

**MODULE III BREAK DOWN IN SOLID DIELECTRICS 8**

Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, Solid dielectrics used in practice.

**MODULE IV GENERATION OF HIGH VOLTAGES AND CURRENTS 8**

Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Triggering and control of impulse generators.

**MODULE V MEASUREMENT OF HIGH VOLTAGES AND CURRENTS 7**

Measurement of High DC, AC and impulse voltages, Measurement of High DC, AC and impulse currents, Digital techniques in high voltage measurements.

**MODULE VI HIGH VOLTAGE TESTING** **7**

High voltage testing of Transformers, Insulators and bushings, cables, Isolators and circuit breakers, surge Arresters- Radio Interference measurements.

**Total Hours : 45**

**REFERENCES:**

1. C.L.Wadhwa, “High Voltage Engineering”, by New Age Internationals (P) Limited, 1997.
2. Ravindra Arora, Wolfgang Mosch, “High Voltage Insulation Engineering”, by New Age International (P) Limited, 1995.
3. M.S.Naidu and V. Kamaraju - High Voltage Engineering”, by – TMH Publications, 3rd Edition, 2000.
4. E.Kuffel, W.S.Zaengl, J.Kuffel, “High Voltage Engineering”, Fundamentals by Elsevier, 2nd Edition, 1999.

**OUTCOMES:**

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

- Knowledge of the electrical properties of various gaseous,liquid and solid insulating materials.
- Generation of high DC, AC and impulse voltage measurement.
- High voltage testing of various equipments used in power systems.

**EEB4103 EVOLUTIONARY COMPUTING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory.
- To provide comprehensive knowledge of fuzzy logic control and its application to real time systems.
- To expose the ideas of GA and EP in optimization and control.

**MODULE I FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS 9**

Objectives, history, biological inspiration, neuron model, McCulloch-Pitts neuron model, single-input neuron, multi-input neuron, network architectures, perceptron architecture, single-neuron perceptron, multi-neuron perceptron, perceptron learning rule, constructing learning rules, training multiple-neuron perceptrons.

**MODULE II ASSOCIATIVE NETWORKS 9**

Simple associative networks, auto-associative and hetero-associative nets, learning in neural nets, supervised and unsupervised learning, unsupervised hebb rule, kohonen rule, ADALINE and MADALINE network, back propagation neural networks, hopfield networks, adaptive networks, applications.

**MODULE III FUZZY SET THEORY 6**

Fuzzy versus crisp, crisp sets, fuzzy sets, operations and properties, membership function, crisp relations, fuzzy relations.

**MODULE IV FUZZY SYSTEMS 6**

Crisp logic – fuzzy logic – fuzzy rule based system- defuzzification methods – applications – Greg Viot's fuzzy cruise controller - fuzzy logic control for LFC.

**MODULE V FUNDAMENTALS OF GENETIC ALGORITHMS 7**

Genetic algorithms, history, basic concepts, working principle, encoding ,fitness function, reproduction.

**MODULE VI GENETIC MODELING AND APPLICATIONS 8**

Genetic operators, cross over types, mutation operator, coding steps of GA, convergence characteristics, applications of AI techniques, load forecasting , load flow studies.

**Total Hours : 45**

**REFERENCES:**

1. Laurance Fausett, Englewood cliffs, N.J., “Fundamentals of Neural Networks”, Pearson Education, 1992.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Tata McGraw Hill,1997.
3. David Goldberg, “Genetic Algorithms and Machine learning”, PHI.
4. Wassermann, P. D. “Neural Computing”, Van Reinhold, 1988.
5. Zimmermann, H. J., “Fuzzy Set Theory and Its Applications”, 2nd Edition, Kluwer Academic Publishers, 2000.
6. Martin T. Hogan, Howard B.Demuth. M, “Neural network design”, 4th Edition, 2005.
7. Zureda, J.M., “Introduction to Artificial Neural Systems”, Jaico publishing house Bombay, 1994.
8. Bose N.K, Liang P. “Neural Network Fundamentals with graphs”, “Algorithms and applications”, TMH Pub. Co. Ltd, 2001.
9. S.Rajasekaran, G.A.Vijayalaksmi Pai, “Neural Networks, Fuzzy logic and Genetic algorithms Synthesis and Applications”, by PHI private learning ltd. New Delhi, 2011.

## OUTCOMES

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

- Design suitable neural networks, fuzzy systems, genetic representations with appropriate fitness functions for simple problems.
- Know the key issues in using these techniques for search of difficult search-spaces.
- Be aware of the different approaches and different applications in the field.

| EEB4105 | POWER SYSTEM SIMULATION LAB | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1 |

**OBJECTIVES:**

- To study steady state analysis of Power systems using Gauss seidal, Newton-Raphson and Fast decoupled power flow methods.
- To study and analyze transient stability of power systems.
- To study and analyze electromagnetic transients in power systems.

**LIST OF EXPERIMENTS:**

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Network Matrices and Solution of Networks.
3. Power Flow Analysis I: Solution of Power Flow using Gauss-Seidel Method.
4. Power Flow Analysis II: Solution of Power Flow using Newton-Raphson and Fast-Decoupled Methods.
5. Short Circuit Analysis.
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System.
7. Transient Stability Analysis of Multi machine Power Systems.
8. Electromagnetic Transients in Power Systems.
9. Load - Frequency Dynamics of Single and Two-Area Power Systems.
10. Unit Commitment and Economic Dispatch in Power Systems.

**Total Hours : 45**

**OUTCOMES:**

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

- Perform load flow studies using Gauss seidal , Newton Raphson and fast decoupled method.
- Short circuit studies for singe phase to ground fault and three phase fault.
- Perform transient and small signal stability study.
- Perform load frequency dynamics of single area and two area power systems.
- Find optimal scheduling using economic dispatch programme.

**EEB4106** **COMPREHENSION** **L T P C**
**0 0 3 1**

- The objective of comprehension is to provide opportunity for the student to apply the knowledge acquired during the academic programme to real life problems that he/she may have to face in future as an engineer.
- Three periods per week shall be allotted in the time table for this activity and this time shall be utilized by the student to receive guidance from the members of faculty on solving real life problems, practice solving these problems and on group discussions, seminar presentations, library reading as assigned by the faculty member in-charge. The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued from time to time. For which.

1. Two written tests of objective type question from the courses up to 6$^{th}$ semester may be conducted.
2. Seminars on latest topics may be conducted.
3. Oral Exams on G.K, “Technical knowledge, reasoning”, may be conducted.
4. Group discussions may be conducted.

**EEB4107 CAD FOR ELECTRICAL APPARATUS – LAB**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1 |

**OBJECTIVE:**

- To impart knowledge in writing programmes to tackle and solve problems in electrical engineering.

**LIST OF EXPERIMENTS:**

1. C/C++ Programming Exercises- Solution of Differential equations :

**MATLAB and SIMULINK-**

2. Simulation of Buck, Boost and Buck-boost converters
3. Simulation of 1-Ph and 3-Ph VSI with sine-triangle modulation
4. Solution to RLC circuit and resonance problems
5. Solution to network theorems
6. Pole-zero plots

**PSPICE EXERCISES**

7. Switched mode power supplies
8. Single phase and Three phase PWM Inverters.
9. Calculation of voltage regulation and efficiency of shorts, medium and long lines
10. Fault analysis in power systems.

**OUTCOMES:**

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

- Ability to write software programme, debug and run the same, for any problem in electrical engineering.

**Total Hours :45**

| EEB3215 | INDUSTRIAL TRAINING | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 01 | *** |

* Minimum 30 days of Industrial Training, in a single slot, is required.

** The credit to be awarded for "EEB3215 Industrial Training course is "one"

* The credit for the successful completion of "EEB3215 Industrial Training" course will be awarded in the seventh semester, while a student can complete the course in a single slot between $6^{th}$ and $8_{th}$ semester Vacation.

- The students of EEE will be allowed to undergo training only in reputed Companies/research labs/design centres.
- For the same, a student needs to get an approval from the Head of the Department, before applying for the industrial training.
- The evaluation for the industrial training programme shall be done by the company /research labs/design centres.
- The evaluation format will be prepared by the Department and it will be sent to the Company/research labs/design centres offering industrial training.
- After the successful completion of “EEB3215 Industrial Training", the student will be awarded "ONE CREDIT" and the same will be accounted in the $7^{th}$ Semester [Grade Point Average(GPA)].
- A report as the industrial training along with the industry certificate needs to be submitted to the department.

The exceptional achievements of the students in co-curricular activities are recognized by awarding special credits to the achievements in the grade sheet. The grade awarded will not be considered for the calculation of GPA and CGPA.

## PROFESSIONAL ELECTIVES (PE)

### Professional Electives Category

1. Power System
2. Power Electronics & Drives
3. High Voltage Engineering
4. Electronics, Communication & Instrumentation
5. Computer Science & Information Technology

## POWER SYSTEM

**EEBX01 POWER DISTRIBUTION SYSTEM**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To impart knowledge on

- The importance of the design of distribution systems.
- Various components of the distribution systems.
- The methods of analysis of distribution systems.
- Protection of the distribution systems.
- Concepts of demand side management.

**MODULE I INTRODUCTION TO DISTRIBUTION SYSTEMS 7**

General - Introduction to distribution system, an overview of the role of computers in distribution system planning. Load modeling and characteristics: Definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor - Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics.

**MODULE II DISTRIBUTION FEEDERS 7**

Design consideration of Distribution feeders - Radial and loop types of primary feeders - voltage levels - feeder loading.

**MODULE III SUBSTATIONS AND GROUNDING SYSTEM 8**

Types of substations - Design considerations of the secondary distribution system - Bus-bar arrangements - Substation bus schemes - Location of substations - Rating of a distribution substation - Service area with primary feeder - Benefits derived through optimal location of substations. Resistance of grounding systems - Resistance of driven rods, resistance of grounding point electrode - Grounding grids - Design principles of substation grounding system - Neutral grounding.

**MODULE IV DISTRIBUTION SYSTEM ANALYSIS 8**

Voltage drop and power loss calculations - Derivation for volt-drop and power

loss in lines - Manual methods of solution for radial networks - Three-phase balanced primary lines - Non-three-phase primary lines.

**MODULE V PROTECTIVE DEVICES AND COORDINATION 8**

Objectives of distribution system protection - Types of common faults and procedure for fault calculation. Protective devices - Principle of operation of fuses, circuit reclosers, line sectionalizer and circuit breakers. Coordination of protective devices - General coordination procedure

**MODULE VI CONCEPTS AND METHODS OF DSM, LOAD CONTROL 7**

Load control - Energy efficiency - Load management - DSM planning, design, marketing, impact assessment - Direct, distributed and local control – Interruptible load - Configuration of control system for load control - Assessment of impact on load shape.

**Total Hours :45**

**REFERENCES:**

1. Turan Gonen, “Electric Power Distribution System Engineering”, Mc.Graw-Hill Book Company, 1986.
2. A.S.Pabla, “Electric Power Distribution”, Tata Mc Graw-Hill Publishing Company, 5th Edition, 2003.
3. V.Kamaraju, “Electrical Power Distribution Systems”, Tata Mc Graw Hill publication, 2009.
4. S.N. Singh, “Electric Power Generation, Transmission and Distribution”, Prentice Hall of India Pvt. Ltd, New Delhi, 2002.
5. Luces M.Fualkenberry, Walter Coffer, “Electrical Power Distribution and Transmission”, Pearson Education, 1996.
6. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Publishing Company, 2003
7. Gellings, C.W. and Chamberlin, J. H., “Demand-Side Management: Concepts & Methods”, Firmont Press, 1993.
8. Gellings, C.W. and Chamberlin, J. H., ‘Demand-Side Management Planning’, Firmont Press, 1993.
9. B.R.Gupta, ‘Power System Analysis and Design’, S.Chand, New Delhi, 2003.

**OUTCOMES:**

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

- Various components of the distribution systems.
- The parameters to be analyzed for an effective distribution system design.
- The importance of Demand side management.

**EEBX02 POWER SYSTEM PLANNING AND RELIABILITY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To impart knowledge on:

- Load forecasting in power systems.
- Basic probability theory and concepts of reliability analysis.
- Factors influencing the reliability of generation systems, transmission systems and distribution systems.
- Expansion planning.

**MODULE I INTRODUCTION TO POWER SYSTEMS AND LOAD FORECASTING** **8**

A perspective: brief introduction to structure of power systems, growth of power system in India, present Indian power industry, GRID formation, concept of National GRID.

Objectives of forecasting - Load growth patterns and their importance in planning - Load forecasting based on discounted multiple regression technique - Weather sensitive load forecasting - Determination of annual forecasting - Use of AI in load forecasting.

**MODULE II INTRODUCTION TO RELIABILITY ANALYSIS** **7**

Review of probability distribution, binomial distribution and exponential distribution – Network modeling and evaluation of simple and complex systems – System reliability evaluation using probability distributions – Frequency and duration techniques. Reliability concepts: Meantime to failure – Series and parallel systems – MARKOV process – Recursive technique.

**MODULE III GENERATION SYSTEM RELIABILITY ANALYSIS** **8**

Probabilistic generation and load models - Determination of reliability of isolated and interconnected generation systems – Energy transfer and off peak loading.

**MODULE IV TRANSMISSION SYSTEM RELIABILITY ANALYSIS** **7**

Deterministic contingency analysis - Probabilistic load flow - Fuzzy load flow - Probabilistic transmission system reliability analysis - Determination of reliability indices like LOLP and expected value of demand not served.

**MODULE V EXPANSION PLANNING** **7**

Basic concepts on expansion planning - Procedure followed to integrate transmission system planning, current practice in India - Capacitor placement problems in transmission systems and radial distribution systems.

**MODULE VI DISTRIBUTION SYSTEM PLANNING AND RELIABILITY** **8**

Introduction, sub transmission lines and distribution substations - Design primary and secondary systems - Distribution system protection and coordination of protective devices. Distribution system reliability evaluation: Reliability analysis of radial systems with perfect and imperfect switching.

**Total Hours : 45**

**REFERENCES:**

1. R.L .Sullivan, "Power System Planning", Heber Hill, 1987.
2. Roy Billington, “Power System Reliability Evaluation”, Gordan & Breach Scain Publishers, 1990.
3. A.S.Pabla, “Electric Power Distribution”, Tata Mc Graw-Hill Publishing Company, 5th edition, 2003.
4. Turen Gonen, “Electric Power Distribution System Engineering”, McGraw Hill, 1986.
5. Turen Gonen, “Electric Power Transmission System Engineering Analysis and Design”, McGraw Hill, 2nd Edition, 2010.
6. Eodrenyi, J., “Reliability Modelling in Electric Power System”, John Wiley, 1980.
7. B.R. Gupta, “Power Sytem Analysis and Design”, S.Chand, New Delhi, 2003.

**OUTCOMES:**

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

- Familiarity with load forecasting techniques.
- Familiarity with reliability analysis techniques.
- Expansion planning of power systems.

**EEBX03 EHV AC AND DC TRANSMISSION ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVE**

- To provide an in depth understanding of the different aspects of Extra High Voltage AC and DC transmission system analysis and design.

**MODULE I INTRODUCTION** **8**

Need of EHV transmission-standard transmission voltages-comparison of EHV AC and HVDC transmission systems and their applications & limitations-surface voltage gradients in conductor- distribution of voltage gradients on sub-conductors- mechanical considerations of transmission lines-modern trends in EHV AC and HVDC transmission.

**MODULE II PARAMETERS OF EHV LINES** **8**

Resistance of conductors- bundle conductors-inductance of EHV Line configurations line capacitance-sequence inductance and capacitance- line parameters for modes of propagation- resistance and Inductance of ground returns.

**MODULE III EHV AC TRANSMISSION** **7**

Corona loss formulas- corona current- audible noise – generation and characteristics corona pulses their generation and properties- radio interference (RI) effects- over voltage due to switching- ferroresonance-reduction of switching surges on EHV system.

**MODULE IV EXTRA HIGH VOLTAGE TESTING AND DESIGN OF EHV LINES** **7**

Characteristics and generation of impulse voltage -generation of high AC and DC voltages- measurement of high voltages by sphere gaps and potential dividers- Consideration for Design of EHV Lines: Design factors under steady state limits- EHV line insulation design based upon transient over voltages-Effects of pollution on performance of EHV lines.

**MODULE V HVDC TRANSMISSION** **7**

Types of dc links- converter station-choice of converter configuration and pulse number- effect of source inductance on operation of converters- Principle of

dc link control- converter controls characteristics- firing angle control- current and excitation angle control- power control-starting and stopping of dc link.

**MODULE VI CONTROL AND PROTECTION OF HVDC LINE 8**

Converter faults- protection against over currents and over voltages-smoothing reactors-generation of harmonics-ac and dc filters- Multi Terminal DC systems (MTDC): Types, control- protection and applications-control of HVDC system desired features of control-control characteristics

**Total Hours : 45**

**REFERENCES:**

1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering" Revised Second Edition, John Wiley.
2. K.R. Padiyar, "HVDC Power Transmission System", Second revised Edition, New Age Int. 2012
3. S. Rao, "EHV-AC and HV DC Transmission Engineering Practice", Khanna Publishers, 2000.
4. Arrillaga J "High Voltage Direct current Transmission" 2nd Edition (London) Peter Peregrinus, IEEE.
5. Hingorani HG and Gyugyi L "Understanding FACTS-concepts and Technology of Flexible AC Transmissions Systems" New York, IEEE Press, 2010.
6. Padiyar K R "FACTS controllers in Power Transmission and distribution" New Delhi, New Age Int. publishers.
7. Clayton R.Paul, "Analysis of multi-conductor transmission lines", Wiley publication, 2000.

**OUTCOME**

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

- Design commercial transmission systems.

**EEBX04 POWER SYSTEM DYNAMICS**

| L | T | P | C |
|---|---|---|---|
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## OBJECTIVES

- To model and analyze the dynamics of power system with synchronous machines, turbines and various controllers.
- To analyze the small signal and large signal disturbances and to design the system with enhanced stability.

## MODULE I INTRODUCTION 8

Concepts and importance of stability in power system operation and design-Basic concepts and definition-Classification of power system stability-complexity of stability problem in large system-Need for reduced models-stability of interconnected systems.

## MODULE II SYNCHRONOUS MACHINE MODELLING 8

Physical description-Park's transformation :flux linkage equations ,voltage equation and torque equation-per unit conversion-normalizing the equation-equivalent circuit-flux linkage state space model with transient and sub transient inductances and time constants- Simplified models(one axis and constant flux linkage), steady state equations and pharsor equation.

## MODULE III MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEMS 8

Excitation system requirements-Elements of Excitation system-Types of Excitation system-Typical excitation system configuration-block diagram and state space representation of IEEE type 1 excitation system-saturation function-stabilizing circuit. Function of speed governing systems-block diagram and state space representation of IEEE steam turbine and hydraulic governor.

## MODULE IV TRANSIENT STABILTY 8

State equation for multimachine –transient stability simulation of multimachine power system with one axis machine model including excitation system and speed governing system using R-K method of fourth order (Gill's Technique), Power system stabilizer.

**MODULE V SMALL SIGNAL STABILTY 8**

System response to small disturbance –Linear model of the synchronous machine and load -modes of oscillation-effect of excitation on dynamic stability-approximation system representation-supplementary stabilizing signals-small signal performance measures.

**MODULE VI ENHANCEMENT OF SMALL SIGNAL STABILITY AND TRANSIENT STABILITY 5**

Methods of enhancing transient stability –methods based on reduction of disturbance severity-methods by increasing synchronizing forces-methods of enhancing small signal stability-Power system stabilizers-delta-omega stabilizer.

**Total Hours : 45**

**REFERENCES:**

1. P.Kundur, “Power System Stability and Control”, Mc Graw-Hill ,1993.
2. P.M.Anderson and A.A Fouad, “Power System Control and stability”, Lowa State university Press, Ames, lowa,1978.
3. R.Ramanujam, “Power system dynamics, Analysis and simulation”, Prentice Hall India Learning Pvt.Ltd., New Delhi, 2009.

**OUTCOMES:**

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

- Ability to model a synchronous machine and its controllers for dynamics studies.
- Ability to analyze small signal and transient stability of power system.
- Understanding the methods to enhance the small signal stability and transient stability.

**EEBX05 POWER SYSTEM TRANSIENTS**

| L | T | P | C |
|---|---|---|---|
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## OBJECTIVES

- To identify and analyze the cause of surges and their propagation and their effect on power system components.
- To understand & distinguish between power frequency and surge voltages and currents and accordingly model the power system components for analysis.

## MODULE I 8

Types of power system transients – modeling of lines for surges and power frequency over voltages – effect of transients & power system components – importance of study of transients in planning.

## MODULE II 8

Lightning phenomenon: charge formation in clouds, rate of charging of thunder clouds, mechanism of lightning strokes, characteristic of lightning strokes - protection against lightning over voltage by shielding &non shielding methods

## MODULE III 8

Circuit closing transients in RL and RLC circuits with sinusoidal excitation to simulate faults – circuit breaker restriking and recovery voltage – double frequency transients.

## MODULE IV 8

Generation of system over voltages - current chopping – reclosing circuit breaker and compound transients – control of switching over voltages.

## MODULE V 8

Wave equations and its solution- travelling voltage and current waves: velocity, attenuation and distortion-reflection,refraction of travelling waves – behaviour at line termination multiple reflections – Lattice diagram.

**MODULE VI** **5**

Over voltage on integrated power system and its simulation and analysis using EMTP.

**Total Hours : 45**

**REFERENCES:**

1. Allan Greenwood, “Electrical Transients in Power Systems”, Wiley Interscience, NewYork, 2nd edition,1991.
2. R.D. Begamudre, “Extra High Voltage AC Transmission Engineering”, Wiley Eastern Limited,1986.
3. Pritidra Choudary, “Electromagnetic Transients in Power System”, John Wiley and sons Inc,1996.

**OUTCOMES:**

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

- Familiarity with transient disturbance on power system.
- Ability to design protection schemes for power frequency, lightning and surges.

**EEBX06 SMART POWER GRID**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To introduce the fundamentals of smart grid and associated Information Technology services.
- To introduce the modeling of devices associated with smart grid.
- To familiarize about the concept of wide area measuring systems (WAMS) and Phasor Measurement units.

**MODULE I RECENT TRENDS IN INFORMATION AND COMMUNICATION TECHNOLOGIES 9**

Distributed services - Web services – Creation and deployment – Application development frameworks – XML – RPC-AXIS- SOAP - Communication models - Service oriented architecture fundamentals.

**MODULE II SMART GRID FUNDAMENTALS 8**

Smart grid structure – Interactive grid – Micro grid – Distributed resources modeling – Communication Infrastructure – Sensing and control devices – Smart grid characteristics.

**MODULE III COMPONENTS AND STANDARDS 8**

Smart grid components – Metering - Virtual power plants – Benefits and cost elements - Pricing regulations – Networking Standards and integration – Analytics.

**MODULE IV AUTOMATION TECHNOLOGIES 8**

Control centre systems – Data management principles – Smart Grid implementation standards and procedure – Operational Issues – Modelling and control – Advanced metering infrastructure – Outage management – Distribution and substation automation – Customer interactions.

**MODULE V CASE STUDY I 7**

Smart meters – Smart grid experimentation plan for load forecasting – Optimal placement of Phasor Measurement Units (PMU) .

**MODULE VI CASE STUDY II** **5**

Coordination between cloud computing and smart power grids- Development of power system models and control and communication software.

**Total Hours : 45**

**REFERENCES:**

1. Tony Flick and Justin Morehouse, " Securing the Smart Grid – Next Generation Power Grid Security", Elsevier Publications, 2011.
2. Ali Keyhani- "Design of Smart Power Grid Renewable Energy Systems", First Edition, John Wiley Inc., 2011.

**OUTCOMES:**

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

- Ability to design and implement Smart Grid Power Systems independently.
- Ability to use Software for Load Forecasting with special reference to Smart Grids.

**EEBX07 WIND ENERGY CONVERSION SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## OBJECTIVES

- To understand the demand for electrical power generation from the renewable wind energy and fundamentals of wind power.
- To study and understand about the wind turbine components, power generation machinery, control systems.

## MODULE I INTRODUCTION 8

Historical development and current status of Wind power-Generators and power electronics for wind turbines - Impacts of wind power-Wind speed estimation-Wind speed measurements-Rayleigh distribution-Maximum Power obtainable-Bertz limit-Power coefficient –Aerodynamics of wind rotor-Blade element theory-Aerodynamic efficiency-Wind energy conversion system components.

## MODULE II WIND TURBINE 8

Types of Wind Turbine-Rotor design considerations-Tip speed ratio-Blade profile-Power regulation-Yaw control –Pitch angle control-Stall control-Schemes for maximum power extraction.

## MODULE III FIXED SPEED AND VARIABLE SPEED SYSTEMS 8

Fixed speed and variable speed wind turbine- Need of variable speed systems-Power-wind speed characteristics-Generation schemes with fixed and variable speed turbines-Comparison of different schemes.

## MODULE IV MODELING AND SIMULATION OF FIXED SPEED AND VARIABLE SPEED WIND GENERATORS 8

Modeling of fixed speed Induction generator-axes transformation-flux linkage equations-voltage equations-state equations-modeling of variable speed DFIG for wind energy conversion systems-converter control system- transient stability simulation of fixed speed induction generator using EUROSTAG - Doubly Fed Induction Generator(DFIG) modeling - controller modelling - Modelling of DFIG in EUROSTAG - Transient stability simulation of power systems with induction generators using EUROSTAG.

**MODULE V POWER ELECTRONICS IN WIND ENERGY CONVERSION SYSTEM 8**

Induction generator-Controlled firing angle scheme with AC and DC side Capacitor-Scalar method-flux vector scheme-Control scheme for synchronous generator with variable speed drive-Variable speed synchronous generator control with boost converter.

**MODULE VI GRID CONNECTED SYSTEMS 5**

Stand alone and grid connected WECS system-Grid connection Issues- - Impacts of wind power on power system stability-wind plant reactive power capability and its requirements-voltage control and active power control - Storage technologies.

**Total Hours: 45**

**REFERENCES:**

1. S.N.Bhadra,D.Kasthra,S.Banerjee, “Wind Electrical Systems,”Oxford Higher Eduction, 2005.
2. Thomas Ackermann,”Wind Power in Power system, ”Wiley 2012.
3. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990.
4. Jian Zhang, Adam Dysko, John O'Reilly, William E. Leithead," Modeling and performance of fixed-speed induction generators in power system oscillation stability studies", Electric Power System Research Vol. 78 (2008) 1416-1424.
5. Andre´s Feijoo, Jose Cidras, Camilo Carrillo, "A third order model for the doubly-fed induction machine", Electric Power Systems Research 56 (2000) 121-127.
6. Eurostag 4.3 Theory Manual Part I.
7. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
8. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge, 1976.
9. S.Heir "Grid Integration of WECS", Wiley 1998.

**OUTCOMES:**

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

- Understanding the fundamental concepts of wind power, detailed model of the Wind Energy components and its control systems.
- Knowledge about the modeling of various wind generator and its dynamic behavior when integrate with grid.

**EEBX08 FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS)** **L T P C**
**3 0 0 3**

**OBJECTIVES**

- To understand the need for reactive power compensation in AC transmission system.
- To become familiar with modeling and operation of thyristor and voltage source inverter based FACTS controllers.
- To study the effect of FACTS controllers on AC transmission system.

**MODULE I REACTIVE POWER CONTROL IN TRANSMISSION SYSTEM** **8**

Reactive power - uncompensated transmission lines - load compensation - system compensation - lossless distributed parameter lines -symmetrical lines - midpoint conditions of a symmetrical line case study - passive compensation - shunt compensation -series compensation effect on power-transfer capacity.

**MODULE II CONVENTIONAL FACTS DEVICES** **8**

Types, definitions and representation of various FACTS controllers - synchronous Condensers - saturated Reactor (SR) - thyristor-controlled reactor (TCR) - operating characteristics of a TCR- fixed Capacitor–thyristor-controlled reactor (FC–TCR)- thyristor-switched capacitor (TSC)- thyristor-switched capacitor–thyristor-controlled reactor (TSC–TCR).

**MODULE III STATIC VAR COMPENSATOR** **8**

Voltage Control - V-I characteristics of the SVC - dynamic Characteristics-steady-State characteristic advantages of the slope in the SVC dynamic characteristic influence of the SVC on system voltage.

**MODULE IV THYRISTOR-CONTROLLED SERIES CAPACITOR (TCSC)** **8**

Fixed-series compensation - need for variable series compensation-advantages of the TCSC - TCSC controller- operation of the TCSC - modes of TCSC operation - capability characteristics - single-module TCSC- multi - module TCSC - variable-reactance model of TCSC.

**MODULE V EMERGING FACTS CONTROLLERS 8**

STATCOM : principle of operation - V-I characteristic - SSSC : principle of operation - UPFC : principle of operation.

**MODULE VI APPLICATIONS OF FACTS DEVICES 5**

Increase in steady-state power-transfer capacity - enhancement of transient stability. -TCSC applications - applications of STATCOM , SSSC and UPFC.

**Total Hours : 45**

**REFERENCES:**

1. Mohan Mathur.R., Rajiv. K.Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc 2000.
2. Narain G. Hingorani, “Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors, Delhi, 2001.
3. A.T.John, “Flexible A.C. Transmission Systems”, Institution of Electrical and Electronic Engineers (IEEE), 1999.

**OUTCOMES:**

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

- Derive basic mathematical models for FACTS components.
- Design and analyze FACTS.
- Analyze the impact of these components on power system stability.
- Perform calculations on different control strategies for these devices.

| EEBX09 | INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN | L | T | P | C |
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**OBJECTIVE**

- To provides practical knowledge in the field of power system analysis and design for industrial applications.

**MODULE I ELECTRICAL POWER SYSTEM BACKGROUND 7**

Overview of power systems generation, transmission and distribution- utility-scale systems versus industrial power systems; utility restructuring and deregulation- smart grid.

**MODULE II POWER SYSTEM STUDIES 9**

Load flow – short circuits – protective coordination – arc flash hazard calculation – harmonic analysis – power system stability – simple calculation.

**MODULE III TRANSMISSION LINE MODELING AND TRANSFORMER 8**

Line configurations and physical parameters- lumped circuit equivalent models- Power flow formulation-solution techniques-decoupling- applications- Transformer – types – transformer for non linear loads – instrument transformers.

**MODULE IV FAULTS AND SYSTEM PROTECTION 7**

Symmetrical components- symmetrical and unsymmetrical faults- protection devices.

**MODULE V SWITCHGEAR CIRCUIT BREAKER- MOTOR CONTROL CENTRE 7**

Switchgear : low voltage medium voltage – load interrupt switchgear – power fuse – medium and high voltage circuit breaker – SF6 gas insulated switchgear – low and medium voltage motor control centre.

**MODULE VI APPLICATION & PROTECTION OF MEDIUM VOLTAGE MOTORS 7**

Introduction overview – load characteristics – squirrel cage induction motor – wound rotor induction motor – synchronous motor – electric motor for variable frequency drives – motor controllers and starting methods.

**Total Hours : 45**

## REFERENCES:

1. J Duncan Glover, “Power system analysis and design”, 4th edition, Thompson, USA.
2. Arnold, C.P., Arrillaga, J. &Harker, B. J., “Computer Modelling of Electrical Power Systems”, John Wiley & Sons, 1983.
3. Davies, T., “Protection of Industrial Power Systems”, 2nd edition, 1998.
4 Shoaib khan, “Industrial Power Systems”, CRC publication, 1997.
5. Elgerd, O. I., “Electric Energy Systems Theory”, 2nd edition, McGraw-Hill, 1983.
6. Kusic, G., “Computer-Aided Power Systems Analysis”, 2nd edition, CRC, 2008.
7. John J. Grainger and William D. Stevenson, Jr., “Power system analysis”, McGraw-Hill, Inc,, 2000.
8. T. K. Nagsarkar and M.S.Sukhija, “Power system analysis”, Oxford University press.
9. PrabhaKundur, “Power system stability and control”, McGraw-Hill, Inc, 1999.

## OUTCOMES:

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

- Ability to model and predict the operation of power system components.
- Understand the environmental impacts of engineering design.

## POWER ELECTRONICS & DRIVES

**EEBX10 SPECIAL ELECTRICAL MACHINES**

| L | T | P | C |
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**OBJECTIVES:**

- To impact knowledge on Construction, principle of operation and performance of AC commutator motors.
- Construction, principle of operation, control and performance of Synchronous Reluctance, stepping and switched motors.
- Construction, principle of operation, emf and Torque speed characteristics of PM brushless and PM synchronous motors.

**MODULE I AC COMMUTATOR MOTORS** **6**

Principle of operation - Equivalent circuit - Phasor diagram - Performance of Repulsion motor and Universal motor.

**MODULE II SWITCHED RELUCTANCE MOTORS** **8**

Constructional features – Principle of operation – Torque prediction – Power controllers – Non-linear analysis – Microprocessor based control – Characteristics.

**MODULE III STEPPING MOTORS** **8**

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics.

**MODULE IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS** **8**

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

**MODULE V PERMANENT MAGNET SYNCHRONOUS MOTORS** **8**

Principle of operation – EMF and torque equations – Reactance – Phasor diagram – Power controllers - Volt-ampere requirements – Torque speed characteristics - Microprocessor based control.

**MODULE VI SYNCHRONOUS RELUCTANCE MOTORS 7**

Constructional features – Types – Axial and radial air gap motors – Operating principle – Reluctance – Phasor diagram - Characteristics – Vernier motor.

**Total Hours : 45**

**REFERENCES:**

1. Miller, T. J. E., “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, 1989.
2. Taylor E.O., “The Performance and Design of AC Commutator Motors”, Sir Issac Pitmanand Sons, 1998.
3. T. Kenjo, S. Nagamori, “Permanent Magnet and Brushless DC Motors”, Clarendon Press, London, 1988.
4. Kenjo T., “Stepping Motors and their Microprocessor Controls”, Clarendon Press, 1984.
5. Murphy J.M.D., “Power Electronics Control of AC Drives”, Pergamon Press, 1988.
6. Bose B.K., “Power Electronics and Variable Frequency Drives”, Prentice.
7. P.P. Aearnley, “Stepping Motors – A Guide to Motor Theory and Practice”, Peter Perengrinus, London, 1982.
8. Naser A. and Boldea L., “Linear Electric Motors: Theory Design and Practical Applications”, Prentice Hall of India, 1987.

**OUTCOMES:**

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

- Ability to understand the operating principle and performance of AC commutator motors.
- Ability to understand the operating principle, control and performance of Synchronous Reluctance, stepping motors and switched reluctance motors.
- Understanding the problems associated with Emf and torque equations of PM Brushless and synchronous Motors.

**EEBX11 CAD FOR ELECTRICAL APPARATUS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To impart knowledge on using electromagnetic field theory in understanding the modeling concepts of Electrical Apparatus.
- Applying Maxwell's equation to model Electrical Apparatus.
- Providing numerical solutions for the analysis of Electrical Apparatus, using finite element approach.

**MODULE I INTRODUCTION** **5**

Conventional design methodology – computer aided design aspects – Advantages.

**MODULE II ELECTROMAGNETICS AND ELECTROSTATICS** **5**

Basic field equations – calculation of field distribution – flux linkages – voltage induced – inductance – capacitance - force / torque.

**MODULE III CAD PACKAGES** **8**

Recent developments – preprocessing – modeling – boundary conditions – material characteristics – problem formulation – solution – post processing.

**MODULE IV FINITE ELEMENT ANALYSIS** **9**

Mathematical formulation – discretisation – shape functions – stiffness matrix – solution techniques – post processing.

**MODULE V DESIGN PRACTICALS – FUNDAMENTAL** **8**

Design of actuator – solenoid –Inductance – transformer.

**MODULE VI DESIGN PRACTICALS - MOTORS** **10**

Induction motor switched reluctance motor – stepper motor – P.M. machines.

**Total Hours : 45**

**REFERENCES:**

1. Sheppard J.Salon, "Finite Element Analysis of Electrical Machines", Springer Edition, 2009.

2. Nicola Bianchi, “Electrical Machines Analysis Using Finite Elements”, Taylor & Francis group, 2009.

3. P.P. Silvester and Ferrari, “Finite Element for Electrical Engineers”, Cambridge University Press, 1984.

4. D.A. Lowther and P.P. Silvester, “Computer Aided Design in Magnetics”, Springer Verlag, Newyork, 1986.

5. M.V.K. Chari and P.P. Silvester, “Finite Elements in Electric and Magnetic Field Problems”, John Wiley, 1980.

**OUTCOMES:**

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

- Ability to Model Electrical Apparatus.
- To Provide Numerical solutions for FEA.

**EEBX12 SOFTWARE FOR CIRCUIT SIMULATION**

| L | T | P | C |
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**OBJECTIVES:**

- To gain the hands-on experience to simulate, verify, examine, and design electrical, mechanical and electronic circuits using electrical software such as PSPICE, MATLAB, MagNet and Lab View
- To possess the intuitive analysis skill to forecast / illustrate the circuit simulation results.

**MODULE I INTRODUCTION** **7**

Importance of simulation – General purpose circuit analysis – programs – Method of analysis of power electronic systems – Review of modeling of power electronic components and systems - Future trends in computer simulation.

**MODULE II PSPICE** **8**

Introduction – PSpice overview – DC circuit Analysis –AC circuit analysis – Transient and the time domain analysis – Fourier Series and Harmonic components – Modelling of devices like BJT, FET and MOSFET as amplifiers and oscillators and their analysis.

**MODULE III MATLAB** **7**

Introduction - function description – Data types – Tool boxes – Graphical Display - Import and Export of data - programs for the solution of state equations.

**MODULE IV MAGNET** **8**

Introduction - 2D mesh adaption tools - 2D boundary conditions – Modelling and predicting the performance of any electromagnetic or electromechanical device such as Electric Motors / Generators and Transformers.

**MODULE V LABVIEW** **8**

Introduction – Lab view concepts - Environment basics - Graphical programming basics - Common tools - Debugging tools.

**MODULE VI DESIGN** **7**

Solve electrical and electronics circuits and systems by modeling in PSpice, Matlab, MagNet and Labview.

**Total Hours : 45**

**REFERENCES:**

1. Rajagopalan V., Marcell Dekker, "Computer aided analysis of power electronic systems", 1987.
2. Paul Tobin Morgan, "Pspice for Circuit Theory and Electronic Devices", Claypool publishers, 2007.
3. John Keown, "Microsim Pspice and Circuit analysis", Prentice Hall Inc, 1998.
4. "Matlab / Simulink manual", MathWork, 2010.
5. Robert H., "Learning with Labview 2009", Bishop prentice Hall, 2009.

**OUTCOMES:**

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

- Basic concepts of simulation software tools and its applications.
- Describe the techniques to model and solve the application problems.
- Apply modern simulation tools such as PSPICE – MATLAB – MagNet - Labview for the design, analyses, and performance evaluations of electrical and electronics circuits and systems.

| EEBX13 | FEA FOR ELECTRICAL ENGINEERS (Electromagnetic Field Computation and Modeling) | L | T | P | C |
|---|---|---|---|---|---|
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**MODULE I INTRODUCTION** **9**

Review of basic field theory – electric and magnetic fields – Maxwell's equations – Laplace, Poisson and Helmoltz equations – principle of energy conversion – force/torque calculation – Electro thermal formulation.

**MODULE II SOLUTION OF FIELD EQUATIONS I** **8**

Limitations of the conventional design procedure, need for the field analysis based design, problem definition, solution by analytical methods-direct integration method – variable separable method – method of images, solution by numerical methods- Finite Difference Method.

**MODULE III SOLUTION OF FIELD EQUATIONS II** **9**

Finite element method (FEM) – Differential/ integral functions – Variational method – Energy minimization – Discretisation – Shape functions –Stiffness matrix –1D and 2D planar and axial symmetry problem.

**MODULE IV FIELD COMPUTATION FOR BASIC CONFIGURATIONS** **7**

Computation of electric and magnetic field intensities– Capacitance and Inductance – Force, Torque, Energy for basic configurations.

**MODULE V BASIC EXERCISES IN FEA PACKAGES** **6**

Modeling – Pre-processing – A vector and flux plot calculations – deriving point quantities in Post-processing.

**MODULE VI DESIGN APPLICATIONS** **6**

Insulators- Bushings – Cylindrical magnetic actuators – Transformers – Rotating machines.

**Total Hours : 45**

**REFERENCES:**

1. K.J.Binns, P.J.Lawrenson, C.W Trowbridge, "The analytical and numerical solution of Electric and magnetic fields", John Wiley & Sons, 1993.

2. Nathan Ida, Joao P.A.Bastos, “Electromagnetics and calculation of fields”, Springer-Verlage, 1992.

3. Nicola Biyanchi, “Electrical Machine analysis using Finite Elements”, Taylor and Francis Group, CRC Publishers, 2005.

4. S.J Salon, “Finite Element Analysis of Electrical Machines.” Kluwer Academic Publishers, London distributed by TBH Publishers, India, 2007.

5. User manuals of MAGNET, MAXWELL & ANSYS software.

6. Silvester and Ferrari, “Finite Elements for Electrical Engineers” Cambridge University press, 1983.

**OUTCOMES:**

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

- Ability to model electric systems in finite element analysis scenario.
- Ability to calculate any electrical or magnetic parameter from the analysis and co-relate it.

**EEBX14 CHOPPER CONTROLLED DC DRIVES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To study and understand the operation of chopper controller from open loop and closed loop modules.
- To introduce the design concepts of chopper drives.
- To study and analyze the operation of the chopper fed DC drives.
- To study of closed loop control of DC drives.

**MODULE I THYRISTOR FAMILY** **7**

SCR-symbol, working , characteristic, holding current, latching current, dv/dt, di/dt ratings, gate protection- Insulated gate bipolar transistor (IGBT) – MOSFET - Symbol, working and characteristics of DIAC, TRIAC, SUS, SCS, SBS, LASCR, and GTO – symbol, working and characteristics - specifications of the above power devices.

**MODULE II BASICS OF CHOPPER** **8**

Introduction – applications – principle of chopper – control strategies (time ratio and current limit control)– Step down choppers Derivation of load voltage and currents with R, RL and RLE loads- Step up Chopper – load voltage expression Morgan' s chopper – Jones chopper and Oscillation chopper (Principle of operation only) Waveforms.

**MODULE III CHOPPER TYPES** **8**

Types of chopper - type A, B, C, D, and E -step up chopper - Jones chopper - Morgan chopper Chopper using MOSFET - PWM Control circuit for driving MOSFET in chopper.

**MODULE IV CLOSED LOOP CONTROL - CHOPPER** **8**

Introduction Closed loop speed control - current and speed loops, P, PI and PID controllers - response comparison. Simulation of chopper fed D.C drive.

**MODULE V DIGITAL CONTROL OF DC DRIVE** **7**

Closed loop control of dc drives – basic block diagram – Phase locked loop (PLL) control of dc drives –block diagram – microprocessor based closed loop control of DC drive – block diagram and working.

**MODULE VI CASE STUDY** **7**

Simulation of chopper – open loop –closed loop – DC drives –Matlab- PSpice Software.

**Total Hours : 45**

**REFERENCES:**

1. Vedam Subramanyam, “Power Electronics”, New Age International (P) Limited, 2000.
2. V.R.Murthy, “Power Electronics”, OXFORD University Press, 1st edition, 2005.
3. P.C.Sen, “Power Electronics”, Tata Mc Graw-Hill Publishing, 2006.
4. G. K. Dubey, S. R. Doradra, A. Joshi and R. M. K. Sinha, “Thyristorised Power Controllers”, New Age International (P) Limited, 1996.

**OUTCOMES:**

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

- Ability to design a chopper controller for electrical application.
- Knowledge in MATLAB tool box.
- Talent to improve the performance of power electronics application.

**EEBX15 SOLID STATE AC & DC DRIVES**

| L | T | P | C |
|---|---|---|---|
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**OBJECTIVES:**

- To study and understand the operation of electrical drives - D.C. motor drives, Induction motor drives, Synchronous motor drives.
- To analyze the closed-loop control of both DC and AC drives.
- To understand the differences between induction motor drives and synchronous motor drives.

**MODULE I ELECTRIC MOTOR CHARACTERISTICS 7**

Characteristics of DC motors - Induction motors - Synchronous motors - Constant torque and constant HP operations – Four quadrant operations – Rating of motors - Selection of drives.

**MODULE II CONVERTER FED DC DRIVES 8**

Single phase semi and full converter fed drives – three phase semi and full converter fed drives – continuous and discontinuous modes – closed loop converter fed drives.

**MODULE III CHOPPER FED DC DRIVES 7**

Operation of Class A, B, C, D, E chopper fed DC drives - four quadrant operations – closed loop chopper fed drives.

**MODULE IV STATOR CONTROLLED INDUCTION MOTOR DRIVES 7**

AC voltage controller fed induction motor drive – VSI and CSI fed drives – closed loop stator controlled induction motor drives - Braking methods for induction motors.

**MODULE V ROTOR CONTROLLED INDUCTION MOTOR DRIVES 8**

Rotor resistance control – slip power recovery scheme - Scherbius drive - sub synchronous operation, Kramers drive – super synchronous operation – closed loop rotor controlled drives.

**MODULE VI SYNCHRONOUS MOTOR DRIVES 8**

Operation of wound field cylindrical and salient pole synchronous motor for

constant voltage and constant frequency source – brushless excitation – closed loop self controlled synchronous motor drives.

**Total Hours : 45**

**REFERENCES:**

1. Gopal K.Dubey, “Power semiconductor controlled drives”, Prentice Hall international, 1989.
2. Vedam subramanyan, “Thyristor Control of Electrical Drives”, Tata McGraw-Hill Co.Ltd., 1988.
3. Murphy, J.M.D and Turnbull.F.G., “Thyristor control of AC Motors”, Pergamon Press, 1988.
4. B.K. Bose, “Power Electronics and AC Drives”, Prentice Hall Onglewood cliffs, New Jersey, 1986.
5. S.B. Dewan, Gordon R. Slemon and A. Straughen, “Power Semiconductor Drives”, John Wiley Pub., 1996.

**OUTCOMES:**

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

- Select the suitable drive for the required load characteristics.
- Understand the concept of Converter / Chopper control of DC motor drive.
- Gain adequate knowledge about induction motor and synchronous motor drives and various speed control methods.
- Design controllers for drives.

**EEBX16 CONVERTERS, APPLICATIONS & DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To get an overview of different types of power semi-conductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers.
- To design & implement real time industrial application of Power Electronic equipments.
- To know the practical application for power electronics converters in conditioning the power supply.

**MODULE I PROTECTION OF POWER ELECTRONIC DEVICES 7**

SCR – Triac – MOSFET - IGBT - Protection Circuits - Snubber Circuits – Ratings - safe operating Area - Heat sink Design.

**MODULE II DESIGN OF CONTROLLED CONVERTERS 8**

Gate pulse generating circuits - conventional methods, gate pulse generation using microcontroller, gate drive circuits - Pulse Transformers - Opto Triacs - Synchronisation Circuits - fully controlled fed DC motor - Open loop, closed loop.

**MODULE III DC-DC CONVERTERS 7**

Half Bridge and Full Bridge Driver ICs for MOSFET and IGBT - Phase shifted series Resonant Converters - ZCS – ZVS – DC to DC Converter for Electric Vehicle.

**MODULE IV PHASE CONTROLLERS 8**

Photosensors - Temperature sensors - Micro controller Programming for phase angle control - Implementation of phase controller for illuminating lights & Electric furnace control using micro controller -Maximum power point trackers - Grid connected inverter - Implementation of converters for solar panel.

**MODULE V SWITCHING POWER SUPPLIES 8**

Design of PWM inverters - SPPWM inverters - Design and implementation of

UPS and SMPS - Harmonic analysis of inverters using Harmonic Analyser.

**MODULE VI CASE STEADY** **7**

Mini Project Model – Hardware Fabrication – converter – DC to DC Converter - DC Drives.

**Total Hours : 45**

**REFERENCES:**

1. M.H. Rashid, “Power Electronics Handbook”, Elsevier Press, Micro C Manual, 2003.
2. Nihal Kularatna, “Power Electronics Design Handbook”, “Low-Power Components and Applications”, 1999.
3. Keith H. Sueker, “Power Electronics Design - A Practitioner’s Guide”, 1998.
4. “International Rectifiers”, Application note Catalogue.

**OUTCOMES:**

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

- Practical exposure in DC-DC converter and control.
- Knowledge in power control devises.
- Experience to selection of converter for various application.
- Design controllers for drives.

| EEBX17 | POWER ELECTRONICS APPLICATION TO RENEWABLE ENERGY SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
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**OBJECTIVES:**

- To provide basic understanding of the emerging power electronics technologies to Renewable systems.
- To enable students to design power electronics circuit that can control active and reactive power flow in grids.
- To integrate theory and practical knowledge of power system protection.

**MODULE I OVERVIEW OF ENERGY CONVERSION AND RENEWABLE ENERGYSYSTEMS 7**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems -Block diagram.

**MODULE II ELECTRICAL ENERGY CONVERSION SYSTEMS 8**

Review of reference theory fundamentals - principle of operation and analysis: IG, PMSG, SCIG and DFIG - different conversion schemes - fixed and variable speed operation - drive selection - power control - braking systems - grid integration issues.

**MODULE III POWER CONVERSION IN RENEWABLE SYSTEMS 8**

Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters - Inverters for high power applications: Multi-level Inverters, Analysis of their performance, Selection of inverter, Battery sizing, Array sizing, AC and DC harmonics, Interaction with power grid.

**MODULE IV ANALYSIS OF WIND SYSTEMS 8**

Stand alone operation of fixed and variable speed wind energy conversion systems - electrical design - power collection systems – earthing - electrical protection - reactive VAR issues - compensators -remote monitoring and control - economic aspects.

**MODULE V ANALYSIS OF PV SYSTEMS 8**

Technical and non-technical considerations - system size and module choice - mounting systems and building integration- power conditioning system - lightning protection - earthing - metering Stand-alone systems: Modules- Batteries - charge controllers -sizing of PV arrays – applications.

**MODULE VI HYBRID RENEWABLE ENERGY SYSTEMS 6**

Need for Hybrid Systems- Range and type of Hybrid systems- micro wind systems and solar system- Grid integrated PMSG and SCIG Based WECS - Case studies.

**Total Hours : 45**

**REFERENCES:**

1. Rashid M. H, "Power electronics Hand book", Academic press, 2001.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", Prentice Hall Inc, 1995.
5. B.H.Khan, “Non-conventional Energy sources”, Tata McGraw-hill Publishing Company, New Delhi.

**OUTCOMES:**

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

- Identifying integrating and justifying techniques to be used in the planning and operation of grid control with renewable energy sources.
- Identifying power electronics topologies for used in controlling active and reactive power in a power system.
- Awareness on the advancements in designing of power electronics equipments related to renewable energy sources.

**EEBX18 EMBEDDED CONTROL OF ELECTRIC DRIVES** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To make the student into a competent and independent practitioner in the field of embedded systems.
- To provide an In-depth study both of microcontroller design, and of the Power Electronic Converters and Electric Drives to which the microcontroller must interface.
- Study and application of a Real Time Operating System using programming in C.

**MODULE I PIC16F8XX- MICROCONTROLLERS** **8**

Function - I/O Ports – Timers - CCP Modules - Serial Communication Modules - Analog Modules - EEPROM.

**MODULE II MICROCONTROLLER C** **8**

Mikro C Compiler reference - mikro C Libraries: ADC, PWM, Keypad, LCD, Trigonometric Libraries –Preprocessor - Statements.

**MODULE III ALGORITHM AND PROGRAMMING IN MIKROC** **8**

Source codes in Mikro C: ADC and PWM – Unipolar SPWM – Phase Angle Control with Zero Crossing Detection- LCD with Key Pad - Speed Measurement.

**MODULE IV ISOLATORS AND SENSORS** **10**

High Speed Opto-Couplers – Zero Crossing Detectors - Optically Isolated High Voltage and High Current sensing circuits –Optical Encoders – Tachogenerators.

**MODULE V CLOSED LOOP CONTROL OF ELECTRIC DRIVES** **6**

Closed Loop Control - Hardware and Software Implementation: DC Motor control using PWM based DC-DC converters and Controlled Rectifiers – AC Motor Control Using TRIAC Phase Controller, SPWM inverter fed single and three phase induction motors.

**MODULE VI MIKRO C BUILDING APPLICATIONS 5**

Mikro C IDE - Code Editor- Code Explorer – Debugger – Error Window – Statistics – Integrated Tools - Building applications - Projects – Source Files - Search Paths – Managing Source Files – Compilation - Output Files – Assembly View – Error Messages - Burning Software - Overview of Microbrn - ICSP port.

**Total Hours : 45**

**REFERENCES:**

1. John Main, “PIC Microcontroller C”, 2007.
2. “Mikro C- Compiler for PIC Microchip controllers”, Mikro Electronika.
3. Martin P. Bates, “Programming 8-bit PIC Microcontrollers in C: With Interactive Hardware Simulation”, 2006.
4. Tim Wilmshurst, “Designing Embedded Systems with PIC Microcontrollers-Principles and applications”, Newnes, 2007.
5. Martin P. Bates, “PIC Microcontrollers–An Introduction”, Newnes, 2011.

**OUTCOMES:**

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

- Applying the underlying knowledge and skills appropriate to today’s embedded systems, in both hardware and software development.
- The skills and knowledge acquired through the study of this set of microcontrollers can readily be transferred to industrial sectors.
- Master the advancements in designing of power electronics equipments related to renewable energy sources.

**EEBX19 ELECTRIC VEHICLE TECHNOLOGY**

| L | T | P | C |
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**OBJECTIVES:**

- To introduce the concept of Electric Vehicles.
- To familiarize the basic energy transfer processes that govern existing and proposed methods of power generation for Electric Vehicles.
- To familiarize with the traditional and non-traditional sources for Electric Vehicles in terms of energy content, accessibility, required processing steps and projected remaining reserves.

**MODULE I INTRODUCTION** **8**

A Brief History - Types of Electric Vehcle in Use Today : Battery electric vehicles - The IC engine/electric hybrid vehicle - Fuelled electric vehicles - Electric vehicles using supply lines - Solar powered vehicles - Electric vehicles which use flywheels or super capacitors.

**MODULE II BATTERIES** **7**

Battery Parameters - Lead Acid Batteries - Nickel-based Batteries - Sodium-based Batteries - Lithium Batteries - Metal Air Batteries - Battery Charging - Choice of Battery - Use of Batteries in Hybrid - Vehicles - Battery Modelling.

**MODULE III FUEL CELLS** **8**

Hydrogen Fuel Cells - Fuel Cell Thermodynamics - Connecting Cells in Series - Water Management in the PEM Fuel Cell - Thermal Management of the PEM Fuel Cell - A Complete Fuel Cell System - Hydrogen Supply - Fuel Reforming - Hydrogen Storage.

**MODULE IV ELECTRIC VEHICLE MODELLING AND DESIGN CONSIDERATIONS** **7**

Tractive Effort - Modelling Vehicle Acceleration - Modelling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency - Electric Vehicle Chassis and Body Design - General Issues in Design.

**MODULE V DESIGN OF ANCILLARY SYSTEMS** **7**

Heating and Cooling Systems - Design of the Controls - Power Steering -

Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Electric Vehicle Recharging and Refuelling Systems.

**MODULE VI ELECTRIC VEHICLES AND THE ENVIRONMENT 8**

Vehicle Pollution - The Effects - Vehicles Pollution - A Quantitative Analysis - Vehicle Pollution in Context - Alternative and Sustainable Energy Used via the Grid - Using Sustainable Energy with Fuelled Vehicles.

**Total Hours : 45**

**REFERENCE:**

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd, 2003.

**OUTCOMES:**

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

- Identify and quantify the important energy transfer for Batteries and fuel cell schemes.
- Identify the opportunities and challenges of advances in Electric Vehicles.
- Identify the current industry activities by car makers, electricity utilities, parts, suppliers (motors and batteries), including joint ventures, product announcements and pilot projects.

| EEBX20 | HIGH VOLTAGE ENGINEERING BIOELECTRICS | L | T | P | C |
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**OBJECTIVES:**

- To teach the students, some of the basic concepts of bioelectrics through pulsed power principles.
- To impart a detailed knowledge on pulsed power systems.
- To study about various applications of electroporation

**MODULE I BIOELECTRICITY** **8**

Introduction – Diffusion – Comparison of gravity and diffusion – Membrane potential – membrane capacitance – Ion selectivity – Channel density – Channel conductance – Channel number, channel conductance and membrane potential – Channel conductance and random switch – Probability – Membrane potential revisited – Diffusion potential – More realistic view of cell potential – Channel opening probability – Channels in membranes – Classes of selective holes – Total membrane conductance and potential.

**MODULE II PULSED SYSTEMS: DESIGN PRINCIPLES** **7**

Lumped parameter pulsed systems - Principle schemes for pulse generation – Voltage multiplication and transformation. Pulse generation using long lines - Generation of nanosecond pulses – voltage multiplication in line based generators – pulse systems with segmented and non uniform lines.

**MODULE III APPLICATIONS OF PULSED POWER AND PLASMAS TO BIOSYSTEMS AND LIVING ORGANSISMS** **8**

Pulsed power source using magnetic compression system – discharge plasma by pulsed power – action of pulsed power and discharge plasma to bio-systems.

**MODULE IV ELECTROPORATION** **7**

Introduction to Electroporation – Electroporation and cellular physiology – the cell in the electric field.

**MODULE V EQUIPMENT FOR ELECTROPORATION** **8**

Pulse generator – Applicator – Electrode – Electrochemotherapy – Gene Electrotransfer – DNA Vaccination – Irreversible Electroporation.

**MODULE VI APPLICATIONS OF ELECTROPORATION 7**

Case Study.

**Total Hours : 45**

**REFERENCES:**

1. Louis J. Defelice, “Electrical Properties of Cells: Patch Clamp for Biologists”, Plenum press, 1997.
2. Eberhard Neumann, Arthur.E.Sowers, Carol A. Jordan, “Electroporation and Electrofusion in cell biology”, Plenum press, New York, 1989.
3. Gennadii Andreevich Mesiats, “Pulsed power”, Springer, 2005.
4. Yoshinobu Kawai, Hideo Ikegami, Noriyoshi Sato, Akihisa Matsuda, Kiichiro Uchino, Masayuki Kuzuya, Akira Mizuno, “Industrial Plasma Technology”, 2007.
5. Stephen T.Lee, Julie Gehl, Edward W.Lee, “Clinical aspects of Electroporation”, Springer, 2011.

**OUTCOMES:**

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

- Pulsed power principles and bioelectricity.
- Electroporation and applications of electroporation through conducting of case studies.

**EEBX21 MICROGRID PROTECTION L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge in the formation, development, protection and control of Microgrid.
- To study about impacts, protection issues and microgrid economics.

**MODULE I DISTRIBUTED GENERATION AND MICROGRIDS 8**

Distributed generation - Why integration of distributed generation? - Active distribution network. Concept of microgrid - Need & applications of microgrid - Formation of microgrid - Issues of interconnection - protection & control of microgrid – Advantages of Microgrid - Challenges and disadvantages of Microgrid development - Management and operational issues of a Microgrid - Dynamic interactions of Microgrid with main grid.

**MODULE II DISTRIBUTED ENERGY RESOURCES 7**

Introduction - Combined heat and power (CHP) systems - Wind energy conversion systems (WECS) - Solar photovoltaic (PV) systems - Small-scale hydroelectric power generation - Other renewable energy sources - Storage devices.

**MODULE III IMPACTS OF MICROGRID 8**

Introduction – impact on heat utilization – impact on process optimization – impact on market – impact on environment – impact on distribution system – impact on communication standards and protocols.

**MODULE IV MICROGRID AND ACTIVE DISTRIBUTION NETWORK MANAGEMENT SYSTEM 7**

Introduction - Network management needs of Microgrid - Microsource controller - Central controller.

**MODULE V PROTECTION ISSUES FOR MICROGRIDS 8**

Introduction – Islanding, separation from utility: Different islanding scenarios – Major protection issues of standalone microgrid: microgrid distribution protection - protection of microsources - NEC requirements for distribution transformer protection - Neutral grounding requirements.

**MODULE VI MICROGRID ECONOMICS 7**

Introduction – Main issues of Microgrid economies - Microgrids and traditional power system economics - Emerging economic issues in Microgrids - Economic issues between Microgrids and bulk power systems.

**Total Hours : 45**

**REFERENCES:**

1. S. Chowdhury, S. P. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks.” Institution of Engineering and Technology, 2009.
2. J. Duncan Glover, Mulukutla S. Sarma, Thomas Jeffrey Overbye, “Power system analysis and design” 5th edition, Thomson learning, 2011.
3. Tai-hoon Kim, Adrian Stoica, Ruay-Shiung Chang, “Security-Enriched Urban Computing and Smart Grid”, Springer, 2010.

**OUTCOMES:**

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

- In depth knowledge in the formation, development, protection and control of Microgrid.
- Exposure to distributed energy resources, impacts and protection issues for microgrids.

| EEBX22 | HIGH VOLTAGE DIRECT CURRENT TRANSMISSION | L | T | P | C |
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**OBJECTIVES:**

- To develop the skills in the area of HVDC power transmission with the analysis of HVDC converters, harmonics and design of filters.
- To study about different applications of HVDC systems.

**MODULE I INTRODUCTION TO TRANSMISSION SYSTEMS 8**

Introduction – Evolution of HVDC Transmission systems – Comparison of HVAC and HVDC transmission systems – Types of HVDC transmission systems – Components of HVDC transmission systems.

**MODULE II ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM 8**

Analysis of simple rectifier circuits – Bridge Rectifier analysis – Analysis of HVDC Converter: Different modes of converter operation - Output voltage waveforms and DC voltage in rectification - Output voltage waveforms and dc in inverter operation - thyristor voltages - Equivalent electrical circuit.

**MODULE III HVDC SYSTEM CONTROL 8**

HVDC System control features – Control modes - Control schemes – Control comparisons.

**MODULE IV MULTITERMINAL DC SYSTEMS 10**

Converter mal-operations – Commutation failure – starting and shutting down the converter Bridge – Converter Protection - Smoothing reactor and dc lines – Reactive power requirements – Harmonic Analysis – Filter Design.

**MODULE V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 6**

Component Models for the Analysis of AC and DC Systems - Power flow analysis of AC-DC systems - Transient stability analysis - Dynamic stability analysis.

**MODULE VI APPLICATIONS OF HVDC SYSTEMS 5**

Multi-terminal HVDC system - Advances in HVDC transmission - HVDC system application in wind power generation.

**Total Hours : 45**

## REFERENCES:

1. KR Padiyar, “HVDC Power Transmission Systems”, Willey Eastern Limited, Second edition, 2001.
2. J Arrillaga, “High Voltage Direct current Transmission”, Peter Peregrinus Ltd, UK, 1999.
3. EW Kimbark, “Direct Current Transmission”, Wiley-Interscience, New York, 2000.
4. SN Singh, “Electric Power Generation, “Transmission and Distribution”, PHI, New Delhi 2nd edition, 2008.
5. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 1993.
6. Additional reading - Research Papers.
7. Erich Uhlmann, “Power Transmission by Direct Current”, BS Publications, 2004.
8. V.K.Sood, HVDC and FACTS controllers – “Applications of Static Converters in Power System”, Kluwer Academic Publishers, 2004.

## OUTCOMES:

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

- Understand and analyze the operation and control of HVDC systems.
- Design filters for mitigating the effects of harmonics.

**EEBX23 POWER QUALITY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To acquire knowledge on factors affecting Power Quality.
- To analyze and control power quality problems.

**MODULE I POWER QUALITY TERMS AND DEFINITIONS 8**

Introduction – transients - short duration/long duration voltage variations - voltage imbalance - waveform distortion - voltage fluctuations - power frequency variation. Power Quality Problems - Poor load power factor - loads containing harmonics - notching in load voltage -DC offset in loads - unbalanced loads - disturbance in supply voltage.

**MODULE II VOLTAGE SAGS AND INTERRUPTIONS 8**

Sources of sags and interruptions - end user issues - Ferro resonant transformer - on-line UPS - hybrid UPS - motor generator set, SMES etc. - motor starting sags - utility system fault clearing issues.

Transient over Voltage - Sources of transient over voltages - principles of over voltage protection - devices for over voltage protection - utility capacitor switching transients - utility lightning protection - load-switching transient problems.

**MODULE III LONG DURATION VOLTAGE VARIATIONS 8**

Devices for voltage regulation - Utility voltage regulator applications - capacitors for voltage regulation- end-user capacitor application - regulating Utility voltage with dispersed sources.

Quality and Reliability of Power Supply - Reliability of power supply - reliability measurements consumer interruption cost - distribution automation - substation grounding - energy auditing.

**MODULE IV HARMONICS 10**

Voltage and current harmonics distortions - harmonics of single-phase power supplies - three phase power converters - arcing devices - storable devices - effects of harmonics distortion - system response characteristics - locating

sources of harmonics, peripherals for controlling harmonics - devices for filtering harmonics.

**MODULE V WIRING AND GROUNDING 6**

Harmonics study procedure - symmetrical components - modeling harmonics sources - harmonic filter design - telecommunication interferences - Reason for grounding - typical wiring and grounding problems and their solutions.

**MODULE VI POWER QUALITY MONITORING AND CUSTOM POWER DEVICES 5**

Power quality related standards - standard test waveform and detailed power quality monitoring - power quality measurement equipments.

Custom Power Devices: Utility customer interface - network reconfiguring device load compensation using shunt compensators - voltage regulation using shunt compensators - dynamic voltage restorer - unified power quality conditioner - Computer tools for harmonic analysis.

**Total Hours : 45**

**REFERENCES:**

1. Roger C.Dugan, Mark F. Mc Granhgan, Surya Santoso," Electrical Power System Quality", Mc Graw hill, 2nd Edition, 2001.
2. Arindam Ghosh and Gerard Ledwich, "Power Quality Enhancement using custom power devices", Kulwer academic publisher, 2004.
3. C.L Wadhwa, "Generation and Distribution utilization of electrical Energy", New Age International.
4. C. Sankarm, "Power Quality" CRC Press USA, 2000.
5. Barry W. Kennedy, "Power Quality Primer "McGraw Hill, 2000.
6. Wilson E. Kazibwe, Van Nostrand Reinhold, "Electrical power quality controls techniques".

**OUTCOMES:**

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

- Understand the power quality issues and its importance.
- Evaluate the characteristics of power quality disturbances.

**EEBX24 ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY**

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**OBJECTIVES:**

This course conveys essential facts on:

- Different electromagnetic Interference problems occurring in Intersystem and their possible mitigation techniques in Electronic design.
- EMI Sources, EMI problems and their solution methods in PCB level / Subsystem and system level design.
- Possible EMC standards.

**MODULE I BASIC CONCEPTS** **6**

Definition of EMI and EMC with examples - Classification of EMI/EMC - CE, RE, CS, RS Modules of parameters - Sources of EMI - EMI coupling modes - CM and DM, ESD phenomena and effects - Transient phenomena and suppression.

**MODULE II EMI MEASUREMENTS** **8**

Basic principles of RE, CE, RS and CS measurements - EMI measuring instruments- Antennas, LISN, Feed through capacitor, current probe, EMC analyzer and detection technique - Open area site - shielded anechoic chamber - TEM cell.

**MODULE III EMC STANDARD AND REGULATIONS** **8**

National and Intentional standardizing organizations- FCC, CISPR, ANSI, DOD, IEC, CENEEC, FCC CE and RE standards - CISPR, CE and RE Standards - IEC/EN, CS standards - Frequency assignment - spectrum conversation.

**MODULE IV EMI CONTROL METHODS AND FIXES** **8**

Shielding – Grounding – Bonding – Filtering - EMI gasket - Isolation transformer - Opto isolator.

**MODULE V GROUNDING FOR THE EMI CONTROL** **8**

Characteristics of grounding systems: Impedance characteristics - Antenna characteristics – Ground, related interference - Circuit, Equipment, and System grounding: Single-point grounding scheme - Multipoint grounding Scheme -

Selection of a grounding Scheme - Ground system con?gurations - EMI control devices and techniques.

**MODULE VI EMC DESIGN AND INTERCONNECTION TECHNIQUES 7**

Cable routing and connection - Component selection and mounting - PCB design - Trace routing - Impedance control – decoupling - Zoning and grounding.

**Total Hours : 45**

**REFERENCES:**

1. Prasad Kodali.V, “Engineering Electromagnetic Compatibility”, S.Chand & Co, New Delhi, 2000.
2. Clayton R.Paul, “Introduction to Electromagnetic compatibility”, John Wiley & Sons, 1992.
3. Keiser, “Principles of Electromagnetic Compatibility”, Artech House, 3rd Edition, 1994.
4. Donwhite Consultant Incorporate, “Handbook of EMI / EMC - Vol I”, 1985.

**OUTCOMES:**

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

- Ability to understand Electromagnetic Interference problems and their mitigation techniques.
- Be aware of grounding systems for EMI control.
- Knowledge and awareness on EMC design and interconnection techniques.

**EEBX25 OUTDOOR INSULATORS L T P C**
**3 0 0 3**

**OBJECTIVE:**

The course aims at giving a comprehensive knowledge on

- Outdoor Insulators, which are mainly, used for Transmission and Distribution systems.

**MODULE I INTRODUCTION 7**

Overview – Important Definitions – Types of Outdoor Insulators – Uses of Outdoor Insulators – Stresses Encountered in Service – Electrical Performance – Mechanical Performance – Role of Insulators on Overall Power System Reliability – Shapes of Outdoor Insulators – Mechanical and Electrical Ratings of Insulators – Comparison of Porcelain, Glass and Composite Insulators – Life Expectancy.

**MODULE II NONCERAMIC INSULATOR TECHNOLOGY 7**

Introduction - Materials for Weathersheds / Housings – Shed Design – Insulator Core – Hardware – Establishing Equivalency to Porcelain/Glass – Manufacturing Changes and Quality Control (QC) – Un-standardization/ Propagation - Live-line Maintenance Handling, Cleaning and Packaging - Brittle Fracture – Water Drop Corona – Aging and Longevity – Grading Control Rings.

**MODULE III DESIGN AND MANUFACTURE OF INSULATORS 8**

Porcelain Insulators – Manufacture of Porcelain Insulators – The Porcelain Suspension Insulator – Porcelain Pin-type Insulators – Porcelain Multicone Insulators – Porcelain Long-rod and Post Insulators – Porcelain Insulators Glazes - Porcelain Insulator Hardware – Porcelain Insulator Cement – The Porcelain Dielectric.

Glass Insulators – The Glass Suspension Insulator – Glass Pin-type Insulators – Glass Multicone Post Insulators – Manufacture of Glass Insulators – Glass Insulator Hardware – Glass Insulator Cement – The Glass Dielectric.

Nonceramic Insulators - Nonceramic Suspension Insulator – Line Post Insulator – Hollow Core Insulator – Manufacture of Nonceramic Insulators – The Composite Dielectric – Voltage Stress Control.

**MODULE IV TESTING STANDARDS FOR INSULATORS 8**

Need for Standards – Standards Producing Organizations – Insulator Standards – Classification of Porcelain / Glass Insulator Tests – Brief Description and Philosophy of Various Tests for Cap and Pin Porcelain/Glass Insulators – Summary of Standards for Porcelain/Glass Insulators – Standards of Nonceramic (Composite) Insulators – Classification of Tests, Philosophy and Brief Description – Standards for Nonceramic Insulators.

**MODULE V DETECTING DEFECTIVE INSULATORS 7**

Detecting defective porcelain insulators – principles involved – electrical methods – thermography - Detecting defective non ceramic insulators – detection prior to installation – detecting degraded insulator during service.

**MODULE VI SELECTION AND MAINTENANCE OF INSULATORS 8**

Introduction – Cost and Weight – National Electricity Safety Code (NESC) – Basic Lightning Impulse Insulation Level (BIL) – Contamination Performance – Experience with Silicone Rubber Insulators in Salt Areas – Compaction – Grading Rings for Nonceramic Insulators - Maintenance of Insulators - Maintenance Inspection – Hotline washing – equivalent salt deposit.

**Total Hours : 45**

**REFERENCES:**

1. Ravi S. Gorur, Edward A. Cherney and Jeffrey T. Burnham, “Outdoor Insulators”, Ravi S. Gorur. Inc., 1999.
2. J.S.T. Looms, “Insulators for High Voltages”, Peter Peregrinus Ltd., 1988.
3. A.O. Austin, “Porcelain Insulators”, Ohio Brass Company, 1980.
4. IEC 1109, “Composite Insulators for AC overhead lines with a Nominal Voltage Greater than 1000V, Definition, Test Methods and Acceptance Criteria”, 1992.
5. EPRI, “Transmission Lines Reference Book – 345kV and above”, 1982.
6. ANSI C 29.1, “Electrical Power Insulator – Test Methods”, 1992.

**OUTCOMES:**

Upon completing the Course, the student will be able to do the following:

- Become familiar with different stresses encountered in the service of the insulator as well as the types and performance of Insulators.
- Able to connect the current area of Research in insulators including non-ceramic insulators.
- Design and Manufacturing process of insulators can be understood.
- The testing standards, selection and maintenance of insulators will also be made aware.

| EEBX26 | HIGH VOLTAGE GENERATION AND MEASUREMENT | L | T | P | C |
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**OBJECTIVES:**

- To study about high voltage,high current generation and measurement techniques.
- To study about the destructive and nondestructive testing of electrical equipments.

**MODULE I INTRODUCTION** **5**

Introduction to HV technology - Advantages of electric power transmission at high AC and DC voltages - Need for generating high AC and DC voltages in a laboratory.

**MODULE II GENERATION OF HIGH VOLTAGE AC AND DC** **8**

HVAC - HV transformer - Need for cascade connection and working of transformer MODULEs connected in cascade - Series resonant circuit - Principle of operation and advantages - Tesla coil - HVDC - Voltage doubler circuit – Cockcroft - Walton type high voltage DC set - Calculation of voltage regulation - Ripple - Optimum number of stages for minimum voltage drop.

**MODULE III GENERATION OF IMPULSE VOLTAGES AND CURRENTS** **8**

Introduction to standard Lightning and Switching impulse voltages - Analysis of single stage impulse generator - Expression for output impulse voltage - Multistage impulse Marx generator and its working - Rating of impulse generator - Components of multistage impulse generator - Triggering of impulse generator by three electrode gap arrangement - Trigatron gap and oscillograph time sweep circuits - Generation of switching impulse voltage - Generation of high impulse currents.

**MODULE IV MEASUREMENT OF HIGH VOLTAGES** **8**

Electrostatic voltmeter - Principle, construction and limitations - Chubb and Fortescue method for HVAC measurement - Generating voltmeter - Principle and construction - Series resistance micro ammeter for HVDC measurement - Standard sphere gap for measurement of HVAC, HVDC and impulse voltages - Factors affecting measurements - Potential dividers - Resistance dividers

- Capacitance divider - Mixed RC potential divider - Surge current measurement - Klydanograph and magnetic links.

**MODULE V NON-DESTRUCTIVE INSULATION TESTING TECHNIQUES 8**

Dielectric loss and loss angle measurement using Schering Bridge - Transformer ratio - Arm bridge - Need for discharge detection and PD measurement aspects - Factors affecting discharge detection - Discharge detection methods - Straight and balance methods.

**MODULE VI HIGH VOLTAGE TESTS ON ELECTRICAL APPARATUS 8**

Terminologies used for Tests on isolators - circuit breakers – cables - insulators and transformers - bushings and surge absorbers.

**Total Hours : 45**

**REFERENCES:**

1. M.S. Naidu and V. Kamaraju, “High Voltage Engineering”, 3rd edition, Tata McGraw Hill, 1995.
2. C.L. Wadhwa, “High Voltage Engineering”, New Age International Private Limited, 1995.
3. E. Kufell and W.S. Zaengl, “High voltage Engineering fundamentals”, 2nd edition, Pergamon press, 1984.
4. Dieter Kind, Kurt Feser, “High Voltage Test Techniques”, SBA Electrical Engineering Series, 1999.
5. Gallagher, T.J., and Permain, A., “High Voltage Measurement, Testing and Design”, John Wiley Sons, New York, 1983.
6. R.Mazen, Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, Roshdy Radwan, “High Voltage Engineering Theory and Practice”, 2nd Edition, Revised and Expanded, Marcel Dekker Inc., New York, 2000.
7. N.H.Malik, A.A.Al_Arainy, M.I.Qureshi, “Electrical Insulation in Power Systems”, Marcel Dekker,Inc., New York, 1988.
8. Adolf J. Schwab, “High Voltage Measurement Techniques”, M.I.T Press, 1972.

**OUTCOMES:**

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

- Execute a vibrant analysis of high voltage measurement techniques.
- Portray the generating principles of high DC, AC and impulse voltages and currents.
- Illustrate the principles for measurement of capacitance and dielectric loss.
- Confer the measurement principles behind partial discharges.

**EEBX27 INSULATION TECHNOLOGY**

| L | T | P | C |
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**OBJECTIVES:**

- To acquire knowledge in the area of insulation technology.
- To study about different applications of insulating materials.

**MODULE I TYPES OF INSULATING MATERIALS IN USE TODAY 8**

Insulating materials – classification - brief study of preparation and properties of ceramics, mica, paper, PVC, PE Epoxy resin, teflon, SF6 transformer oil, polychlorobiphenyls (PCB) vacuum purification of transformer oil - drying and degassing - Impregnation of paper and cotton insulation.

**MODULE II GENERAL PROPERTIES OF INSULATING MATERIALS 8**

Requirements of insulating materials – electrical properties – molecular properties of dielectrics – dependence of permittivity on temperature, pressure, humidity and voltage - permittivity of mixtures, practical importance of permittivity – behavior of dielectric under alternating fields – complex dielectric constants – bipolar relaxation and dielectric loss - dielectric strength.

**MODULE III BREAKDOWN MECHANISMS IN GASEOUS DIELECTRICS 8**

Behaviour of gaseous dielectrics in electric fields – gaseous discharges – different ionization processes – effect of electrodes on gaseous discharge – Townsend's theory, Streamer theory – electronegative gases and their influence on gaseous discharge – Townsend's criterion for spark breakdown - gaseous discharges in non-uniform fields - breakdown in vacuum insulation.

**MODULE IV BREAKDOWN MECHANISMS IN SOLID DIELECTRICS 8**

Intrinsic breakdown of solid dielectrics – electromechanical breakdown - Streamer breakdown - thermal breakdown and partial discharges in solid dielectrics - electrochemical breakdown – tracking and treeing – classification of solid dielectrics - composite insulation and its mechanism of failure.

**MODULE V BREAKDOWN MECHANISMS IN LIQUID DIELECTRICS 7**

Liquids as insulators - conduction and breakdown in pure and commercial liquids - Cryogenic insulation.

**MODULE VI APPLICATION OF INSULATING MATERIALS 6**

Application of insulating materials in transformers - rotating machines - circuit breakers – cables - power capacitors and bushings.

**Total Hours : 45**

**REFERENCES:**

1. Adrinaus, J.Dekker, “Electrical Engineering Materials”, Prentice Hall of India Pvt. Ltd., New Delhi, 1979.
2. Alston, L.L, “High Voltage Technology”, Oxford University Press, London, B.S Publications, 1st Indian Edition 2006.
3. Kuffel, E., Zaengl, W.S. and Kuffel J., “High Voltage Engineering Fundamentals”, Elsvier India Pvt. Ltd, 2005.
4. Dieter Kind and Hermann Karner, “High Voltage Insulation Technology”, (Translated from German by Y. Narayana Rao, Friedr. Vieweg & Sohn, Braunschweig), 1985.
5. M.S Naidu, V.Kamaraj, “High Voltage Engineering”, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, 2004.
6. V.Y.Ushakov, “Insulation of High Voltage Equipment”, Springer ISBN.3-540-20729-5, 2004.

**OUTCOMES:**

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

- Portray the general properties of insulating materials.
- Execute a vibrant analysis of breakdown mechanisms and applications of insulating materials.

**EEBX28 ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING**

| L | T | P | C |
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**OBJECTIVES:**

- To provide a theoretical framework for understanding the electrical and magnetic fields.
- To understand electromagnetic (EM) waves and EM properties of various materials.
- To exposes the students to introduction of modern physics with basic knowledge of relativity and quantum mechanics as well.

**MODULE I INTRODUCTION** **7**

Review of basic field theory – electric and magnetic fields – Maxwell's equations – Laplace, Poisson and Helmoltz equations – principle of energy conversion – force/torque calculation – Electro thermal formulation.

**MODULE II SOLUTION OF FIELD EQUATIONS I** **8**

Limitations of the conventional design procedure - Need for the field analysis based design - problem definition, solution by analytical methods-direct integration method – variable separable method – method of images, solution by numerical methods- Finite Difference Method.

**MODULE III SOLUTION OF FIELD EQUATIONS II** **8**

Finite element method (FEM) – Differential/ integral functions – Variational method – Energy minimization – Discretisation – Shape functions –Stiffness matrix –1D and 2D planar and axial symmetry problem.

**MODULE IV FIELD COMPUTATION FOR BASIC CONFIGURATIONS** **8**

Computation of electric and magnetic field intensities – Capacitance and Inductance – Force, Torque, Energy for basic configurations.

**MODULE V DESIGN APPLICATIONS** **8**

Insulators- Bushings – Cylindrical magnetic actuators – Transformers – Rotating machines.

**MODULE VI COMPUTATIONAL METHODS FOR ELECTROMAGNETIC ANALYSIS 6**

Frequency versus time domain analysis – High frequency asymptotic techniques – First principle numerical methods – Time domain simulation methods – Hybrid techniques.

**Total Hours : 45**

**REFERENCES:**

1. K.J.Binns, P.J.Lawrenson, C.W Trowbridge, “The analytical and numerical solution of Electric and magnetic fields”, John Wiley & Sons, 1993.
2. Nathan Ida, Joao P.A.Bastos, “Electromagnetics and calculation of fields”, Springer-Verlage, 1992.
3. Nicola Biyanchi , “Electrical Machine analysis using Finite Elements”, Taylor and Francis Group, CRC Publishers, 2005.
4. S.J Salon, “Finite Element Analysis of Electrical Machines”, Kluwer Academic Publishers, London, 1995.
5. User manuals of MAGNET, MAXWELL & ANSYS software.
6. Silvester and Ferrari, “Finite Elements for Electrical Engineers”, Cambridge University press, 1983.
7. Jian Ming Jin, “Theory and Computation of Electromagnetic fields”, John Wiley and Sons, 2010.

**OUTCOMES:**

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

- Understand the basic concepts of electric charge, electric field and potential, electrical energy and power.
- To apply laws of electromagnetic induction in simple situations.
- Understand magnetic circuits and apply laws of magnetism to analyse them.
- Appreciate the principles of operation of electromagnetic devices.
- Understand basic modern physics with the ideas of particle–wave duality and a quantum mechanical model of an atom.

| EEBX29 | PULSED ELECTRIC FIELD AND FOOD PRESERVATION | L | T | P | C |
|---|---|---|---|---|---|
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**OBJECTIVES:**

- To acquire skills in the area of food preservation using pulsed electric field treatment.
- To study about different inactivation techniques used in pulsed electric field.

**MODULE I FUNDAMENTALS OF PULSED ELECTRIC FIELD 7**

Introduction- Methods of Applying Electricity – High Intensity PEF Processing System – Basics of High Intensity PEF – Energy Requirements – Applications of PEF in Food Preservation – Disadvantages of PEF.

**MODULE II DESIGN OF PEF PROCESSING EQUIPMENT 8**

Introduction – High Voltage Pulsers – Switches – Treatment Chambers – Cooling system – Typical Measurements in PEF system – Packaging and Storaging.

**MODULE III MICROBIAL INACTIVATION IN ELECTRIC FIELDS 7**

Introduction – Transmembrane Potential – Electromechanical Compression and instability – Osmotic Balance – Viscoelastic Model – Hydrophobic and Hydrophilic pores - Theories based on conformational changes – Electric Field induced structural changes.

**MODULE IV PEF INDUCED BIOLOGICAL CHANGES 8**

Introduction – Electropermeabilization – Electrofusion – Disruption and Biological Alteration – Electrical and Thermal Gradients induced by PEF on microbial cell membranes – Main factors in Microbial inactivation.

**MODULE V PEF INACTIVATION OF VEGETATIVE CELLS SPORES AND ENZYMES IN FOODS AND FOOD PROCESSING BY PEF 7**

Introduction – Microbial Inactivation – Inactivation of yeasts - E.Coli - S.Aureus – Lactobacillus – Bacillus – Salmonella – Pseuomonas - Inactivation of other microorganisms - Spore Inactivation – Standardization of inactivation assessment - Enzyme inactivation.

**MODULE VI FOOD PROCESSING BY PEF 8**

Microbial Analysis – Chemical and Physical Analysis – Sensory evaluation and Shelf life studies - Quality and Shelf Life Evaluation of PEF products – Processing of Apple Juice, Orange Juice, Milk, Eggs and Green Pea Soup - Processing of Brine solutions and water in cooling systems.

**Total Hours : 45**

**REFERENCES:**

1. Gustavo V. Barbosa Canovas, M. Marcela gongora nieto, Usha R. Pothakamury, Barry G. Swanson, “Preservation of Foods with Pulsed Electric Fields”, Academic Press, 1999.
2. Javier Raso, Volker Heinz, “Pulsed electric field technology for the food industry, Fundamentals and applications”, Springer Science and Business Media, 2006.
3. Huub L. M. Lelieveld, S. L. H. Notermans, S. W. H. De Haan, “Food preservation by pulsed electric fields from research to application”, Wood head publishing limited, 2007.

**OUTCOMES:**

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

- Understand and analyze the PEF concept in different applications.
- Study different inactivation techniques used in pulsed electric field.

| ITB3103 | COMPUTER SCIENCE & INFORMATION TECHNOLOGY DATABASE MANAGEMENT SYSTEMS | L | T | P | C |
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**OBJECTIVES:**

- Master the basic concepts and appreciate the applications of database systems.
- Master the basics of SQL and construct queries using SQL.
- Be familiar with the relational database theory, and be able to write relational algebra Expressions for queries.
- Mastering the design principles for logical design of databases, including the E-R method and normalization approach.
- Be familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B-tree, and hashing.
- Master the basics of query evaluation techniques and query optimization.
- Be familiar with the basic issues of transaction processing and concurrency control.

**MODULE I INTRODUCTION AND CONCEPTUAL MODELING 7**

Introduction to File and Database systems- Database system structure – Data Models – Introduction to Network and Hierarchical Models – ER model.

**MODULE II RELATIONAL MODEL 7**

Relational Model - Relational Algebra and Calculus - SQL – Data definition- Queries in SQL- Updates- Views – Integrity and Security.

**MODULE III DATA STORAGE 8**

Relational Database design – Functional dependences and Normalization for Relational Databases (up to BCNF) - Record storage and Primary file organization- Secondary storage Devices- Operations on Files- Heap File- Sorted Files.

**MODULE IV HASHING, INDEXING AND QUERY PROCESSING 7**

Hashing Techniques – Index Structure for files –Different types of Indexes- B-Tree - B+Tree – Query Processing.

**MODULE V TRANSACTION MANAGEMENT 8**

Transaction Processing – Introduction- Need for Concurrency control- Desirable properties of Transaction- Schedule and Recoverability - Serializability and Schedules – Concurrency Control – Types of Locks - Two Phases locking- Deadlock- Time stamp based concurrency control – Recovery Techniques – Concepts- Immediate Update- Deferred Update - Shadow Paging.

**MODULE VI CURRENT TRENDS 8**

Object Oriented Databases – Need for Complex Data types - OO data Model- Nested relations - Complex Types- Inheritance Reference Types - Distributed databases- Homogenous and Heterogenous- Distributed data Storage – XML – Structure of XML- Data- XML Document- Schema- Querying and Transformation – Data Mining and Data Warehousing.

**TOTAL: 45 Hours**

**REFERENCES:**

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, “Database System Concept”’, 4th Edition, McGraw-Hill, 2002.
2. Ramez Elmasri and Shamkant B. Navathe, “Fundamental Database Systems”, 3rd Edition, Pearson Education, 2003.
3. Raghu Ramakrishnan, “Database Management System”, Tata McGraw-Hill Publishing Company, 2003.
4. Peter Rob and Corlos Coronel, “Database System, Design, Implementation and Management”, Thompson Learning Course Technology, 5th edition, 2003.
5. Hector Garcia Molina, Jeffrey D.Ullman and Jennifer Widom, “Database System Implementation”, Pearson Education, 2000.

**OUTCOMES:**

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

- Study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
- Understand and use data manipulation language SQL to query, update, and manage a database.

- Develop an understanding of essential DBMS concepts such as: Integrity, Concurrency, Object oriented database, Distributed database, Data mining and Data Warehousing.
- Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

**ITBX21 WEB COLLABORATION AND TECHNOLOGY**

| L | T | P | C |
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**OBJECTIVES:**

- To have current knowledge about the collaborative and interactive web.
- To describe the actions, including those related to the cache, performed by a browser in the process of visiting a Web address.
- To demonstrate techniques for improving the accessibility of JavaScript Webpage.
- To demonstrate server side programming with semantic web implications.

**MODULE I INTRODUCTION** **8**

History of the Internet and World Wide Web – HTML 4 protocols – HTTP, SMTP, POP3, MIME, and IMAP. Introduction to JAVA Scripts – Object Based Scripting for the web. Structures – Functions – Arrays – Objects – Jquery implementation of JavaScript.

**MODULE II DYNAMIC HTML** **7**

Introduction – Object reference - Collectors all and Children. Dynamic style - Dynamic positioning - Event Model – Filters –Transitions – Data Binding – Sorting table data – Binding of an Image and table – Cascading Style Sheets – Types and Dynamic Implementation.

**MODULE III TRANSFORMATION OF WEB 1.0 to WEB 2.0 and WEB 3.0** **7**

Technology Overview, Rich User Experience, User Participation, Dynamic Content, Metadata, Web Standards and scalability, Openness and collective intelligence, Web 1.0 vs. Web 2.0 – Mashups- Semantic Web and its Implications.

**MODULE IV SERVER SIDE PROGRAMMING** **8**

Three tiers Architecture – Java Servlets – Architecture Overview – Generating Dynamic Content – Life cycle – JSP - Applications – Introduction to JSF- Java struts - Data base Connectivity- Open source Languages - Introduction to PHP and MYSQL – WAMP- Web servers – Apache – Nginix.

**MODULE V WEB SERVICES, STANDARDS & SPECIFICATIONS 8**

Description Languages, Protocols - REST (Representational State Transfer), SOAP, Collaboration architecture and standards (Enterprise bus) – Security – Messaging – Reliability – Transaction - Business Process & Management - Collaboration - SOA.

**MODULE VI RICH INTERNET APPLICATIONS 7**

Introduction to Photoshop - Dream weaver – Flash – AJAX – Cloud and RIA - Software as a Service –Applications in SaaS - Impact of RIA on cloud.

**TOTAL: 45 Hours**

**REFERENCES:**

1. Deitel & Deitel, Goldberg, “Internet and World Wide Web – How to Program”, Pearson Education Asia, 2001.
2. Eric Ladd, Jim O’ Donnel, “Using HTML 4, XML and JAVA”, Prentice Hall of India.
3. QUE, Aferganatel, “Web Programming: Desktop Management”, PHI, 2004.
4. Ravi Kumar, Jain Brajesh, Prabhakar, “Wiki - A New Wave In Web Collaboration”, Icfai University Press, 2006.
5. Vivek Chopra, Sing Li, Rupert Jones, Jon Eaves, John T. Bell, “Beginning JavaServer Pages”, Wrox Publishers, 2005.
6. Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Prentice Hall, 2006.
7. Jason Gerner, Yann Le Scouarnec, Jeremy Stolz, Imothy Boronczyk, Elizabeth Naramore, “Beginning PHP 6, Apache, MySQL 6 Web Development”, Wrox Publications, 2001.

**OUTCOMES:**

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

- Analyze the web page and identify elements and attributes.
- Create Web pages dynamically using Cascading style sheets and XHTML.
- Imbibe knowledge about new technologies like JSF, PHP and Jquery.
- Acquire knowledge about Cloud and RIA.

**ITB2101 DATA STRUCTURES**

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**OBJECTIVES:**

- Describe the usage of various data structures.
- Explain the operations for maintaining common data structures.
- Recognize the associated algorithm operations and complexity.

**MODULE I PROBLEM SOLVING & ABSTRACT DATA TYPES 8**

Problem solving - Top-down Design - Implementation - Verification - Efficiency - Analysis - Sample algorithms.

**MODULE II ADT 7**

Introduction to data structures – Arrays - Sparse matrices – Strings - Abstract Data Type (ADT) - The List ADT - The Stack ADT - The Queue ADT.

**MODULE III TREES 7**

Preliminaries - Binary Trees - The Search Tree ADT - Binary Search Trees - AVL Trees - Tree Traversals - Hashing - General Idea - Hash Function - Separate Chaining - Open Addressing - Linear Probing - Model - Simple implementations - Binary Heap.

**MODULE IV SORTING 8**

Preliminaries - Insertion Sort - selection sort- Shell sort - Heap sort – Merge sort - Quick sort - External Sorting.

**MODULE V GRAPHS 8**

Definitions - Topological Sort - Shortest-Path Algorithms - Unweighted Shortest Paths - Dijkstra's Algorithm - Minimum Spanning Tree - Prim's Algorithm - Applications of Depth-First Search - Undirected Graphs - Biconnectivity.

**MODULE VI APPLICATIONS 7**

Linked List - Maintaining an inventory - Stack - conversion of infix to postfix expression, evaluation of arithmetic expression - Queue - scheduler in OS - Tree - Priority queue - Graph - Traveling Salesman Problem.

**Total Hours : 45**

## REFERENCES:

1. R. G. Dromey, “How to Solve it by Computer”, Prentice Hall of India, 2009.
2. M. A. Weiss, “Data Structures and Algorithm Analysis in C”, 3rd Edition, Pearson Education Asia, 2007.
3. A.V. Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures and Algorithms”, Pearson Education, 1st Edition Reprint, 2003.
4. Y. Langasam, M.J Augenstein and A.M. Tenenbaum, “Data Structures using C and C++”, 2nd Edition, Prentice - Hall of India, 2000.

## OUTCOMES:

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

- Design and apply appropriate data structures for solving computing problems.
- Develop computer programs to implement different data structures and related algorithms.
- Possess the ability to design simple algorithms for solving computing problems.

**ITB2104 COMPUTER NETWORKS**

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**OBJECTIVES:**

- To understand the layering concepts in computer networks.
- To understand the functions of each layer.
- To have knowledge in different applications that use computer networks.

**MODULE I DATA COMMUNICATIONS** **8**

Components – Direction of Data flow – Networks – Components and Categories – Types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems – RS232 Interfacing sequences.

**MODULE II DATA LINK LAYER** **8**

Error – Detection and correction – Parity – LRC – CRC – Hamming code – low Control and Error control - Stop and wait – Go back-N ARQ – Selective repeat ARQ- Sliding window – HDLC - LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.11 – FDDI - SONET – Bridges.

**MODULE III NETWORK LAYER** **8**

Internetworks – Packet Switching and Datagram approach – IP addressing methods – Sub netting – Routing – Distance Vector Routing – Link State Routing – Routers.

**MODULE IV TRANSPORT LAYER** **7**

Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services.

**MODULE V APPLICATION LAYER** **7**

Domain Name Space (DNS) – SMTP – FTP – HTTP – WWW – Network Simulation Tools – NS2 / Glomosim.

**MODULE VI CRYPTOGRAPHY** **7**

OSI Security Architecture – Classical Encryption techniques – Data Encryption

Standard – Block Cipher Design Principles and Modes of Operation – Principles of Public key Cryptosystems – RSA algorithm.

**Total Hours : 45**

## REFERENCES:


1. Behrouz A. Forouzan, “Data Communication and Networking”, Tata McGraw-Hill, 2004.
2. James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Pearson Education, 5th Edition, 2003.
3. Larry L.Peterson and Peter S. Davie, “Computer Networks”, Harcourt Asia Pvt. Ltd., 2nd Edition, Pearson education Asia, 2000.
4. Andrew S. Tanenbaum, “Computer Networks”, PHI, 4th Edition, 2003.
5. William Stallings, “Data and Computer Communication”, 6th Edition, Pearson Education, 2000.
6. William Stallings, “Cryptography and Network Security – Principles and Practices”, Prentice Hall of India, 3rd Edition, 2003.


## OUTCOMES:

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

- Master the terminology and concepts of the OSI reference model and the TCP-IP reference model.
- Master the concepts of protocols, network interfaces and design/performance issues in local area networks and wide area networks.
- Be familiar with contemporary issues in networking technologies.
- Be familiar with network tools and network programming.

**ITBX82 JAVA PROGRAMMING**

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**OBJECTIVES:**

- To understand the basic concepts of java programming using OOPs concepts.
- To acquire knowledge and skills in Graphical User Interface (GUI) using AWT Applet & Swing programming.
- To understand database connectivity using JDBC.

**MODULE I JAVA FUNDAMENTALS 8**

Features of Java - OOPs concepts - Java virtual machine - Reflection byte codes Byte code interpretation - Data types - variable, arrays, expressions, operators, and control structures.

**MODULE II OBJECTS AND CLASSES 8**

Java Classes - Abstract classes - Static classes - Inner classes – Packages - Wrapper classes - Interfaces This Super Access control.

**MODULE III EXCEPTION HANDLING AND IO PACKAGE 8**

Exception as objects - Exception hierarchy - Try catch finally – Throw – throws - IO Package - Input streams, Output streams, Object serialization and Deserialization - Sample programs on IO files - Filter and pipe streams.

**MODULE IV MULTI THREADING 7**

Thread - Thread Life cycle - Multi threading advantages and issues - Simple thread program - Thread synchronization.

**MODULE V GRAPHICAL USER INTERFACE 7**

Introduction to AWT programming - Layout and component managers - Event handling - Applet class - Applet life cycle - Passing parameters embedding in HTML - Swing components – JApplet, JButton, JFrame, etc. - Sample swing programs.

**MODULE VI DATABASE CONNECTIVITY 7**

Database Connectivity - JDBC architecture - Establishing connectivity and working with connection interface Working with statements.

**Total Hours : 45**

## REFERENCES:

1. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, 8th Edition, Sun Microsystems Press, 2008.
2. K. Arnold and J. Gosling, “The JAVA programming language”, 3rd Edition, Pearson Education, 2000.
3. Herbert schildt TMH, “The complete reference JAVA2”.
4. C. Thomas Wu, “An introduction to Object-oriented programming with Java”, 4th Edition, Tata McGraw-Hill Publishing company Ltd., 2006.

## OUTCOMES:

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

- Experience in basic concepts of java programming.
- Know practical knowledge in java concepts like objects, classes, streams, multi-threading & GUI.
- Design a small-scale application oriented java program.

**CSBX53 COMPUTER HARDWARE & INTERFACING** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

To enable the student to

- Get a detailed knowledge of all the hardware components that make up a computer and to understand the different interfaces required for connecting these hardware devices.

**MODULE I CPU AND MEMORY** **8**

CPU essentials – Processor modes – Modern CPU concepts – Architectural performance features – The Intel's CPU – CPU over clocking – Over clocking requirements – over clocking the system – Over clocking the Intel processors – Essential memory concepts – Memory organizations – Memory packages – modules – Logical memory organizations – Memory considerations – Memory types – Memory techniques – Selecting and installing memory.

**MODULE II MOTHERBOARDS** **7**

Active motherboards – Sockets and slots – Intel D850GB – Pentium 4 mother board – expansion slots – Form factor – Upgrading a mother board – Chipsets – North bridge – South bridge – CMOS – CMOS optimization tactics – Configuring the standard CMOS setup – Motherboard BIOS – POST – BIOS features – BIOS and Boot sequences – BIOS shortcomings and compatibility issues – Power supplies and power management – Concepts of switching regulation – Potential power problems – Power management.

**MODULE III STORAGE DEVICES** **8**

The floppy drive – Magnetic storage – Magnetic recording principles – Data and disk organization – Floppy drive – Hard drive – Data organization and hard drive – Sector layout – IDE drive standard and features – Hard drive electronics – CD-ROM drive – Construction – CDROM electronics – DVD-ROM – DVD media – DVD drive and decoder.

**MODULE IV I/O PERIPHERALS** **7**

Parallel port – Signals and timing diagram – IEEE1284 modes – Asynchronous communication - Serial port signals – Video adapters – Graphic accelerators

– 3D graphics accelerator issues – DirectX – Mice – Modems – Keyboards – sound boards – Audio bench marks.

**MODULE V BUS ARCHITECTURE** **8**

Buses – Industry standard architecture (ISA), peripheral component Interconnect (PCI) – Accelerated Graphics port (AGP) – Plug-and-play devices – SCSI concepts – USB architecture.

**MODULE VI** **7**

Scanners- types. Web and Digital camera. Printers – Dot Matrix – Laser, Inkjet. MODEMS and standards – Lap Top specifications – Configuration and Assembling of a latest PC System.

**Total Hours : 45**

**REFERENCES:**

1. Craig Zacker & John Rourke, “The complete reference: PC hardware”, Tata McGraw-Hill, New Delhi, 2001.
2. Stephen J. Bigelow, “Trouble Shooting, maintaining and Repairing PCs”, Tata McGraw-Hill, New Delhi, 2003.
3. B.Ram, “Computer Fundamentals”, 2001.
4. B. Govinda Rajulu, “IBM Clones”, TATA McGraw Hill.

**OUTCOMES:**

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

- Describe and explain the difference between various analyses in computer field.
- Differentiate issues related to CPU and memory.
- Understand the components on the motherboard.
- Feature the different I/O peripheral devices and their interfaces.

| CSBX47 | CYBER SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the basic concepts related to security.
- To study various security models and authentication techniques.
- To give an exposure to security threats and evaluation mechanisms.

**MODULE I INTRODUCTION TO SECURITY FUNDAMENTALS 8**

Introduction to security - Information security- Security triad - Confidential, Integrity, Availability - Focus of control - Security threats and attacks - Security management- Identification - Authentication - Authentication by passwords - Protecting passwords.

**MODULE II ACCESS CONTROL AND SECURITY LEVELS 7**

Access control structures -Types of access control-Security levels and categories - Lattice diagram -Reference monitors -Security kernel - Hardware security features - Protecting memory.

**MODULE III SECURITY MODELS AND CRYPTOGRAPHY 8**

Security Models - Bell-LaPadula - Biba - Non-deducibility - Non-interference - Cryptography Basics- Cryptographic mechanisms - Digital signatures - Encryption - Digital Certificates.

**MODULE IV ADVANCED SECURITY MECHANISMS 8**

Authentication in distributed systems - Key establishments and authentication - Kerberos - Public key infrastructures - Single sign-on-Network security - Protocol design principles ISO architecture- IP security - SSL/TLS - Firewalls - Intrusion detection.

**MODULE V SOFTWARE AND DATABASE SECURITY 7**

Software security - Database security - Memory management - Data and code -Relational databases - Access control in databases - Statistical database security-Unix Security-Windows Security.

**MODULE VI EMERGING SECURITY FOCUS 7**

Java Security - Mobile Security - GSM security - Wireless LAN security- Protection measures - Business risk analysis - Prevention, detection and response - Information classifications- Security evaluation.

**Total Hours : 45**

**REFERENCES:**

1. Edward Amoroso, “Cyber Security”, Silicon, 1st Edition, 2006.

2. Dieter Gollmann , “Computer Security”, Wiley, 2011.

**OUTCOMES:**

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

- Be able to understand security principles, threats and attack techniques.
- Be able to recommend appropriate authentication and access controls.
- Be able to understand concepts pertaining to network security, operating system security, software security and database security.

**CSBX08 CLOUD COMPUTING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To learn the various cloud concepts and deployment models.
- Describe the landscape of different types of virtualization.
- Comprehend the technical capabilities and business benefits of virtualization and cloud computing and learn how to measure those benefits.

**MODULE I VIRTUALIZATION 7**

Virtualization – Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – Limitations - Types of hardware virtualization – Full virtualization - Partial virtualization - Para virtualization - Desktop virtualization – Software virtualization – Memory virtualization - Storage virtualization – Data virtualization – Network virtualization - Thin client.

**MODULE II CLOUD INTRODUCTION - ARCHITECTURAL INFLUENCES 7**

Cloud Computing Overview – Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling and Rapid elasticity - Architectural influences – High-performance computing - Utility and Enterprise grid computing - Autonomic computing - Service consolidation - Horizontal scaling - Web services - High scalability architecture.

**MODULE III CLOUD SCENARIOS AND DEPLOYMENT MODEL 7**

Cloud Scenarios – Benefits – Scalability, simplicity, vendors and security - limitations – application development – security concerns - privacy concern with a third party - security level of third party - security benefits - Regularity issues – Government policies - Cloud deployment model – Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

**MODULE IV CLOUD ARCHITECTURE MODELS 7**

Cloud architecture – Cloud delivery model - Software as a Service (SaaS) – SaaS service providers – Google App Engine, Salesforce.com and google

platfrom – Benefits – Operational benefits - Economic benefits – Evaluating SaaS - Platform as a Service ( PaaS ) - PaaS service providers – Right Scale – Salesforce.com – Rackspace – Force.com – Services and Benefits - Infrastructure as a Service ( IaaS) - IaaS service providers – Amazon EC2, GoGrid – Microsoft soft implementation and support – Amazon EC service level agreement – Recent developments – Benefits.

**MODULE V CLOUD COLLABORATION 8**

Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files.

**MODULE VI CLOUD SERVICES 9**

Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services –Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis.

**Total Hours : 45**

**REFERENCES:**

1. Haley Beard, “Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud With SLAs”, Emereo Publishing Limited, July 2008.
2. Borivoje Furht, Armando Escalante, “The Hand Book of Cloud Computing”, Springer, 2010.
3. Anthony T.Velte , Toby J. Velte Robert Elsenpeter, “Cloud computing a practical approach”, TATA McGraw- Hill, 2010.
4. Michael Miller Que, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, 2008.

**OUTCOMES:**

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

- Understand cloud computing concepts and deployment of cloud models.

- Recognize the pros and cons of cloud computing and operational issues such as vendor selection, initial migration, onsite support, costs, and private versus public deployment.
- Aware of the risks associated with cloud computing, including data security and disaster recovery.

**CSBX51 OPERATING SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To learn the concepts and creation computer processes and threads.
- To understand memory management and virtual memory concepts.
- To understand process concurrency and synchronization.
- To learn the scheduling policies of modern operating systems.

**MODULE I OVERVIEW OF OPERATING SYSTEMS 7**

Operating Systems Objectives and Functions – Evolution of the Operating systems – Operating System Structures.

**MODULE II PROCESS MANAGEMENT & SCHEDULING 7**

Process Life cycle – Process control – Threads – Multi Threads – Scheduling criteria – Types of scheduling – Scheduling Algorithms.

**MODULE III PROCESS SYNCHRONIZATION 7**

Concurrent process – Principles of Concurrency – IPC – Semaphores – Deadlock – Deadlock Prevention, Avoidance, Detection and recovery.

**MODULE IV MEMORY MANAGEMENT 7**

Introduction – Partitions – paging – segmentation – segmentation and paging – Need for virtual memory management – Demand Paging – Page fault and page replacement policies.

**MODULE V I/O MANAGEMENT AND DISK SCHEDULING 8**

Organization of I/O functions – Evolution of I/O Functions – Logical Structure of I/O functions – I/O Buffering and Blocking – Disk I/O – Disk Scheduling algorithms.

**MODULE VI FILE MANAGEMENT 9**

Principles – File management Techniques – File directories – File System Architecture – file allocation.

**Total Hours : 45**

## REFERENCES:

1. Mauerer, Wolfgang , “Professional Linux® Kernel Architecture”, Wrox, 2008.
2. Deitel H M, “Operating Systems”, Pearson education, New Delhi, 2007.
3. Jim Mauro and Richard McDougall, “Solaris Internals - Solaris 10 and Open Solaris kernel architecture”, Sun Microsystems Press, Prentice Hall, 2007.
4. Dhamdhere D M, “Operating Systems”, Tata Mc Graw Hill, New Delhi, 2006.

## OUTCOMES:

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

- A high level understanding of the structure of operating systems, applications, and the relationship between them.
- The students will able to have knowledge of the services provided by operating systems.
- The students will able to have an exposure to some details of major OS concepts.

| EIBX81 | ELECTRONICS, COMMUNICATION & INSTRUMENTATION BIO INSTRUMENTATION AND SIGNAL ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide an acquaintance of the physiology of the brain , heart and lungs.
- To introduce the student to the biosensors, electrodes and amplifiers.
- To introduce the typical measurement and devices of bio-electric origin.
- To provide the latest ideas on devices of imaging techniques and monitoring and awareness of electrical safety of medical equipments.
- To bring out the importance of bio-signal analysis and diagnosis.

**MODULE I ANATOMY AND PHYSIOLOGY** **7**

Basic components of a biomedical system, Cell and its structure – Action and resting – Potential propagation of action potential – Sodium pump – Nervous system – Nerve cell – Synapse – Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration.

**MODULE II TRANSDUCERS AND AMPLIFIERS** **7**

Transducers – Different types – Piezo-electric, ultrasonic, resistive, capacitive, inductive transducers – Selection criteria. Electrodes – Micro, needle and surface electrodes – Amplifiers – Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier- ECG isolation amplifiers.

**MODULE III ELECTRO – PHYSIOLOGICAL MEASUREMENTS** **7**

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.

**MODULE IV MEDICAL IMAGING AND PMS** **7**

X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – types of biotelemetry systems and patient monitoring systems (PMS) – Electrical safety.

**MODULE V BIO SIGNAL ANALYSIS** **8**

Objectives of biomedical signal analysis – Fundamental of Biosignals – classification of biosignals - Difficulties encountered in biomedical signal

acquisition and analysis – Filtering for removal of artifacts – biosignal processing algorithms – time domain alaysis and frequency domain analysis – Computer aided diagnosis.

**MODULE VI CASE STUDY** **9**

Problem statement: Connect up to 8/16 ECG input leads with ECG system or get available ECG data. Use automated analysis features for HRV, to classify heartbeats, identify arrhythmias, perform ECG averaging and report.

**Total Hours : 45**

**REFERENCES:**

1. R.S.Khandpur, "Hand Book of Bio-Medical instrumentation', 12th reprint, Tata McGraw Hill Publishing Co Ltd., 2008.
2. J.Webster, "Medical Instrumentation – Application and Design", 4th Edition, John Wiley & Sons, 2009.
3. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2006.
4. L.A. Geddes and L.E.Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 1975.
5. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", 2nd Edition, Pearson Education, 2008.
6. Rangaraj M. Rangayan, "Biomedical signal analysis", John Wiley and sons (ASIA) Pvt Ltd., 2009.

**OUTCOMES:**

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

- Students will have an exposure of the physiology of the brain ,heart and lungs.
- Students will be well equipped to choose the proper electrodes and required amplifiers for specific bioapplication.
- They will be able to analyze typical waveforms of bio potentials.
- They will show their enhanced knowledge on Imaging and will be able provide safety during measurement.
- The students will have the ability to acquire, analyse and identify the abnormalities in biosignals.

**ECBX81 INTRODUCTION TO COMPUTER GRAPHICS AND IMAGE PROCESSING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce students to various two and three dimensional primitives and concepts.
- To provide an opportunity for students to represent, design and implement two dimensional and three dimensional objects.
- To identify all techniques related to modern graphics programming concepts.

**MODULE I DIGITAL IMAGE FUNDAMENTALS** **7**

Elements of digital image processing systems, Vidicon and Digital Camera working principles - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries, 2D transforms -DFT, DCT.

**MODULE II IMAGE SEGMENTATION** **7**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and Merging – Segmentation by morphological watersheds – basic concepts.

**MODULE III IMAGE COMPRESSION** **7**

Need for data compression – Huffman - Run Length Encoding - Shift codes - Arithmetic coding - Vector Quantization - Transform coding - JPEG standard - MPEG.

**MODULE IV 2D PRIMITIVES** **8**

Output primitives – Line, Circle and Ellipse drawing algorithms - Attributes of output primitives – Two dimensional geometric transformation - Two dimensional viewing – Line and Text clipping algorithms.

**MODULE V 3D CONCEPTS** **8**

Parallel and Perspective projections – Three dimensional object representation – Polygons, Curved lines, Splines and Quadric Surfaces - Visualization of data sets - 3D transformations – Viewing -Visible surface identification.

**MODULE VI GRAPHICS PROGRAMMING 7**

Color Models – RGB, YIQ, CMY, HSV – Animations – General Computer Animation, Raster, Keyframe - Graphics programming using OPENGL – Basic graphics primitives – Drawing three dimensional objects.

**Total Hours : 45**

**REFERENCES:**

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson Education Inc., 2nd Edition, 2004.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education Inc., 2002.
3. William K. Pratt, “Digital Image Processing”, John Wiley, New York, 2002.
4. Milan Sonka et al, “Image Processing, Analysis and Machine vision”, Brookes/ Cole Vikas Publishing House, 2nd edition, 1999.
5. Donald Hearn, M.Pauline Baker, “Computer Graphics – C Version”, 2nd edition, Pearson Education, 2004.
6. Prabhat K Andleigh, Kiran Thakrar, “Multimedia systems design”, PHI, 2007.
7. F.S.Hill, “Computer Graphics using OPENGL”, 2nd edition, Pearson Education, 2003.
8. Ralf Steinmetz and Klara, “Multimedia Computing, Communications and Applications”, Pearson Education, 2004.

**OUTCOMES:**

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

- The students will be able to process digital images.
- The students will be able to analyze the images to get information.
- The students will be able to generate images.

**EIBX82 SENSORS FOR BIO-MEDICAL APPLICATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To introduce the student to the various principles, technologies, methods and applications of biosensors and bioinstrumentation.
- To link engineering principles to understanding of bio systems in sensors and bioelectronics.
- To bring out the important and modern methods of sensor techniques.
- To provide the student with detail methods and procedures used in the design, fabrication and application of biosensors and bio electronic devices.

**MODULE I INTRODUCTION TO BIOSENSORS** **8**

Introduction to biosensors - Types of bio sensors – Bio transducers – Different types - active and passive transducer – factors influencing and selection criteria of transducers for physiological parameters - Transducer for biomedical application.

**MODULE II BIO RESISTIVE SENSORS** **7**

Resistive Transducers – Strain Gauge - types, construction, selection materials, Gauge factor, Bridge circuit and calibration - Strain Gauge type Blood pressure transducers - Thermistor used for cardiac output measurement - nasal air flow measurement - Photoelectric type resistive transducer.

**MODULE III NON CONTACT TYPE BIOSENSORS** **7**

Non contact type infrared thermometry; Optical pyrometer - Electrochemical Biosensors – Electrochemical principles - Glucose biosensors – piezoelectric sensors – ultrasonic sensors.

**MODULE IV BIO ELECTRODES AND AMPLIFIERS** **8**

Electrodes – Micro needle and surface electrodes – Amplifiers – Preamplifiers, differential amplifiers, and chopper amplifiers – Isolation amplifier – ECG isolation amplifiers.

**MODULE V BIO-CHEMICAL SENSORS AND NON ELECTRICAL MEASUREMENT** **8**

pH - $pO_2$ - $pCO_2$ – Electrophoresis – photometer - Auto analyzer - Blood flow sensors – phonocardiogram - respiratory measurement – pulse - Blood cell counters.

**MODULE VI CASE STUDY** **7**

To analyse a diabetic patient using glucose biosensors – to analyse an asthma patient using respiratory sensors – selection of temperature, pressure and flow sensors for biomedical application.

**Total Hours : 45**

**REFERENCES:**

1. R.S. Khandpar, “Hand Book of Biomedical Instrumentation and measurement”, McGraw Hill publishing Co., 2009.
2. Aston, “Principles of Biomedical Instrumentation and measurements”, McGraw Hill publishing Co., 2007.
3. Arumugam, “Biomedical Instrumentation”, Anuradha Agencies Publishers, 2008.
4. John G. Webster, “Medical Instrumentation application and design”, 3rd Edition, Wiley, 1997.
5. E.A.H.Hall, “Biosensors”, Advanced Reference Series, Engineering, Prentice Hall, New Jersey, 1991.

**OUTCOMES:**

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

- On bio sensing and transducing techniques, design and construct biosensors instrumentation.
- Possess knowledge of detailed methods and procedures used in the design, fabrication and application of biosensors and bio electronic devices.
- To apply the above techniques for biomedical applications.

**ECBX82 VLSI DESIGN L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the students to VLSI Design Flow, Transistor-Level CMOS Logic Design, VLSI Fabrication and Physical Design.
- To enable the student to Analyze Gate Function and Timing Characteristics and to study High-Level Digital Functional Blocks.

**MODULE I VHDL MODELING AND DESIGN FLOW 8**

Introduction to VLSI - complete VLSI design flow (with reference to an EDA tool) – Sequential, Data flow, and Structural Modeling – Functions, Procedures and attributes - Test benches, Synthesizable, and non synthesizable statements - packages and configurations - Modeling in VHDL with examples of circuits such as counters, shift registers, bidirectional bus, etc.

**MODULE II FSM AND SEQUENTIAL LOGIC PRINCIPLES 7**

Sequential Circuits – Meta-stability Synchronization – Design of Finite State Machines and State minimization - FSM CASE STUDIES - Traffic Light control - Lift Control and UART STA and DTA.

**MODULE III PROGRAMMABLE LOGIC DEVICES 7**

Introduction to the CPLDs - Study of architecture of CPLD and Study of the Architecture of FPGA.

**MODULE IV SYSTEM ON CHIP 8**

One, two phase clock, Clock distribution - Power distribution - Power optimization - SRC and DRC - Design validation - Global routing - Switch box routing - Off chip connections - I/O Architectures - Wire parasitic - EMI immune design - Study of memory - Basics of memory Includes types of memory cells and memory architectures - Types of memory based on architecture specific and application specific viz. SRAM, DRAM, SDRAM, FLASH, FIFO.

**MODULE V CMOS VLSI 8**

CMOS parasitic - Equivalent circuit - Body effect - Technology Scaling - A parameter - Detailed study of Inverter Characteristics - Power dissipation -

power delay product - CMOS combinational logic design and W/L calculations - Transmission gates - Introduction to CMOS layout.

**MODULE VI TESTABILITY** **7**

Need of Design for testability - Introduction to Fault Coverage – Testability - Design for Testability, Controllability and Observability - Stuck-at Fault Model - Stuck-Open and Stuck - Short faults - Boundary Scan check - JTAG technology - TAP Controller and TAP Controller State Diagram - Scan path - Full and Partial scan - BIST.

**Total Hours : 45**

**REFERENCES:**

1. Charles Roth, "Digital System Design using VHDL", McGraw Hill, 2001.
2. Xilinx Data Manual, "The Programmable Logic Data Book", 2004.
3. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Electronics", 2003.
4. "Logic with VHDL Design", 2nd Edition, McGraw-Hill, 2005.
5. Michael John, Sebastian Smith, "Application-Specific Integrated Circuits", Addison Wesley.
6. Wayne Wolf, "FPGA-Based System Design", Prentice Hall, 2001.
7. Miron Abramovici, "Digital Systems Testing and Testable Design", Jaico Publishing, 2002.
8. Sung-Mo (Steve) kang, Yusuf Leblebici, "CMOS Digital", 1991.
9. "Integrated Circuit", Tata McGraw-Hill Publication, 2005.

**OUTCOMES:**

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

- The student will have an understanding of how to construct fundamental VLSI systems structures from primitive circuit structures, we also will learn about the processes associated with fabricating CMOS devices.
- The student will have a complete picture of the VLSI systems design flow, starting at the Systems level, proceeding through the Register Transfer Level, to the Digital Logic, level therefore having a complete idea of the VLSI systems architecture and engineering design process and associated design methods.

**ECBX83 INTEGRATED CIRCUITS AND SYSTEM DESIGN** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the students to active and passive components available in CMOS and their parasitic elements of first order transistor modelling for initial manual design and the limits of applicability.
- To teach the student behaviour and design of basic analogue and digital circuit primitives, including quantitative treatment of matching.
- The students are introduced to switched capacitor techniques and continuous time filters.

**MODULE I BASIC SEMICONDUCTOR PHYSICS** **7**

Quantum mechanical concepts and atomic states – Solid state structure – Intrinsic, Extrinsic and compensated semiconductors – Lattice vibrations – Electron and hole mobilities and drift velocities.

**MODULE II DEVICES** **7**

Diode - CMOS – Wire models – CMOS inverter - Static behavior, Dynamic Behavior, Power, Energy.

**MODULE III DIGITAL SYSTEMS** **7**

DTL IC – HTL IC – TTL IC – ECL IC – Basic digital circuits – Special Purpose gates – Flip flops – Clock and waveform generators.

**MODULE IV SEQUENTIAL AND COMBINATIONAL LOGIC DESIGN** **8**

Ripple Adder, Look Ahead Carry Generator, Binary Parallel Adder, n-Bit Parallel Subtractor, Priority Encoder, Design considerations of the above combinational logic circuits with relevant Digital ICs.

MSI Registers - Shift Registers - Modes of Operation of Shift Registers, Ring Counter, Johnson Counter -Basic sequential logic Design steps - Design considerations of the above sequential logic circuits with relevant Digital ICs.

**MODULE V ANALOGUE INTEGRATED CIRCUIT DESIGN** **8**

CMOS amplifier basics – Current and Voltage sources – CMOS operational amplifiers – Data conversion circuits.

**MODULE VI SYSTEM DESIGN EXAMPLES 7**

Frequency counter – DACs and ADCs – Filter design - Filter response, Low pass RC active filter, Bandpass RC active filter, Switched C filter – Combinational logic design.

**Total Hours : 45**

**REFERENCES:**

1. Michael Shur, “Physics of Semiconductor Devices”, Prentice Hall, 2004.
2. B.S. Sonde, “Introduction to system design”, New Age International, 2003.
3. Razavi B., “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 1998.
4. John F. Wakerly, “Digital Design Principles & Practices”, PHI Publications, 3rd Edition, 2005.
5. Jan M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits-A Design Perspective Pearson Education”, 2005.
6. Alan B. Marcovitz, “Introduction to Logic Design”, TMH, 2nd Edition, 2005.
7. Mano, “Digital Logic and Computer Design”, Pearson Education, 2000.

**OUTCOMES:**

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

- The student has a thorough understanding of the characteristic and design aspects of IC circuits.
- The student will be able to build simple digital and analogue ICs.

**ECBX84 COMMUNICATION SYTEM SECURITY** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To familiarize the students with the issues and technologies involved in designing a communication network system that is robust against attack.
- Students will gain an understanding of the various ways in which a network can be attacked and the tradeoffs in protecting it.

**MODULE I NETWORK FUNDAMENTALS AND PHYSICAL LAYER 7**

Introduction to Networks - definition of layers – services - interface and protocols - OSI reference model - layers and duties - TCP/IP reference model – layers and duties - Physical layer - general description – characteristics - signaling media types – topologies - examples physical layer (RS232C, ISDN, ATM, SONET).

**MODULE II INTRODUCTION ON SECURITY 7**

Security Goals, Types of Attacks - Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability - Security services and mechanisms, Techniques – Cryptography - Steganography - Revision on Mathematics for Cryptography.

**MODULE III SYMMETRIC & ASYMMETRIC KEY ALGORITHMS 7**

Substitution Ciphers - Transposition Ciphers - Stream and Block Ciphers - Data Encryption Standards (DES) - Advanced Encryption Standard (AES) - RC4 - principle of asymmetric key algorithms - RSA Cryptosystem.

**MODULE IV INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT 8**

Message Integrity - Hash functions – SHA - Digital signatures - Digital signature standards - Authentication Entity Authentication – Biometrics - Key management Techniques.

**MODULE V NETWORK SECURITY, FIREWALLS AND WEB SECURITY 8**

Introduction on Firewalls - Types of Firewalls - Firewall Configuration and Limitation of Firewall - IP Security Overview - IP security Architecture - authentication Header - Security payload - security associations - Key

Management - Web security requirement - secure sockets layer - transport layer security - secure electronic transaction - dual signature.

**MODULE VI WIRELESS NETWORK SECURITY 8**

Security Attack issues specific to Wireless systems - Worm hole – Tunneling - DoS.WEP for Wi-Fi network - Security for 4G networks - Secure Ad hoc Network - Secure Sensor Network.

**Total Hours : 45**

**REFERENCES:**

1. Behrouz.A. Forouzan, “Data Communication And Networking”, 4th Edition, Tata McGraw Hill, 2007.
2. John C. Bellamy, “Digital Telephony”, 3rd Edition, John Wiley 2006.
3. Nichols and Lekkas, “Wireless Security – Models, Threats, and Solutions,” McGraw-Hill, 2002.
4. Behrouz A. Fourcuzan, “Cryptography and Network security”, Tata McGraw-Hill, 2008.
5. William Stallings, "Cryptography and Network security- principles and practice", 2nd Edition, Prentice Hall of India, New Delhi, 2002.
6. Atul Kahate, ”Cryptography and Network security”, 2nd Edition, Tata McGraw Hill, 2008.
7. R.K.Nichols and P.C. Lekkas , “Wireless Security”, 2000.

**OUTCOME:**

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

- Students will gain an appreciation of the need to develop an understanding of underlying system applications and potential security issues early in the design process.

**ECBX85 EMBEDDED HARDWARE & SOFTWARE SYSTEM DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- The objective of this course is to present to the student the computation devices, peripherals and networks associated with an embedded system.
- The students are introduced to embedded - C used in the design of a modern day embedded system.

**MODULE I ARCHITECTURE OF EMBEDDED SYSTEMS** **7**

Categories of Embedded Systems - Specifications of Embedded systems - Resent trends in Embedded Systems - Hardware Architecture - Software Architecture - Communication software - Process of generation of executable image-development/testing tools.

**MODULE II HARDWARE FUNDAMENTALS** **7**

Buses – DMA – interrupts – Built-ins on the microprocessor – Conventions used on schematics – Microprocessor Architectures – Software Architectures – RTOS Architectures – Selecting and Architecture. PIC microcontroller - Architecture of PIC 16c6x/7x – FSR - Reset action – Oscillatory connection - Memory organization - Instructions - Addressing modes - I/O ports – Interrupts – Timers – ADC - Assembly language programming.

**MODULE III RTOS** **7**

Tasks and Task states – Semaphores – Shared data – Message queues, Mail boxes and pipes – Memory management – Interrupt routines – Encapsulating semaphore and queues – Hard Real-time scheduling – Power saving.

**MODULE IV PROGRAMMING EMBEDDED SYSTEMS** **8**

Embedded Program – Role of Infinite loop – Compiling, Linking and locating – downloading and debugging – Emulators and simulators processor – External peripherals – Memory testing – Flash Memory.

**MODULE V OPERATING SYSTEM** **8**

Embedded operating system – Real time characteristics – Selection process – Flashing the LED – serial ports – Zilog 85230 serial controlled code efficiency – Code size – Reducing memory usage.

**MODULE VI EMBEDDED SOFTWARE DEVELOPMENT TOOLS 8**

Host and target machines – Linkers / Locators for Embedded Software – Debugging techniques – Instruction set simulators Laboratory tools – Practical example – Source code.

**Total Hours : 45**

**REFERENCES:**

1. David E.Simon, “An Embedded Software Primer”, Pearson Education, 2003.
2. Michael Bass, “Programming Embedded Systems in C and C++”, Oreilly, 2003.
3. K.V.K.K.Prasad, “Embedded /Real-Time Systems-Concepts, Design and Programming”, Dream tech, Wiley, 2003.
4. Ajay V Deshmukh, “Microcontroller Theory and Applications”, Tata McGraw Hill, 2005.
5. Raj Kamal, “Embedded Systems Architecture Programming and Design”, 2nd Edition, TMH, 2008.
6. David E Simon, “An Embedded Software Primer”, Pearson Education, 2003.
7. Daniel 5.W Lewis, “Fundamentals of Embedded Software”, Pearson Education, 2001.
8. Peatman, “Designing with PIC Micro Controller”, Pearson, 2003.

**OUTCOME:**

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

- Will provide a knowledge foundation which will enable students to pursue subsequent courses in real-time embedded systems software and computer design.

**ECBX86 SPEECH PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce fundamental models for production, perception and recognition of speech.
- To provide an introduction to the field of digital speech processing.
- The students are introduced to speech synthesis analysis and application.

**MODULE I BASIC CONCEPTS 8**

Speech Fundamentals- Articulatory Phonetics – Production and Classification of Speech Sounds- Acoustic Phonetics – acoustics of speech production- Review of Digital Signal Processing concepts - Short-Time Fourier Transform - Filter-Bank and LPC Methods.

**MODULE II SPEECH ANALYSIS 7**

Features - Feature Extraction and Pattern Comparison Techniques - Speech distortion measures – mathematical and perceptual – Log Spectral Distance - Cepstral Distances-Weighted Cepstral Distances and Filtering- Likelihood Distortions - Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients - Time Alignment and Normalization – Dynamic Time Warping - Multiple Time – Alignment Paths.

**MODULE III SPEECH MODELING 7**

Hidden Markov Models - Markov Processes - HMMs – Evaluation, Optimal State Sequence – Viterbi Search - Baum-Welch Parameter Re-estimation - Implementation issues.

**MODULE IV TIME DOMAIN METHODS FOR SPEECH PROCESSING 8**

Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude, Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function.

**MODULE V FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING** **8**

Short Time Fourier analysis - Fourier transform and linear filtering interpretations - Sampling rates - Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis - Analysis synthesis systems - Phase vocoder - Channel Vocoder - Homomorphic speech analysis - Cepstral analysis of Speech - Formant and Pitch Estimation - Homomorphic Vocoders.

**MODULE VI APPLICATION OF SPEECH SIGNAL PROCESSING** **7**

Algorithms - Dynamic time warping - K-means clustering and Vector quantization - Gaussian mixture modeling - hidden Markov modeling - Automatic Speech Recognition- Feature Extraction for ASR - Deterministic sequence recognition - Statistical Sequence recognition - Language models - Speaker identification and verification – Voice response system – Speech synthesis- basics of articulatory - source-filter, and concatenative synthesis – VOIP.

**Total Hours : 45**

**REFERENCES:**

1. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing, 1997.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004.
3. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.
4. Ben gold and Nelson Morgan, “Speech and audio signal processing”, processing and perception of speech and music, Wiley, Indian Edition, 2006.
5. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing”, John Wiley and Sons Inc., Singapore, 2004.
6. L.R.Rabiner and R.W.Schaffer , “Digital Processing of Speech signals”, Prentice Hall, 1979.
7. L.R. Rabiner and B. H. Juang, “Fundamentals of Speech Recognition”, Prentice Hall, 1993.
8. R. Deller, J.H.L. Hansen and J.G. Proakis, “Discrete Time Processing of Speech Signals”, John Wiley, IEEE Press, 1999.

**OUTCOMES:**

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

- To be able to describe and implement methods and systems for efficient quantization and coding of speech signals.
- To be able to describe and implement simple pattern-recognition applications of speech processing, such as speaker and speech recognition.

**EIBX83 INTELLIGENT CONTROL L T P C**
**3 0 0 3**

**OBJECTIVES:**

- This course will obtain a basic understanding of artificial neural networks, fuzzy logic control and intelligent technique.
- Students will know how these techniques are applied to engineering problems, including control systems.

**MODULE I INTRODUCTION TO INTELLIGENT CONTROL 7**

Introduction and motivation - Approaches to intelligent control - Architecture for intelligent control - Symbolic reasoning system - rule-based systems - the AI approach - Knowledge representation - Expert systems.

**MODULE II MATHEMATICAL MODELING 7**

Concept of Artificial Neural Networks and its basic mathematical model - McCulloch-Pitts neuron model - simple perceptron - Adaline and Madaline - Feed-forward Multilayer Perceptron - Learning and Training the neural network - Data Processing - Scaling, Fourier transformation - principal-component analysis and wavelet transformations.

**MODULE III NEURAL NETWORKS 7**

Networks: Hopfield network - Self-organizing network and recurrent network - Neural Net based controller. Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab - Neural Network toolbox.

**MODULE IV INTRODUCTION TO FUZZY LOGIC 8**

Introduction to crisp sets and fuzzy sets - basic fuzzy set operation and approximate reasoning - Introduction to fuzzy logic modeling and control – Fuzzification - inference and defuzzification - Fuzzy knowledge and rule bases - Fuzzy modeling and control schemes for nonlinear systems - Fuzzy logic control for nonlinear time-delay system - Implementation of fuzzy logic controller using Matlab fuzzy - logic toolbox.

**MODULE V FUZZY LOGIC SYSTEM 8**

Fuzzy logic system: Basic concepts of Fuzzy logic approaches - classical sets & Fuzzy sets - linguistic variables - membership functions - basic

operation - Fuzzy relations - numbers and arithmetic & logical operations - different de-Fuzzification techniques - Fuzzy rule based model & model based controllers - PID controllers, and application of Fuzzy controllers.

**MODULE VI GENETIC ALGORITHM 8**

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps - adjustment of free parameters - Solution of typical control problems using genetic algorithm.

**Total Hours : 45**

**REFERENCES:**

1. Freeman, "Neural network: Algorithms Applications and Programming Techniques", 2005.
2. Goldberg, "Genetic Algorithm in Search, Optimization, and Machine Learning", Addison Wesley Publishing Company Inc., 1989.
3. Millon W.T., Sutton R.S., and Webrose P.J., "Neural Networks for control", MIT Press, 1992.
4. MATLAB Neural Network Tool Box Manual.
5. MATLAB Fuzzy Logic Tool Box Manual.
6. R. Eberhart, P.Simpson and R. Dobbins, "Computional Intelligence" PC Tools, 2004.
7. Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall, Englewood cliffs, N.J., Professional, Boston, 1996.
8. Jacek M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1997.
9. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 1997.

**OUTCOMES:**

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

- Students will be able to design control systems using fuzzy logic and artificial neural networks.
- Students will understand the advantages and disadvantages of these methods relative to other control methods.
- Students will be aware of current research trends and issues.

## 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 |
|---|---|---|---|
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**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 |
|---|---|---|---|
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**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 |
|---|---|---|---|---|---|
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**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**

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**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.