Scheme and Syllabus of

Bachelor of Engineering (Electrical & Electronics Engg.)
First-Eighth Semesters Examinations,
2016-17
VISION OF DEPARTMENT
To impart knowledge of Electrical and Electronics Engineering and prepare graduates to achieve excellence in engineering education and research.

MISSION OF DEPARTMENT
• To prepare students with deep understanding of fundamentals of Electrical and Electronics Engineering.
• To prepare professionals with positive attitude, values and vision.
• To collaborate with industry, research organizations and academia to encourage innovation.
• To provide a platform for engineering graduates to create and design new products and systems that can help industry and society as a whole.

PROGRAMME EDUCATIONAL OBJECTIVES
• Graduates will have knowledge of electrical and electronics engineering to solve problems of social relevance, pursue higher education and research.
• Graduates will undertake complex problems and develop appropriate solutions.
• Graduates will work effectively as individuals and as team members in multidisciplinary projects.

PROGRAMME OUTCOMES
1. Graduates will have an ability to apply knowledge of mathematics, science and engineering in all aspects of electrical and electronics engineering.
2. Graduates will have an ability to identify, formulate and solve electrical and electronics engineering problems.
3. Graduates will have ability to design/develop components and processes which meet needs of society rationally.
4. Graduates will have an ability to apply theoretical knowledge of electrical and electronics engineering and to conduct experiments with electrical systems, analyze and interpret data for conclusions.
5. Graduates will have ability to model real life problems using software and hardware platforms both offline and in real time.
6. Graduates will have ability to design and construct a system, component or process to meet desired needs within realistic constraints.
7. Graduates will possesses leadership and managerial skills with professional ethical practices and social concerns.
8. Graduates will demonstrate an ability to visualize and work as individual or leader in multidisciplinary tasks.
9. Graduates will be able to communicate effectively in both verbal and written form.
10. Graduate will show understanding of impact of engineering solutions on society and also will be aware of contemporary issues.
11. Graduates will have ability to align to and upgrade to higher learning and research.
12. Graduate will have ability to participate and succeed in competitive examinations like GATE, GRE.
### EXISTING REGULATIONS FOR FOUR YEAR B.E. and FIVE YEAR INTEGRATED B.E.- M.B.A. COURSES BEING OFFERED UNDER PANJAB UNIVERSITY IN THE UNIVERSITY INSTITUTE OF CHEMICAL ENGINEERING & TECHNOLOGY, PANJAB UNIVERSITY, CHANDIGARH; UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY, PANJAB UNIVERSITY, CHANDIGARH; SWAMI SARVANAND GIRI PANJAB UNIVERSITY REGIONAL CENTRE, BAJWARA, HOSHIARPUR; AND CHANDIGARH COLLEGE OF ENGG. & TECH., CHANDIGARH w.e.f. THE SESSION 2010-11

### MODIFIED REGULATIONS FOR FOUR YEAR B.E. and FIVE YEAR INTEGRATED B.E.- M.B.A. COURSES BEING OFFERED UNDER PANJAB UNIVERSITY IN THE UNIVERSITY INSTITUTE OF CHEMICAL ENGINEERING & TECHNOLOGY, PANJAB UNIVERSITY, CHANDIGARH; UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY, PANJAB UNIVERSITY, CHANDIGARH; SWAMI SARVANAND GIRI PANJAB UNIVERSITY REGIONAL CENTRE, BAJWARA, HOSHIARPUR; AND CHANDIGARH COLLEGE OF ENGG. & TECH., CHANDIGARH w.e.f. THE SESSION 2010-11.

### Approved Regulations

1. General:
   1.1 The duration of the course of instruction for Bachelor of Engineering in all disciplines being offered by the Panjab University, shall be Four years (comprising of eight semesters, with two semesters per year). Each semester shall be at least of fourteen weeks duration.

1.2 The duration of the course of instruction for Integrated B.E.- M.B.A. in all disciplines being offered by the Panjab University shall be Five years. The teaching period will be divided in ten semesters. Each semester shall be at least of fourteen weeks duration.

1.3 The subjects to be studied in each semester will be as per the prescribed scheme of study for a particular course, indicating the minimum number of lectures to be delivered, distribution of marks in Major examination (End Semester Examination), Internal Assessment including two Minor Examinations (Mid semester examinations) (Minor-I, Minor-II) etc. Each subject shall have specified number of

### Modification Proposed

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   1.1 The duration of the course of instruction for Bachelor of Engineering in all disciplines being offered by the Panjab University, shall be Four years (comprising of eight semesters, with two semesters per year). Each semester shall be at least of fourteen weeks duration.

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1.4 The mode of admission to the First Semester course in any branch will be decided by the Syndicate. It will be open to a candidate, who has passed 10+2 examination of the Central Board of Secondary Education, New Delhi or its equivalent with Physics and Mathematics as compulsory subjects along with one of the following subjects: Chemistry, Biotechnology, Computer Science or Biology.

1.5 Provided that a candidate must have obtained a minimum of 60% marks in the qualifying examination i.e. +2 for admission to the first year B.E. and Integrated B.E. M.B.A courses in all the University Engineering Departments and Colleges affiliated to it except in the case of SC/ST/Physically Handicapped categories for which the percentage shall be 55% for admission to Engineering courses. The candidates shall be admitted on the basis of AIEEE merit conducted by CBSE.

1.6 The mode of admission to the Second year B.E Programme (lateral entry) where ever applicable will be decided by the Syndicate from time to time. It will be open to a candidate who has passed 3 year Diploma from the recognised State Board of Technical Education in India with 60% marks in the aggregate. The admission will only be made in the corresponding or equivalent branches of degree courses. Admission to various affiliated colleges and Swami Sarvanand Giri P.U. Regional Centre, Bajwara, Hoshiarpur will be made on the basis of merit obtained in the Entrance Examination to be conducted by the Panjab University.

1.7 1st, 3rd, 5th, 7th and 9th end semester examinations (major examinations) will usually be held in the month of November/December and 2nd, 4th, 6th, 8th and 10th end semester examinations (major examinations) will be held in the month of May/June every year or on such other dates as may be fixed by the
examinations) will be held in the month of May/June every year or on such other dates as may be fixed by the Syndicate. Besides, for improvement of “E” Grade only, examination for such candidates shall be conducted within one month of the last end semester examination in which the candidate had secured ‘ E ‘ Grade in a particular subject.

1.8 There shall be at least ten lectures/tutorials/Practical /drawing classes during the semester, for every hour of lecture/tutorial/practical per week i.e for each credit assigned to a subject shown in the schedule of teaching.

1.9 A student shall be eligible to appear in the examination only if he/she has attended at least 75% of the total classes held as mentioned above during the semester. The attendance shall be certified by the Chairperson of the University Department(s)/institutes/Director of Institute/Principal of College as the case may be.

1.10 On the recommendations of the Chairperson of the University Department(s)/institutes/Director of Institute/Principal of College as the case may be, Board of Control will have the power to condone the shortage of the attendance up to 10% per subject only as per the merit of each case.

1.11 A candidate who does not fulfill the attendance requirements in any subject will have to repeat the course of instruction in that subject.

1.12 A candidate will be promoted to second year only if he has earned at least 27 credits in first year (12 credits in first semester and 15 credits in second semester) with a minimum CGPA of 5.0. Subsequently, candidate need to earn at least 30 credits every year (15 credits in each subsequent semester) with a minimum CGPA of 5.0 (Syndicate).

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1.11 A candidate who does not fulfill the attendance requirements in any subject will have to repeat the course of instruction in that subject.

1.12 A candidate will be promoted to second year only if he has earned 50% of the total credits of preceding years. It means that for promotion to 2nd year, candidate should have earned 50% of the total credits of Ist year.

For promotion to 3rd year a candidate should have earned 50% of the total credits of Ist and 2nd year and so on.
5.5 in case of five year integrated B.E-M.B.A program) to get promoted to next subsequent year.

1.13 A candidate will be required to pass in all the subject as per the scheme of study of B.E./B.E- (MBA) course, where minimum pass grade/satisfactory completion is prescribed in a maximum duration of 6 / \(7\frac{1}{2}\) academic years respectively counted from academic session in which candidate is first admitted in B.E./ B.E.-MBA program. If a candidate fails to pass the examination in the period of 6 / \(7\frac{1}{2}\) academic years B.E/B.E-M.B.A, his/ her candidature will stand automatically cancelled. This period of 6 / \(7\frac{1}{2}\) academic years will also include the entire period of duration which he/she had suspended his/her studies on his/her own or has failed in the examination or debarred by the Panjab University from taking any examination.

1.14 If an error is detected in the grades despite every possible care having been exercised, the teacher-in-charge will bring the fact to the notice of the Chairperson of University Department(s)/Director of Institute/Principal of College as the case may be for being placed before the competent authority appointed for the purpose by the university like Board of Control or equivalent. If the Board of Control approves the change, then revised grades shall be submitted to the University duly countersigned by the members of the Board of Control and Chairperson of University Department(s)/Director of Institute/Principal of College as the case may be for consideration within a maximum period of seven working days from the date of declaration of the result.

1.15 In case of any grievance, the student can always represent before the Board of Control.

1.16 A detailed grade card will be issued to each student for each semester. A candidate will be awarded the degree of B.E (Bachelor of
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1.16 A detailed grade card will be issued to each student for each semester. A candidate will be awarded the degree of B.E (Bachelor of Engineering) or integrated B.E-M.B.A in respective discipline on earning minimum number of prescribed credits (corresponding to core + electives (departmental + open) + other allied subjects) as prescribed in the scheme of study. The minimum C.G.P.A of 5.0 is required to qualify for the award of B.E degree. In case of 5 year of integrated B.E-M.B.A program a minimum C.G.P.A of 5.5 is required to qualify for the award of integrated B.E-M.B.A degree.

1.17 A candidate with CGPA of 8.5 and above will be awarded B.E/B.E-M.B.A degree with honours.

1.18 Fee for appearing in each semester examination will be as prescribed by the Syndicate/Senate from time to time. Any candidate who is required to improve upon “E” grade after each End term examination shall have to pay required re-examination fee as prescribed by the Syndicate/Senate from time to time. Any student who obtains “F” grade in a subject will have to repeat the subject subsequently and registration/admission fee shall have to be paid by the candidate as prescribed by the Syndicate/Senate.

2.0 Credit System:
2.1 All B.E / integrated B.E-M.B.A programmes are organised around semester-based credit system of study. The credit system is based on continuous evaluation of a student’s performance/progress and includes flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

2.2 Performance/progress of a student is measured by the number of credits that he/she has earned (completed satisfactorily). Based on the course credits and grades obtained by the student, grade point average is
suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

2.2 Performance/progress of a student is measured by the number of credits that he/she has earned (completed satisfactorily). Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the programme. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree.

2.3 Course Credit Assignment:

Each course has a certain number of credits assigned to it depending on the associated number of lecture, tutorials and laboratory contact hours in a week. A few courses are without credit and are referred to as non-credit (NC) courses.

Lectures and Tutorials: One lecture hour or one tutorial hour per week per semester is assigned one credit.

Practical / Laboratory Work: One laboratory hour per week per semester is assigned half credit.

The credits are rounded off to the nearest whole number.

For each lecture or tutorial the self study component is 1 hour/week.

2.4 Earning Credits:

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade (at least ‘D’ grade), the student accumulates the course credits as earned credits. Performance of a student is measured by the number of credits that
2.4 Earning Credits:

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3.0 Grading System:

3.1 Relative standing of the student in the class shall be clearly indicated by his/her grades. The process of awarding grades shall be based upon fitting performance of the class to a defined statistical model.

3.2 The grades and their respective description, along with grade points are listed in the table given below in Table-1

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>10</td>
<td>Outstanding</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>Excellent</td>
</tr>
<tr>
<td>B+</td>
<td>8</td>
<td>Very Good</td>
</tr>
<tr>
<td>B</td>
<td>7</td>
<td>Good</td>
</tr>
<tr>
<td>C+</td>
<td>6</td>
<td>Average</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>Below average</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>Marginal</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>Very Poor</td>
</tr>
<tr>
<td>I</td>
<td>-</td>
<td>Incomplete</td>
</tr>
<tr>
<td>NP</td>
<td>-</td>
<td>Audit Pass</td>
</tr>
<tr>
<td>NF</td>
<td>-</td>
<td>Audit Fail</td>
</tr>
<tr>
<td>W</td>
<td>-</td>
<td>Withdrawal</td>
</tr>
<tr>
<td>X</td>
<td>-</td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td>S</td>
<td>-</td>
<td>Satisfactory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Completion</td>
</tr>
</tbody>
</table>

3.2 Description of Grades:
A+ Grade: An A+ Grade stands for outstanding achievement.
<table>
<thead>
<tr>
<th>NF</th>
<th>-</th>
<th>Audit Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>-</td>
<td>Withdrawal</td>
</tr>
<tr>
<td>X</td>
<td>-</td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td>S</td>
<td>-</td>
<td>Satisfactory Completion</td>
</tr>
<tr>
<td>Z</td>
<td>-</td>
<td>Course continuation</td>
</tr>
</tbody>
</table>

### 3.3 Description of Grades:

- **A+ Grade**: An A+ grade stands for outstanding achievement. Under any circumstances A+ grade shall not be awarded for percentage of marks less than 80. There will not be more than 10% A+ grade in any course.

- **D Grade**: The D grade stands for marginal performance. It is the minimum passing grade in any course. D grade shall not be awarded for percentage of marks less than 35 in any case. Still further, no student having 40 percent or more marks would be awarded failing grades of E and F.

- **E and F Grades**: The E and F Grades denote poor and very poor performance i.e failing the course. F grade is also awarded in case of poor class / lab attendance (< 75%). If candidate gets F grade he/she will have to reappear in subsequent University examination as well as Internal Assessment examination for that subject.

- **I Grade**: An I grade denotes incomplete performance in any L(lecture), P(practical), V(special module) category courses. It may be awarded to a student if he/she has not fulfilled all the requirements of the course due to some extraordinary circumstances. I grade does not appear permanently in the grade card. Upon completion of all course requirements, the I grade is converted to regular grade (A to F, NP or W).
student if he/she has not fulfilled all the requirements of the course due to some extra-ordinary circumstances. I grade does not appear permanently in the grade card. Upon completion of all course requirements, the I grade is converted to regular grade (A to F, NP or NF).

NP and NF Grades: These grades are awarded in a course that the student opts to audit. Audit pass grade (NP) is awarded if the student’s attendance is above 75% in the class and has obtained at least D grade. If either of these requirements is not fulfilled, audit fail (NF) grade is awarded. The grades obtained in an audit course are not considered in the calculation of SGPA or CGPA.

W Grade: A W grade is awarded in a course where the student has opted to withdraw from the course. Withdrawal from the course is permitted until one week after the first minor test.

X Grade: The X grade is awarded for incomplete/unsatisfactory work in independent study like thesis work, project work, field work, industrial training etc.

S Grade: The S grade is awarded for complete/satisfactory work in independent study like thesis work, project work, field work, industrial training etc.

The overall distribution of number of different grades shall be according to the statistical distribution (Normal distribution).

NP and NF Grades: These grades are awarded in an audit course. Audit pass grade (NP) is awarded if the student’s attendance is above 75% in the class and has obtained at least D grade. If either of these requirements is not fulfilled, audit fail (NF) grade is awarded. The grades obtained in an audit course are not considered in the calculation of SGPA or CGPA.

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4.0 Evaluation System:
4.1 Continuous Assessment:

There shall be continuous evaluation of the student during the semester. For evaluation purpose, total marks assigned to each subject shall be
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There shall be continuous evaluation of the student during the semester. For evaluation purpose, total marks assigned to each subject shall be distributed as:

Two Mid semester Examination (Minor-1 and Minor-2) with 30 % of total marks assigned to the subject.

Assignments/Class projects/ short class tests/MCQ based quizzes/projects/presentations/group discussions with 20 % of total marks assigned to the subject.

One End Semester Examination ( Major Examination) with 50 % of total marks assigned to the subject.

Total score on a scale of 100 i.e in % obtained by a student in a subject shall be hence forth referred as raw score in that subject.

Following the concept of relative grading, before assigning the letter grades, scientific normalization method shall be used to standardize the raw score.

4.2 Statistical Method for the Award of Grades:

For the award of grades in a course, all component wise evaluation shall be done in terms of marks. The components include: Midterm-1 and Midterm-2 examinations, Assignments/projects/class presentations/Attendance, and End semester examination as per regulation 4.1. After converting the marks obtained in percentage, the grades will be assigned as per the guidelines given below:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Marks</th>
<th>Grade</th>
<th>Grade Point</th>
</tr>
</thead>
</table>

Two Mid semester Examination (Minor-1 and Minor-2) with 30 % of total marks assigned to the subject. Best Marks of one of these two will be considered for award of sessional.

Assignments/Class projects/ short class tests/MCQ based quizzes/projects/presentations/group discussions/ Attendance with 20 % of total marks assigned to the subject.

One End Semester Examination (Major Examination) with 50 % of total marks assigned to the subject. It is compulsory to appear in End Semester Examination and secure at least 20% marks of total End semester exam marks.

If a candidate secures less than 20% marks of total End semester exam marks, he/she will be awarded F grade.
regulation 4.1. After converting the marks obtained in percentage, the grades will be assigned as per the guidelines given below:

4.2.1 For less than 15 students in a course, the grades shall be awarded on the basis of cutoff in the absolute marks as shown in Table-2.

<table>
<thead>
<tr>
<th>Absolute marks in %</th>
<th>Grade</th>
<th>Absolute marks in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>91</td>
<td>A+</td>
<td>100</td>
</tr>
<tr>
<td>82</td>
<td>A</td>
<td>90</td>
</tr>
<tr>
<td>73</td>
<td>B+</td>
<td>81</td>
</tr>
<tr>
<td>64</td>
<td>B</td>
<td>72</td>
</tr>
<tr>
<td>55</td>
<td>C+</td>
<td>63</td>
</tr>
<tr>
<td>46</td>
<td>C</td>
<td>54</td>
</tr>
<tr>
<td>40</td>
<td>D</td>
<td>45</td>
</tr>
<tr>
<td>35</td>
<td>E</td>
<td>39</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>35</td>
</tr>
</tbody>
</table>

4.2.2 For more than 30 students in a course, the statistical method shall be used for the award of grades. After expressing the score obtained by the students in a course in percentage (X), the class mean (\( \bar{X} \)) and class standard deviation (S) of the marks shall be calculated and grades shall be awarded to a student as shown in Table-3.

If X is the raw score in %; \( \bar{X} \) is class mean in % and S is class standard deviation in % (based on raw score), N is the number of students in a course, then for the course:

\[
X = \frac{\text{Sum of all scores}}{\text{Number of Scores}} = \frac{\sum X_i}{N}
\]
\[ s = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{N}} \]

Table-3

<table>
<thead>
<tr>
<th>Lower Range of Marks(%)</th>
<th>Grade Assigned</th>
<th>Upper Range of Marks (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \bar{X} + 2S )</td>
<td>( \leq ) A+</td>
<td></td>
</tr>
<tr>
<td>( \bar{X} + 1.5S )</td>
<td>( \leq ) A  &lt;</td>
<td>( \bar{X} + 2S )</td>
</tr>
<tr>
<td>( \bar{X} + 1S )</td>
<td>( \leq ) B+ &lt;</td>
<td>( \bar{X} + 1.5S )</td>
</tr>
<tr>
<td>( \bar{X} + 0.5S )</td>
<td>( \leq ) B &lt;</td>
<td>( \bar{X} + 1S )</td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td>( \leq ) C+ &lt;</td>
<td>( \bar{X} + 0.5S )</td>
</tr>
<tr>
<td>( \bar{X} - 0.5S )</td>
<td>( \leq ) C &lt;</td>
<td>( \bar{X} )</td>
</tr>
<tr>
<td>( \bar{X} - 1S )</td>
<td>( \leq ) D &lt;</td>
<td>( \bar{X} - 0.5S )</td>
</tr>
<tr>
<td>( \bar{X} - 1.5S )</td>
<td>( \leq ) E &lt;</td>
<td>( \bar{X} - 1S )</td>
</tr>
<tr>
<td>( \leq ) F &lt;</td>
<td></td>
<td>( \bar{X} - 1.5S )</td>
</tr>
</tbody>
</table>

4.2.3 In case, class student strength in a course lies between 15 and 30, any of the above methods (given in 4.2.1 and 4.2.2) may be used for the award of grades.

4.3 Finalization of Grades:

Finalization of the grades shall be done by the Board of Control of the department/institute or appropriate body/committee approved by the university for the purpose.
In order to maintain a normal distribution in grades, following recommendations of UGC shall be kept in view and considered as broad guidelines by the Board of Control of the department/ institute or appropriate body/committee approved by the university for the purpose.

<table>
<thead>
<tr>
<th>Grade</th>
<th>% of Population</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7</td>
<td>Includes A+ and A</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
<td>Includes B+ and B</td>
</tr>
<tr>
<td>C</td>
<td>38</td>
<td>Includes C+ and C</td>
</tr>
<tr>
<td>D</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

* Note: In case Board of Control of the department/ institute or appropriate body/committee approved by the university for the purpose, is convinced on broad variations in grade distribution in a class for a particular subject, B.O.C may make some minor variations in $\sum$ while maintaining the grade distribution as recommended by the UGC.

5.0 Evaluation of Performance:
5.1 The performance of a student shall be evaluated in terms of two indices, viz. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

SGPA is the grade point average for the semester, and CGPA is the cumulative grade point average for all the completed semesters at any point in time.

The earned credits (E.C) are defined as the sum of course credits for course in which A+ to D grade has been obtained. For U.G students (B.E), credits from courses in which NP or S grade has been obtained are also added.

Points earned in a semester = $\sum (Course\ Credits \times \ Grade\ Points) \ for \ courses \ in \ which \ A+ \ to \ D \ grade \ has \ been \ obtained$

The SGPA is calculated on the basis of grades obtained in all courses,
Points earned in a semester = \[ \sum_{\text{all courses except audit}} \text{Course Credits} \times \text{Grade Points} \] for courses in which A+ to D grade has been obtained

The SGPA is calculated on the basis of grades obtained in all courses, except audit courses and courses in which S/Z grade is awarded, registered for the particular semester.

\[ \text{SGPA} = \frac{\sum_{\text{all courses except audit and S/Z grade Courses}} \text{Course Credits} \times \text{Grade Points}}{\sum_{\text{all courses except audit and S/Z grade Courses}} \text{Course Credits}} \]

\[ \text{SGPA} = \frac{\text{Points Secured in the Semester}}{\text{Credits Registered the Semester, excluding audit and S/Z grade courses}} \]

The CGPA is calculated as given below:

\[ \text{CGPA} = \frac{\sum_{\text{all courses with pass grade except audit and S/Z grade Courses}} \text{Course Credits} \times \text{Grade Points}}{\sum_{\text{all courses with pass grade except audit and S/Z grade Courses}} \text{Course Credits} \times \text{Grade Points}} \]

except audit courses and courses in which S/Z grade is awarded, registered for the particular semester.
### CGPA

\[
CGPA = \frac{\text{Cumulative points secured in all passed courses (A+ to D Grade)}}{\text{Cumulative earned credits, excluding audit and 3/5 grade courses.}}
\]

### 5.2 Example for the calculation of SGPA and CGPA

#### Semester-I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
<th>Column 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assigned Course Credits</td>
<td>Grade Awarded</td>
<td>Earned Credits</td>
<td>Grade Point (GP)</td>
<td>Points Secured</td>
<td></td>
</tr>
<tr>
<td>PH101</td>
<td>5</td>
<td>C+</td>
<td>5</td>
<td>6</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>AM101</td>
<td>4</td>
<td>C</td>
<td>4</td>
<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>ME101</td>
<td>4</td>
<td>A+</td>
<td>4</td>
<td>10</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>EE101</td>
<td>2</td>
<td>B+</td>
<td>2</td>
<td>8</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>CH101</td>
<td>4</td>
<td>E</td>
<td>0</td>
<td>2</td>
<td>08</td>
<td></td>
</tr>
<tr>
<td>CH102</td>
<td>2</td>
<td>S</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21</td>
<td></td>
<td>17</td>
<td></td>
<td>114</td>
<td></td>
</tr>
</tbody>
</table>

Credits registered in the semester (= sum total of column 2) = 21
Credits registered in the semester excluding audit and S/Z grade courses = 21-2 = 19
Earned credits in the semester (= sum total of column 4) = 17
Earned credits in the semester excluding audit and S/Z grade courses = 17-2 = 15
Points secured in this semester (= sum total of column 6) = 114
Points secured in this semester in all passed courses (= sum total of column 6 with only
\[ A+ \text{ to } D \text{ grades) } = 114-08 = 106 \]

\[
\text{SGPA} = \frac{\text{Points Secured in the Semester}}{\text{Credits Registered the Semester, excluding audit and } S/\text{Z} \text{ grade courses}}
\]

\[
= \frac{114}{19} = 6.000
\]

\[
\text{CGPA} = \frac{\text{Cumulative points secured in all passed courses (A+) to D grades)}}{\text{Cumulative earned credits, excluding audit and } S/\text{Z} \text{ grade courses:}}
\]

\[
= \frac{154}{15} = 7.067
\]

Semester Performance : Earned Credits (E.C) = 17 , with SGPA = 6.000
Cumulative performance : Earned Credits (E.C) = 17 , with CGPA = 7.067

| Semester-II |
|---|---|---|---|---|
| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 |
| Course Code | Assigned Course Credits | Grade Awarded | Earned Credits | Grade Point (GP) | Points Secured |
| CY202 | 5 | B+ | 5 | 8 | 40 |
| AM201 | 4 | A | 4 | 9 | 36 |
| ME201 | 4 | W | - | - | - |
| ME250 | 2 | B | 2 | 7 | 14 |
| CY201 | 4 | C+ | 4 | 6 | 24 |
| CH201 | 4 | A+ | 4 | 10 | 40 |
| HU201 | 1 | S | 1 | - | - |
| Total | 24 | | 20 | | 154 |

Credits registered in the semester (= sum total of column 2) = 24
Credits registered in the semester excluding audit and S/Z grade courses =24-1= 23
Earned credits in the semester (= sum total of column 4) = 20
Earned credits in the semester excluding audit and S/Z grade courses = 20-1 = 19
Points secured in this semester (= sum total of column 6) = 154
Points secured in this semester in all passed courses (= sum total of column 6 with only A+ to D grades) = 154-0 = 154
Cumulative points earned in all passed courses till date (all past semesters + current semester) = 106+154 = 260
Cumulative earned credits till date (Earned credits in all past semesters + Earned Credits in the current semester) = 17 + 20 = 37

\[ \text{SGPA} = \frac{\text{Points Secured in the Semester}}{\text{Credits Registered in the Semester, excluding audit and $F/E$ grade courses}} \]

\[ = \frac{184}{20} = 9.2 \]

\[ \text{CGPA} = \frac{\text{Cumulative points secured in all passed courses (A+ to D Grade)}}{\text{Cumulative earned credits, excluding audit and $F/E$ grade courses.}} \]

\[ = \frac{(195+180)}{34} = 7.647 \]

Semester Performance: Earned Credits (E.C) = 20, with SGPA = 8.105

Cumulative performance: Earned Credits (E.C) = 37, with CGPA = 7.647

5.3 Degree Requirements:

For Four year B.E programmes, the requirements are:
   (i) Minimum Earned credits: completion of 180 earned credits

For Five year Integrated B.E - M.B.A programmes, the requirements are:
   (i) Minimum Earned credits: completion of 220 earned credits

These credits are needed to be earned under different categories as specified for each programme.
   (ii) Cumulative Grade Point Average (CGPA) requirements

   Under Four Year B.E program, a student must obtain Cumulative Grade Point Average (CGPA) of 5.0 to be

5.3 NOT REQUIRED
eligible for award of B.E degree. Under Five year B.E-M.B.A integrated program, a student must obtain a Cumulative Grade Point Average (CGPA) of 5.5

(iii) Practical training
A student of B.E and Integrated B.E-M.B.A programs must complete the prescribed number of days of practical training (Industrial Training or any other training as prescribed under the program) to the satisfaction of concerned department. This training will normally be arranged in the summer vacation following 6th semester. Practical training is of six weeks duration. Practical training should be carried out preferably in industry or R & D institutions in India. Practical training in academic institutions is not allowed.

(iv) NCC/NSS: All first year students are required to enrol for either NCC or NSS.

5.4 Degree requirements for Under Graduate programmes (Four year B.E program)

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>UG (Core) :</td>
<td>144</td>
</tr>
<tr>
<td>Departmental Core :</td>
<td>80 (Min)</td>
</tr>
<tr>
<td>Basic Sciences :</td>
<td>20 (Min)</td>
</tr>
<tr>
<td>Engineering Art and Sciences :</td>
<td>20 (Min)</td>
</tr>
<tr>
<td>Humanities and Social sciences :</td>
<td>1</td>
</tr>
<tr>
<td>UG (Elective) :</td>
<td>36</td>
</tr>
</tbody>
</table>

5.4 NOT REQUIRED
Departmental Elective : 12 (min)
Humanities, Social Sciences and Mgt: 08
Open category : 10 (min)

5.5 Degree requirements for Five year Integrated B.E-M.B.A programm

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>UG (Core) + PG(Core) :</td>
<td>140 + 36, Total = 176</td>
</tr>
<tr>
<td>Departmental Core :</td>
<td>98 (Min)</td>
</tr>
<tr>
<td>Basic Sciences :</td>
<td>24 (Min)</td>
</tr>
<tr>
<td>Engineering Art and Sciences :</td>
<td>24 (Min)</td>
</tr>
<tr>
<td>Humanities and Social sciences :</td>
<td>1</td>
</tr>
<tr>
<td>UG (Elective) + PG (Elective) :</td>
<td>35+09, Total = 44</td>
</tr>
<tr>
<td>Departmental Elective :</td>
<td>15 (min)</td>
</tr>
<tr>
<td>Humanities, Social Sciences and Mgt:</td>
<td>10</td>
</tr>
<tr>
<td>Open category :</td>
<td>12 (min)</td>
</tr>
</tbody>
</table>

5.5 Total Requirement : for four year B.E programm, sucessful completion of atleast 180 credits (UG (Core) + UG (Elective)) with minimum C.G.P.A of 5.0

Total Requirement : for five year integrated B.E-M.B.A programm, sucessful completion of atleast 220 credits ((UG +PG) (Core) + (UG+PG) (Elective)) with minimum C.G.P.A of 5.5

5.6 Maximum permissible number of registered semesters for
completing all degree requirements are:

For 4-year B.E degree programmes : 12 registered semesters


5.7 Conditions for termination of registration
For students admitted through AIEEE

If the performance at the end of first two registered semesters is very poor, then the registration will be terminated. If the performance is poor but not very poor, then the student can opt to start afresh, or else his/her registration will be terminated. The criteria for “very poor” and “poor” performance are:

<table>
<thead>
<tr>
<th>Performance</th>
<th>Earned Credits</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poor</td>
<td>&lt;= 15 for GE/OBC; &lt;= 11 for SC/ST/PH</td>
<td>Termination of registration</td>
</tr>
<tr>
<td>Poor</td>
<td>16 to 26 for GE/OBC; 12-22 for SC/ST/PH</td>
<td>Restart (once only) or Termination of registration</td>
</tr>
</tbody>
</table>

(i) If a student chooses to restart after first two registered semesters, then his or her credits earned and semesters registered will not be carried over. The re-start will be indicated on the transcript. The restart will be permitted only once. If at the end of two registered semesters after re-start, the earned credits are <= 26 for GE/OBC or <= 22 for SC/ST/PH students, then the registration will be terminated.

(ii) Each student is expected to earn at least 12 credits in the first registered semester and 15 credits in each subsequent registered semester with SGPA >= 5.0. If the performance
of a student at the end of any registered semester is below this minimum acceptable level, then he/she will be placed on probation and a warning shall be issued to him/her and parents shall also be informed accordingly.

(iii) The student placed on probation shall be monitored, including mandatory class attendance, special tutorials and mentoring. Mentoring shall include specific guidance under a faculty member/PG student.

(iv) The registration of any student will be limited to 1.5 times the average earned credits of the previous two registered semesters, subject to a minimum of 15 credits and a maximum of 26 credits.

Note:
1. Paper setting for End term examination (Major Examination or End semester examination) shall continue to be as per the procedure in place at present till any further modification is introduced.
2. There shall be no “special reappear examination”
3. Subject wise result in the form of grades awarded to each student at the end of each semester shall be prepared by the respective departments/institutes/college/center and sent to the university examination branch for the declaration of result and issuance of grade cards.
4. Course teacher should display the grades awarded to the students on the notice board after showing the answer scripts to the students within five working days. The process of evaluation should invariably be completed within seven days from the date of conduct of examination.

<table>
<thead>
<tr>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Paper setting for End term examination (Major Examination or End semester examination) shall continue to be as per the procedure in place at present till any further modification is introduced.</td>
</tr>
<tr>
<td>2. There shall be no “special reappear examination”</td>
</tr>
<tr>
<td>3. Subject wise result in the form of grades awarded to each student at the end of each semester shall be prepared by the respective departments/institutes/college/center and sent to the university examination branch for the declaration of result and issuance of grade cards.</td>
</tr>
<tr>
<td>4. Course teacher should display the grades awarded to the students on the notice board after showing the answer scripts to the students within five working days. The process of evaluation should invariably be completed within seven days from the date of conduct of examination.</td>
</tr>
</tbody>
</table>
BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS)
III SEMESTER

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>SCHEDULE OF TEACHING</th>
<th>SCHEME OF EXAMINATION</th>
<th>THEORY</th>
<th>PRACTICAL</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>Total</td>
<td>Int</td>
</tr>
<tr>
<td>EE301</td>
<td>Electric Machinery-I</td>
<td>3</td>
<td>1</td>
<td></td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>EE351</td>
<td>Electric Machinery-I Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
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<tr>
<td>EE305</td>
<td>Network Analysis and Synthesis</td>
<td>3</td>
<td>1</td>
<td></td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>EE356</td>
<td>Network Analysis and Synthesis Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>EE307</td>
<td>Analog and Digital Electronics</td>
<td>3</td>
<td>1</td>
<td></td>
<td>4</td>
<td>50</td>
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<tr>
<td>EE358</td>
<td>Analog and Digital Electronics Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>MATHS301</td>
<td>Linear Algebra and Complex Analysis</td>
<td>4</td>
<td>1</td>
<td></td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Elective (from Social Sciences)</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>50</td>
</tr>
</tbody>
</table>

Total 16 4 9 29 250 250 - 500 150 22

Note:
*marks refer to mid semester evaluation and end semester evaluation.

ELECTIVE (from social Sciences)
- HSS 301(a) Economics
- HSS 301(b) Introduction to Psychology
- HSS 301(c) Sociology
- HSS 301(d) German Basics for Engineering Students
BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS)  
IV SEMESTER

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>SCHEDULE OF TEACHING</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td>AS401</td>
<td>Numerical Analysis</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>EE401</td>
<td>Electric Machinery-II</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>EE451</td>
<td>Electric Machinery-II Lab</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>EE402</td>
<td>Control Engg.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>EE452</td>
<td>Control Engg. Lab</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>EE403</td>
<td>Power Systems-I</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>EE453</td>
<td>Power Systems-I Lab</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>EE405</td>
<td>Microprocessor and Interfacing</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>EE455</td>
<td>Microprocessor and Interfacing Lab</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>16</td>
<td>5</td>
</tr>
</tbody>
</table>

**Note:**
*marks refer to mid semester evaluation and end semester evaluation.
## BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS)
### V SEMESTER

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>SCHEDULE OF TEACHING</th>
<th>SCHEME OF EXAMINATION</th>
<th>THEORY</th>
<th>PRACTICAL</th>
<th>Credits</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>Total</td>
<td>Int</td>
</tr>
<tr>
<td>EE-501</td>
<td>Power Systems-II</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>EE-551</td>
<td>Power Systems-II Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>EE-510</td>
<td>MicroControllers</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>EE-560</td>
<td>MicroControllers Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
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<td>-</td>
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<tr>
<td>EE-507</td>
<td>Communication Engg.</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>EE-557</td>
<td>Communication Engg. Lab</td>
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<td>-</td>
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<tr>
<td>EE-508</td>
<td>Electromagnetic Field Theory</td>
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<td>1</td>
<td>-</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>EE-509</td>
<td>Control Engineering-II</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>EE-559</td>
<td>Control Engineering-II Lab</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>EE-556</td>
<td>Vocational Training after Fourth Semester</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>Total</td>
<td>15</td>
<td>5</td>
<td>12</td>
<td>32</td>
<td>250</td>
</tr>
</tbody>
</table>

Subjects offered by DIC (OPTIONAL)

| DIC-01  | Principles of Designing and Engineering Processes | -  | -  | 3  | 3    | -   | -   | -   | -     | 100    | 2       |

**Note:**
*marks refer to mid semester evaluation and end semester evaluation.
# BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS) VI SEMESTER

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>SCHEDULE OF TEACHING</th>
<th>SCHEME OF EXAMINATION</th>
<th>THEORY</th>
<th>PRACTICAL</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L  T  P  Total  Int</td>
<td>Ext  Hrs. Total Marks*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE-601</td>
<td>Computer Aided Power Systems Analysis</td>
<td>3 1 - 4 50 50 3 100</td>
<td>-</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE-651</td>
<td>Computer Aided Power Systems Analysis Lab</td>
<td>- - 3 3 - -</td>
<td>50 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE-611</td>
<td>Programmable Logic Controller and Distributed Control System</td>
<td>3 1 - 4 50 50 3 100</td>
<td>-</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE-661</td>
<td>Programmable Logic Controller and Distributed Control System Lab</td>
<td>- - 3 3 - -</td>
<td>50 1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EE-612</td>
<td>Signals and Systems</td>
<td>3 1 - 4 50 50 3 100</td>
<td>-</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE-613</td>
<td>Energy Management &amp; auditing</td>
<td>3 1 - 4 50 50 3 100</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE-663</td>
<td>Energy Management &amp; auditing Lab</td>
<td>- - 3 3 - -</td>
<td>50 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE-606</td>
<td>Power Electronics</td>
<td>3 1 - 4 50 50 3 100</td>
<td>-</td>
<td>4</td>
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<td></td>
</tr>
<tr>
<td>EE-656</td>
<td>Power Electronics Lab</td>
<td>- - 3 3 - -</td>
<td>50 1</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Total</td>
<td>15 5 12 32 250 250 500 200 24</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DIC-02</td>
<td>Sensors based Application Systems</td>
<td>3 1 - 4 50 50 3 100</td>
<td>-</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**  
*marks refer to mid semester evaluation and end semester evaluation.
## Elective-I

(i) **Optical Communication**
(ii) **Wireless Communication**
(iii) **Alternate Energy Sources and Energy Conservation**
A student can exercise option I and Option II according to the following:

### Option-I

**Elective-II**

(i) *Electrical Machine Design*

(ii) *High Voltage AC-DC*

(iii) *Advance Control Systems*

(iv) *Data Acquisition and Hardware Interfacing*

### Option II

**Industrial Training**  
EE-850  
**Total Marks-450**

A student may opt for one semester training in lieu of subjects of 8th Semester. The marks for six months training will be equal to the total marks of 8th Semester study. A student can opt for six semester training under following conditions:-

a) The student got selected for job in campus placement and the employer is willing to take that student for the training.

b) The student got offer of pursuing training from reputed government research organization/govt. sponsored projects/govt. research institution provided that student should not be paying any money to get trained. For pursuing this training student needs the prior approval from the Chairperson/Coordinator of the respective branch.

---

**Ref No.** | **Subject** | **Schedule Of Teaching** | **Scheme of Examination** | **Credits**
--- | --- | --- | --- | ---
EE-801 | Non – Conventional Energy Sources | 3 1 - 4 | 50 50 3 100 | 4
EE-807 | Embedded System Design | 3 1 - 4 | 50 50 3 100 | 4
EE-857 | Embedded System Design (Lab) | - - 2 2 | - - - - | 50 | 1
EE-808 | Elective –II | 3 1 - 4 | 50 50 3 100 | 4
EE-805 | Major Project | - - 6 6 | - - - - | 100 | 6
**Total** | | **9 3 8 20** | **150 150 300 150** | **19**
### BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS) III SEMESTER

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>SCHEDULE OF TEACHING</th>
<th>SCHEME OF EXAMINATION</th>
<th>Credits</th>
</tr>
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<tr>
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<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>EE301</td>
<td>Electric Machinery-I</td>
<td>3</td>
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<td>EE351</td>
<td>Electric Machinery-I Lab</td>
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<tr>
<td>EE305</td>
<td>Network Analysis and Synthesis</td>
<td>3</td>
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<td>EE356</td>
<td>Network Analysis and Synthesis Lab</td>
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<td>EE307</td>
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<td>MATHS301</td>
<td>Linear Algebra and Complex Analysis</td>
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<td>-</td>
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<td></td>
<td>Elective (from Social Sciences)</td>
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<td></td>
<td>Total</td>
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**Note:**
*marks refer to mid semester evaluation and end semester evaluation.

**ELECTIVE (from social Sciences)**
- HSS 301(a) Economics
- HSS 301(b) Introduction to Psychology
- HSS 301(c) Sociology
- HSS 301(d) German Basics for Engineering Students
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Electric Machinery-I</th>
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<tr>
<td>Course Code</td>
<td>EE-301</td>
<td>L T P</td>
<td>3 1 0</td>
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<tr>
<td>Contact Hours</td>
<td>40</td>
<td>Max Marks-50</td>
<td>Internal Assessment-50</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Basic Electrical Engineering</td>
<td></td>
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</table>
| Course Objectives       | 1. To understand the working and constructional features of transformer and Electric machines.  
                        | 2. To understand the process to test, control and analyze the performances various electric machines.  
                        | 3. To understand the applications of transformer and electric machines in the field.  |
| Course Outcome(s)       | 1. To apply test procedures for performance analysis of various machines.  
                        | 2. Identification and selection of machine for a specific application.  
                        | 3. To apply starting and speed control techniques on various machines.  
                        | 4. Performance analysis of machine on the basis of operational characteristics.  |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Transformers**

   (10 hours)

2. **Direct Current Machines**
   **Generators:** Mechanical construction, Armature windings, Induced emf equation, Developed torque, Magnetization characteristics, Theory of commutation, Armature reaction, Types of d.c. generators, Voltage regulation, Losses, Separately excited, shunt, series and compound generators and characteristics, Maximum efficiency criterion.
Motors: Operation, Speed regulation, Losses, Series, shunt and compound motors, methods of speed control, Ward Leonard method, Braking or Reversing d.c. motors.

PART-B

3. Polyphase Induction Machines
   Induction Generator: Motor to generator transition, Induction generator starting and operation with other three phase sources, isolated generator operation and voltage build up.

4. Single Phase Induction Motors
   Double revolving field theory, Analysis of single phase induction motor and speed torque characteristics, Split Phase, Capacitor start, Capacitor start capacitor run motor, Permanent split capacitor motor, Shaded pole motor, Testing of single phase induction motor: No load and block rotor tests. [Guru-Hiziroglu:10.1-10.4, 10.6-10.7]

Text book:


Other Recommended Books:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Electric Machinery-I Lab</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
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<td>01</td>
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<tr>
<td>Max Marks</td>
<td>50</td>
<td>P</td>
</tr>
<tr>
<td>P 03</td>
<td></td>
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</tbody>
</table>

Note: At least eight experiments to be done.

1. Open circuit and short circuit test of single phase/ three phase transformer and obtain its equivalent circuit.
2. Parallel operation of two single phase transformers.
4. Different winding connections of three phase two winding transformer and to identify proper combination for parallel operation.
5. Parallel operation of two three phase transformers.
8. Efficiency at different loads of the given dc shunt machine through Swinburne / load test.
9. Speed control characteristics of a given dc shunt motor by (i) Armature control (ii) Field control.
10. No load and blocked rotor test on a three phase induction motor and to obtain its Equivalent circuit
11. Torque speed characteristics of three phase induction motor.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Network Analysis and Synthesis</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-305</td>
<td>L T P</td>
<td>3 1 0</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>40</td>
<td>Max Marks-50 Internal Assessment-50</td>
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<tr>
<td>Pre-requisites</td>
<td>Basic fundamentals and concepts of basic Electrical Engineering.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Objectives</td>
<td>1. To provide the various Basic concepts, laws and various circuit analyzing methods applied in solving Electrical Circuits. 2. To provide the concept of three phase supply systems. 3. To understand the concept of graph theory and Laplace transform to analyze the Electrical Circuits. 4. To provide the basic knowledge of Network Functions and their stability in frequency domain. To understand the concepts of stability and methods to check the stability.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Outcome(s)</td>
<td>1. Students will understand the basic concepts, laws used in the Electrical Circuits. 2. Students will understand the procedures to solve the various Electrical Circuit problems using different methods of analysis like circuit theorems, mesh analysis, nodal analysis, Graph theory and Laplace transformation to solve the Electrical Circuit problems. 3. Students will understand the behaviour of the different networks in frequency domain and stability of networks. Students will understand to synthesize networks.</td>
<td></td>
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</tbody>
</table>

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each or 10 questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Methods of analyzing A.C. Circuits**

Formulation of network equations, Source transformation Nodal Analysis: Node voltages, matrix node equations, Mesh Analysis: Mesh currents, matrix mesh equations, Network Theorems: Superposition, Thevenin’s, Norton’s, Maximum Power Transfer theorem, analysis of circuits using theorems, analysis of three phase system with unbalanced load.

(08 hours)
2. **Network Topology**
   Introduction, Network Graph, Tree and Co-tree, Twigs and Links, Incidence Matrices and its properties, Link currents: Tie-Set Matrix, Cut-Set and Tree Branch Voltages, Solution of Problems.  
   *(7 hours)*

3. **Two-Port Networks**
   Introduction, Open Circuit Impedance Parameter, Short Circuit Admittance Parameter, Transmission Parameter, Inverse Transmission Parameter, Hybrid Parameter, Interrelationship of different parameters, Inter-Connection of Two-Port Networks, Terminated Two-Port Network, T and II representation, solution of problems.  
   *(7 hours)*

**Part B**

4. **Transient Analysis of Networks**
   Network elements, Transient response of R-L, R-C, R-L-C for DC and sinusoidal excitation, Initial condition, Solution using differential equation approach and Laplace transform method.  
   *(5 hours)*

5. **Network Functions**
   Introduction, driving point and transfer functions, poles & zeros and their significance, network functions for one port and two port networks, Properties and Necessary Conditions of Driving Point Functions and Transfer Functions, time domain behavior from the pole-zero plot. Stability check using Routh criterion, solution of problems.  
   *(5 hours)*

6. **Elements of Network Synthesis**
   *(5 hours)*

**Text books**


**Other Recommended Books**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Network Analysis and Synthesis Lab</th>
<th>Credits</th>
<th>01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-356</td>
<td>Max Marks-50</td>
<td>P</td>
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</tbody>
</table>

**List of Experiments**

1. Introduction to Pspice software.
2. To determine phase sequence of three phase supply system and to find the line currents for three phase three wire load when the sequence is i) RYB ii) RBY.
3. To make 3-phase unbalanced network with neutral return of known impedance. Measure phase currents, neutral currents and the potential difference between the load and supply neutral.
5. To check the polarity marking of a transformer and to determine self inductance of each winding and mutual inductance between the windings.
6. Find impedance, admittance, transmission and hybrid parameters of the two port network.
7. Simulation of dc circuits using Pspice.
8. DC Transient response using Pspice.
10. Nodal analysis Pspice.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Analog and Digital Electronics</th>
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<tbody>
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<td>Course Code</td>
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<td>Basic Electronics Engineering</td>
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<tr>
<td>Course Objectives</td>
<td>1. To give students in depth information of the operation, characteristics, design and analysis of basic transistor amplifier circuits.</td>
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<td></td>
<td>2. To make them aware of the concept of feedback amplifiers and oscillators</td>
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<td>3. To study the concept of operational amplifiers.</td>
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<td></td>
<td>4. To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits</td>
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<tr>
<td>Course Outcome(s)</td>
<td>1. Able to analyze and design BJT amplifier circuits</td>
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<tr>
<td></td>
<td>2. Able to analyze and design feedback amplifiers and RC oscillators</td>
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<td></td>
<td>3. Able to apply op-amps fundamentals in design and analysis of op-amps applications</td>
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<tr>
<td></td>
<td>4. Able to design combinational and sequential digital logic circuits.</td>
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</tbody>
</table>

**Note for Examiner-** Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART A**

1. **Transistor Biasing and Stability**
   Transistor fundamentals, transistor configurations, BJT characteristics & parameters, DC operating point ,biasing circuits and their analysis. Transistor hybrid model, Analysis of transistor amplifier using h-parameters in CB, CE and CC configuration.  
   (6hours)

2. **Feedback Amplifiers and Oscillators**
Concept of feedback, Classification of feedback amplifiers, General characteristics of negative feedback amplifiers, Effect of Feedback on Amplifier characteristics, Oscillator, Condition of oscillations, Types of oscillators and their applications (6 hours)

3. **Differential and Operational Amplifiers**

4. **Introduction**
   Boolean Algebra, Boolean Expressions and minimization of Boolean expression using K-Map (up to five variables), Review of Logic Gates, design & Implementation of Adder, Subtractor, Multiplexer, DeMultiplexer, Encoder, Decoder. (7 hours)

5. **Sequential Circuits**
   Types of flip flop, S-R Flip-Flop, JK Flip-Flop, Race around Condition, Master Slave Flip-Flop, D&T type Flip-Flop, Shift Register and counters (7 hours)

6. **Data Converters**
   Sample & Hold switch, D/A converters: weighted resistor type, R-2R Ladder type; A/D Converters: Counter-Ramp type, Dual Slope Type, Successive approximation type. (6 hours)

**Text books**

**Other recommended books**
Note: At least eight experiments to be done.

1. To study the P-spice software & simulation.
2. To study the device modeling using COMSOL software
3. To draw the frequency response of a single stage BJT amplifier using P-spice.
4. To study the oscillator and determine its frequency using P-spice.
5. To study the frequency response of OP-Amp & simulate using P-spice.
6. To study op amp applications and simulate using P-spice.
7. To design Butter worth Low pass filter, High pass filter & simulate using P-spice.
8. To computes the potential and carrier concentrations for a one-dimensional p-n junction using COMSOL.
9. To do the device modeling and analysis of BJT using COMSOL.
10. To calculates the DC characteristics of a simple MOSFET using COMSOL.
11. To verify the truth tables of basic gates.
12. To verify NAND and NOR as universal gates.
13. To realize adder and subtractor using logic gates.
14. To design and implement SR, JK, D and T flip flops.
Course Title: Linear Algebra and Complex Analysis

Credits: 04

Course Code: MATHS-301

L T P: 4 1 0

Contact Hours: 45
Max Marks: 50
Internal Assessment: 50

Elective: N

Pre-requisites: Calculus (MATHS-101)

Course Objectives:
• To learn methods to solve system of linear equations
• To understand the concepts of vector space, linear independence and linear transformation and their applications
• To understand the concept of eigen values and eigen vectors of matrices and applications to engineering problems
• To understand the concepts of functions of complex variables e.g., differentiation, integration and expansion in terms of series and applications
• To understand the need and origin of conformal mappings

Course Outcome(s):
• Students will be able to apply methods to solve system of linear equations including large systems which arise in various engineering problems
• Students are able to understand the applications of linear independence of vectors and linear transformations.
• Students will be able to apply the concepts of eigen values, eigen vectors and diagonalization to simplify and solve engineering problems
• Ability to differentiate, expand and integrate functions of complex variables and to use them to solve real integrals
• Transform regions associated with engineering problems using conformal mappings to simple regions

Note for Examiner: Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

S. No. | Topic | No. of Lectures
--- | --- | ---
PART A
1. Systems of Linear equations: | 5 |

Introduction, Linear equations, solutions, Linear equations in two unknowns,
Systems of linear equations, equivalent systems, Elementary operations, Systems in Triangular and echelon form, Reduction Algorithm, Matrices, Row equivalence and elementary row operations, Systems of Linear equations and matrices, Homogeneous systems of Linear equations. (Scope as in Chapter 1, Sections 1.1-1.10 of Reference 1).

2. **Vector Spaces:**

   Introduction, Vector spaces, examples of vector spaces, subspaces, Linear combinations, Linear spans, Linear dependence and Independence, Basis and Dimension, Linear equations and vector spaces. (Scope as in Chapter 5, Sections 5.1-5.8 of Reference 1).

3. **Eigenvalues and Eigenvectors, Diagonalization:**

   Introduction, Polynomials in matrices, Characteristic polynomial, Cayley-Hamilton theorem, Eigen-values and Eigen-vectors, computing Eigen-values and Eigen-vectors, Diagonalizing matrices. (Scope as in Chapter 8, Sections 8.1-8.5 of Reference 1).

4. **Linear Transformations:**

   Introduction, Mappings, Linear mappings, Kernal and image of a linear mapping, Rank- Nullity theorem (without proof), singular and non-singular linear mappings, isomorphisms. (Scope as in Chapter 9, Sections 9.1-9.5 of Reference 1).

5. **Matrices and Linear transformations:**

   Introduction, Matrix representation of a linear operator, Change of basis and Linear operators. (Scope as in Chapter 10, Sections 10.1-10.3 of Reference 1).

**PART B**

6. **Complex Functions:** Definition of a Complex Function, Concept of continuity and differentiability of a complex function, Cauchy – Riemann equations, necessary and sufficient conditions for differentiability (Statement only). Study of complex functions: Exponential function, Trigonometric functions, Hyperbolic functions, real and imaginary part of trigonometric and hyperbolic functions, Logarithmic functions of a complex variable, complex exponents (Scope as in Chapter 12, Sections 12.3 – 12.4, 12.6 – 12.8 of Reference 4).

7. Laurent Series of function of complex variable, Singularities and Zeros, Residues at simple poles and Residue at a pole of any order, Residue Theorem (Statement only) and its simple applications (Scope as in Chapter 15, Sections 15.1 – 15.3 of Reference 4).
8. Conformal Mappings, Linear Fractional Transformations (Scope as in Chapter 12, Sections 12.5, 12.9 of Reference 4).

References:

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<td>Max Marks-50</td>
<td>Internal Assessment-50</td>
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<td>Pre-requisites</td>
<td>--</td>
<td></td>
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<tr>
<td>Course Objectives</td>
<td>1. To make students understand how society manages its scarce resources for achieving maximum satisfaction.</td>
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<tr>
<td></td>
<td>2. To make students learn about economic aspects related to a consumer, firm, market and economy.</td>
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<tr>
<td>Course Outcome (s)</td>
<td>1. The students are expected to apply engineering knowledge to maximize profit, satisfaction and welfare.</td>
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<tr>
<td></td>
<td>2. The students are able to identify the forces that affect the economy.</td>
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</table>

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 multiple-choice questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**Lecture wise breakup**

<table>
<thead>
<tr>
<th>Introduction to Economics</th>
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<tbody>
<tr>
<td>Nature of Economics, Economic Thoughts, Economic Activities, Relationship of Economics with other Social Sciences and Engineering</td>
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<table>
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<tr>
<th>Theory of Consumer Behaviour</th>
<th>(11)</th>
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<tr>
<td>Demand: Types, Law of Demand, Determinants of Demand and Change in Demand</td>
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</tr>
<tr>
<td>Elasticity of Demand: Nature, Degrees, Types, Measurement and Factors Affecting Elasticity of Demand and its Application</td>
<td></td>
</tr>
<tr>
<td>Laws of Consumption: Concept and Applicability of Law of Diminishing Marginal Utility and Law of Equi-Marginal Utility</td>
<td></td>
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</table>
Theory of Production and Cost

3 Cost: Types of Costs, Production: Law of Variable Proportion, Returns to Factor and Returns to Scale, Economies and Diseconomies of Scale

Theory of Market

4 Nature and Relevance of Perfect Competition, Monopoly and Monopolistic Competition

Basic Concepts of Macro Economics

5 National Income: Concept and Measurement, Determination of Equilibrium of Income

Inflation: Concept, Causes and Effect of Inflation, Measures to Control Inflation

6 Project Presentations

Text Books:
1 Ahuja H. L., “Modern Economics”, S. Chand & Co. Ltd

Reference Books:
1 Ahuja H. L., “Business Economics”, S. Chand & Co. Ltd
2 Jhingan M.L., “Macro Economic Theory”, Konark Publisher Pvt. Ltd.
3 Stiglitz J. & Walsh Carl E., “Principles of Microeconomics”, W.W. Norton & Company
4 Stiglitz J. & Walsh Carl E., “Principles of Macroeconomics”, W.W. Norton & Company
5 Mankiw N Gregory, “Principles of Economics”, Cengage Learning
8 Gravelle H. & Reiss R., “Microeconomics”, Pearson Education
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Introduction to Psychology</th>
<th>Credits</th>
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<td>Contact Hours</td>
<td>42</td>
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<td>Internal 50</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Objectives</td>
<td>1. To provide knowledge and understanding about important concepts in Psychology.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Objectives</td>
<td>2. To make students learn the application of principles of psychology in working life.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Outcome(s)</td>
<td>1. The students will learn the causes and dynamics of human behavior.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Outcome(s)</td>
<td>2. The students will be able to apply psychological principles to enhance their personal and professional life.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note for Examiner:** Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 multiple-choice questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**Lecture wise breakup**

<table>
<thead>
<tr>
<th>No. of Lectures</th>
<th>Understanding Human Behaviour: Definition, methods, branches and application of psychology for engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Measuring Human abilities: Intelligence, theories and assessment</td>
</tr>
<tr>
<td>6</td>
<td>The individual working life: Personality, approaches and trait theories</td>
</tr>
<tr>
<td>6</td>
<td>Psychological problems of everyday life: Stress and coping</td>
</tr>
<tr>
<td>6</td>
<td>Work and mental health, workplace spirituality</td>
</tr>
<tr>
<td>4</td>
<td>Motivation: the concept and theoretical framework, motivating people at work</td>
</tr>
<tr>
<td>5</td>
<td>Group dynamics, Intergroup relations, conflict and negotiation</td>
</tr>
<tr>
<td>6</td>
<td>Leadership and Management</td>
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<tr>
<td>4</td>
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Text Books:


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<td>Contact Hours</td>
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<tr>
<td>Elective</td>
<td>Y</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>--</td>
</tr>
</tbody>
</table>

1. To make the students understand the role of theory in social sciences.
2. To explain students how social problems interact and react with the larger society.
3. To make students learn whether the problem is evaluated on the macro or micro perspective and their cause and effect patterns.

1. The students will be able to identify the function and application of sociology theory in social sciences.
2. The students will be able to understand how social class affects individual life chances.
3. The students will learn about social structure and how it shapes and influences social interactions.

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 multiple-choice questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**Lecture wise breakup**

<table>
<thead>
<tr>
<th>Sociology – The Discipline</th>
<th>No. of Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sociology as a Science, Impact of Industrial and French Revolution on the Emergence of Sociology, Relevance of Sociology for Engineering</td>
</tr>
<tr>
<td>2</td>
<td>Society, Association, Institution, Culture Relativism, Social Structure, Social System, Socialisation, Competition, Conflict, Accommodation, Social Mobility</td>
</tr>
<tr>
<td>3</td>
<td>Pioneering Contributions to Sociology</td>
</tr>
</tbody>
</table>
Seminal Views of Karl Marx, Emile Durkheim, Max Weber, Alwin Toeffler

Evolution of Society

4
Primitive, Agrarian, Industrial and Post-Industrial, Features of Industrial and Post-Industrial Society, Impact of Automation and Industrialization on Society

Economy and Society

4
Economic Systems of Simple and Complex Societies, Sociological Dimensions of Economic Life, Market (free) Economy and Controlled (planned) Economy

Industrial Sociology

4
Nature and Scope of Industrial Sociology, Pre-Conditions and Consequences of Industrialization

Science and Technology

4
Ethis of Science and Social Responsibility of Science

Social Change

5
Theories of Change, Factors of Change, Directed Social Change, Social Policy and Social Development, Social Cost Benefit Analysis, Role of Engineers in Development

Understanding Indian Society

7

Social Problems

3
AIDS, Alcoholism, Drug Addiction, Corruption

Text Books:

Reference Books:

Course Title: German Basics for Engineering Students

Course Code: HSS301 (d)

Credits: 03

Contact Hours: 45
Max Marks: 50
Internal Assessment: 50
Elective: Y

Course Objectives:
4. To learn basic grammar of German language like articles of nouns, alphabet and numbers upto 1000, personal and possessive pronouns, verb conjugations, modal verbs.
5. To learn about German-speaking countries, capital cities, states and basic geography.

Course Outcome(s):
1. Student will be able to understand and frame simple sentences in German language, in order to introduce oneself.
2. Student can enquire about others – e.g., about their living place, their occupation and hobbies in German.
3. Student can seek some information at public places like the railway station, departmental stores, cafeteria etc. in German.

Note for Examiner: Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 multiple-choice questions from the text-book (Landeskunde) of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

Part-A

<table>
<thead>
<tr>
<th>Lerneinheit (Chapter)</th>
<th>Themenkreis-1: Menschen und Reisen</th>
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<tbody>
<tr>
<td>1</td>
<td>Fokus Strukturen</td>
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<tr>
<td>2</td>
<td>Fokus Lesen</td>
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<td>3</td>
<td>Fokus Hören</td>
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<td>4</td>
<td>Fokus Sprechen</td>
</tr>
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<td>5</td>
<td>Fokus Schreiben</td>
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<tr>
<td>Lerneinheit (Chapter)</td>
<td>Themenkreis-2: Personen und Aktivitäten</td>
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<tr>
<td>6</td>
<td>Fokus Strukturen</td>
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<td>Fokus Sprechen</td>
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**Part-B**

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<th>Lerneinheit (Chapter)</th>
<th>Themenkreis-4: Wollen und Sollen</th>
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<tr>
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<tr>
<td>17</td>
<td>Fokus Lesen</td>
</tr>
<tr>
<td>18</td>
<td>Fokus Hören</td>
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</tbody>
</table>

**Text book:**

1. Lagune -1 Kursbuch by Hartmut Aufderstraße a.o., Hueber Verlag.

**Other Recommended Books:**

1. Lagune-1 Arbeitsbuch by Hartmut Aufderstraße a.o., Hueber Verlag.
2. Deutsche Sprachlehre für Ausländer by Schulz und Griesbach.
<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>SCHEDULE OF TEACHING</th>
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*Note:*

*marks refer to mid semester evaluation and end semester evaluation.
### Course Title: Numerical Analysis

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**Pre-requisites:** Mathematics-I and Mathematics-II

**Course Objectives:**
1. To understand the errors involved in computations and to estimate the errors
2. To learn method to solve system of equations
3. To learn the numerical methods to interpolate, extrapolate, differentiate and integrate functions
4. To learn numerical methods to solve differential equation
5. To learn to optimize functions using various techniques including least square method and functional approximations.

**Course Outcome(s):**
1. Ability to estimate errors in numerical result
2. Ability to solve system of equations
3. Ability to use numerical methods to interpolate, extrapolate, differentiate and integrate functions
4. Ability to use numerical method to solve differential equations
5. Ability to learn to optimize various functions to minimize the errors in calculations

**Note for Examiner:** Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

### PART- A

1. **Error Analysis**
   Relative error, Absolute error, Round-off error, Truncation error, significant digits and numerical instability. (Scope as in Section 1.3, Chapter 1 of Reference 1). (4 hours)

2. **Transcendental and Polynomial Equations**
   Bisection method, Iteration Method based on first degree equation: Secant method, Regula-falsi method and Newton – Raphson methods, Rate of convergence of Secant method, Regula-Falsi method and Newton-Raphson Method. Bairestow’s method to find quadratic factor of polynomial (Scope as in corresponding topics in Section 2.3, 2.5, 2.9 of Chapter 2 of Reference 1) (8 hours)
3. **Interpolation**  
Polynomial interpolation: Finite differences, Lagrange and Newton interpolation (Forward, Backward and Divided difference methods), inverse interpolation, Hermite interpolation (Scope as in corresponding topics in Section 4.1-4.3, 4.5 of Chapter 4 of Reference 1) (10 hours)

### PART B

4. **Solution of Linear Systems**  
Gauss elimination method, Gauss-Seidel method, Cholesky’s Decomposition. Matrix inversion: Gauss-Jordan method. Eigenvalue problem: Bounds on Eigenvalues (Gerschgorin and Brauer theorems), Householder’s method for symmetric matrices, Power method (Scope as in corresponding topics in Section 3.2, 3.4, 3.6, 3.9, 3.11 of Chapter 3 of Reference 1). (10 hours)

5. **Numerical Integration**  
Trapezoidal Rule, Simpson’s 1/3 and 1/8 rule, Romberg integration, Newton – Coates formulae (Scope as in corresponding topics in Section 5.7, 5.8 of Chapter 5 of Reference 1). (5 hours)

6. **Numerical solutions of ordinary differential equations**  
Taylor’s series, Euler and Runge – Kutta methods. Finite difference methods for boundary value problems (Scope as in corresponding topics in Section 6.4 of Chapter 6 of Reference 1) (5 hours)

7. **Functional approximation:** Chebyshev polynomials, Economization of power series, Least square approximation (Scope as in corresponding topics in Section 4.9 of Chapter 4 of Reference 1). (3 hours)

### Recommended books

4. James B. Scarborough. *Numerical Mathematical Analysis*
Course Title | Electric Machinery-II | Credits | 04
---|---|---|
Course Code | EE-401 | L T P | 3 1 0
Contact Hours | 40 | Max Marks-50 | Internal Assessment-50 | Elective | N
Pre-requisites | Basic Electrical Engineering
Course Objectives
4. To understand the working and constructional features of Electric Machines.
5. To understand the process to test, control and analyze the performances of Synchronous Machine.
6. To understand the applications of Electric Machines in the field.
   Introduction to special motors like Brushless DC motor, PM Brushless DC motor, universal motor, stepper motor, linear induction motor, Hysteresis motor and reluctance motor.
Course Outcome (s)
1. To be able to explain the principle of operation of various Electric Machines
2. To be able to identify and select machines for specific applications.
3. To be able to apply control procedures for machines during operation.
4. To analyze the characteristics of Electrical Machinery.

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. Synchronous Machines
PART-B

2. Parallel operation of alternators

Synchronizing to infinite Bus-Bars, synchronoscope, parallel operation of alternators, Operating characteristics, generating Machine, motoring machine, power angle characteristic, operation at constant load with variable excitation, generating Machine, motoring machines, minimum excitation, observation, compounding curve, synchronous condenser, consideration of armature resistance, power flow (transfer) equations. (12 hours)

3. Special motors:

Brushless dc motors, schematic and operation, circuit model characteristics of brushless dc motor, PM Brushless dc machine, universal motor and stepper motor, linear induction motor, Hysteresis motor, reluctance motors. (8 hours)

Text Books:


Other Recommended Books:

1. Electrical Machinery and Transformers by Bhag S. Guru and Huseyin R. Hiziroglu, New York Oxford University Press 2004
4. Electric Machinery by M.G.Say
List of Experiments

1. To determine phase sequence of three phase supply system.
2. To perform no load test on a 3-phase alternator (cylindrical rotor).
3. To perform short circuit test on a 3-phase alternator (cylindrical rotor). Measure the resistance of stator winding of alternator. Find out regulation of alternator at full load at (i) unity power factor (ii) 0.85 Power factor lagging (iii) 0.85 Power factor leading using synchronous impedance method.
4. To perform the slip test to determine the $X_d$ and $X_q$.
5. To determine the V and inverted V curves of the synchronous machine working under different loaded conditions.
6. To synchronize an alternator with the 3 phase bus bar.
7. To perform the parallel operation of two alternators.
8. To obtain positive, negative and zero sequence impedances of a 3-phase synchronous generator.
10. Study of speed –torque characteristics of universal motor on DC operation/ AC operation.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Control Engineering</th>
<th>Credits</th>
<th>04</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>EE-402</td>
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<tr>
<td>Contact Hours</td>
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<td>Internal Assessment-50</td>
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<tr>
<td>Pre-requisites</td>
<td>Knowledge of basic electrical engineering.</td>
<td></td>
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<tr>
<td>Course Objective(s)</td>
<td>1. To understand the introductory concepts of control systems. 2. To study the time domain analysis and frequency domain analysis of control systems.</td>
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<tr>
<td>Course Outcome(s)</td>
<td>1. Students will be able to understand the introductory concepts of control systems with their illustrative examples. 2. Students will be able to outline the basic concept of modelling of control systems. 3. Students will be able to do the time domain analysis of control systems. 4. Students will be able to do the frequency domain analysis of control systems.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each or 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**Part-A**

58
1. Introductory Concepts
Open loop and closed loop control systems, Servomechanisms, feedback and effects of feedback, linear and non-linear systems, time variant & invariant, continuous and sampled data control systems, illustrative examples.

(4 hours)

2. Modelling
Mathematical models of linear electrical, mechanical, translational, rotational, gear, thermal, pneumatic and hydraulic systems, electrical and mechanical analogies. Laplace transforms Transfer function, Block diagram representation, signal flow graphs and associated algebra, characteristics equation.

(5 hours)

3. Time Domain Analysis
Typical test-input signals, Transient response of the first and second order systems. Time domain specifications, Dominant closed loop poles of higher order systems. Steady state error and error co-efficient.

(6 hours)

4. Stability
Concepts of absolute and relative stability, pole –zero location, Routh-Hurwitz stability criterion.

(5 hours)

Part-B

5. Root Locus Technique
Asymptotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain & sketch of the root locus plot, Rules for construction of root locus, root contours, root sensitivity, generalized root locus.

(5 hours)

6. Frequency Domain Analysis

(10 hours)

7. Control Components
Error detectors- potentiometers and synchros, a.c. and d.c. servo motors, brushless d.c. motors, A.C. and D.C. techogenerators, stepper motors.

(5 hours)

RECOMMENDED BOOKS:
Course Title: Control Engineering Lab

| Course Code | EE-452 | Max Marks | 50 | Credits | P | 03 |

Note: At 19, 20, 21191919least eight experiments are to be performed out of the following ten experiments.

1. To measure open loop response of AC servomotor and determination of transfer function using computer interfacing.
2. To measure closed loop response of AC servomotor and determination of transfer function using computer interfacing.
3. To study the input-output characteristics of a potentiometer and to use a potentiometer as an error detector.
4. To study transmitter – receiver characteristics of a synchros set and to use the set as control component.
5. To study the operation of dc position control system.
6. To study the operation of dc speed control system.
7. Introduction to MATLAB.
8. Basic programs in MATLAB.
9. Introduction to control system toolbox and SIMULINK.
10. Programs in control system toolbox like bode plot, nyquist plot, root locus, time responses.

**Recommended Experiments:**

11. To study Missile System using SIMULINK in MATLAB.
12. To study Sun-seeker System using SIMULINK in MATLAB.
Course Title: Power System-I  
Credits: 04

Course Code: EE-403  
L T P: 3 1 0

Contact Hours: 40  
Max Marks: 50  
Internal Assessment: 50  
Elective: N

Pre-requisites: Basics of Electrical Engineering

Course Objectives:
1. To understand the basic structure of power system.
2. To understand the role of insulators and towers.
3. To understand the various parameters of transmission lines.
4. To understand the importance of transmission lines and their operation.

Course Outcome (s):
1. Students will be able to understand the basics of power system.
2. Students can understand the various types of conductors and supporting structures for overhead power transfer.
3. Students can determine the parameters transmission lines under different types of configuration.
4. Students can identify the performance of transmission lines.

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. **Supply Systems**  
   Introduction to Power System, Per unit system, Layout of power supply network, System interconnection, AC and DC supply system-comparison of conductors costs. 
   
   (4-hours)

2. **Conductors and Underground Cables**  
   Types of conductors: Hard drawn copper conductors, AAC, AAAC, ACSR and bundled conductors, Resistance, Skin effect, Proximity Effect  
   Types of Underground cables, capacitance of single core cables, grading of cables, capacitance of three core belted cables, power factor and heating of cables 
   
   (7 hours)

3. **Insulators and Supporting Structures**  
   Types of insulators, voltage distribution across suspension insulators, string efficiency, methods of improving string efficiency.
Line supports- Towers and Poles, Vibration of conductors, Effect of vibration on transmission lines, Prevention of vibration, Sag and tension–Various methods of sag and tension calculations, Loading on conductors and it affects, Span of equal and unequal lengths.

(7 hours)

4. **Transients of Transmission lines**

Transmission-line transients, Transient Analysis: Travelling Waves, reflections and refraction of waves. (6 hours)

PART-B

5. **Transmission-Line Parameters**

Conductance and Inductance: Solid Cylindrical Conductor, Inductance: Single-Phase Two-Wire Line and Three-Phase Three-Wire Line with Equal Phase Spacing, Composite Conductors, Unequal Phase Spacing, Bundled Conductors, Series Impedances: Three-Phase Line with Neutral Conductors and Earth Return, Electric Field and Voltage: Solid Cylindrical Conductor

Capacitance: Single-Phase Two-Wire Line and Three-Phase Three-Wire Line with Equal Phase Spacing, Stranded Conductors, Unequal Phase Spacing, Bundled Conductors (10-hours)

6. **Transmission Lines: Steady-State Operation**


**TEXT BOOKS**


**Other Recommended Books**

Course Title | Power System-I (Lab) | Credits | 01
---|---|---|---
Course Code | EE-453 | Max Marks-50 | P | 03

Design/analysis/simulate/projects relating to the following.

1. Determination of ABCD parameters by experimental measurement using tee-port method and by knowing components values and its verification.
2. Line loadability.
3. Steady state operation of transmission lines.
4. To study different types of underground cables.
5. To study different types of insulators.
6. To study various supporting structures.
7. Ferranti effect
8. Power factor improvement

Add-On Experiments

1. Load test and calculations of regulation, efficiency of transmission lines
2. Working of bi-directional three phase AC measurement panel, observing flow of real and reactive power.
3. Static Var compensation
**Course Title** | Microprocessor and Interfacing | **Credits** | 04  
---|---|---|---  
**Course Code** | EE- 405 | **L T P** | 3 1 0  
**Contact Hours** | 40 | Max Marks-50 | Internal Assessment-50 | Elective | N  
**Pre-requisites** | Basic fundamentals of Digital Electronics.  
**Course Objectives** | 1. To understand the basic concepts of a Microprocessor.  
2. To understand the Architecture of microprocessor 8085.  
3. To know Assembly language programming of 8085.  
4. To understand the key concepts of Interfacing.  
5. To understand the Architecture of 8086  
**Course Outcome(s)** | 1. Students will understand fundamental concepts of Microprocessors 8085 and of 8086  
2. Students will analyse Architecture of 8085 and 8086  
3. Students will learn the 8085 Assembly language Programming.  
4. Students will be able to learn real world Interfacing of Microprocessor which includes both hardware and software concepts.  

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 conceptual questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

**Microprocessor Architecture and Microcomputer Systems**
Microprocessor Architecture & Operations, Memory, Input and Output Devices, The 8085 MPU, Example of an 8085-Based Microcomputer, Memory Interfacing. (04)

**Programming the 8085**
Introduction to 8085 Assembly Language Programming, The 8085 Programming Model, Instruction Classification, Instruction Format. Data Transfer (Copy) Operations, Arithmetic Operations, Logic Operations, Branch Operations, Writing Assembly Language Programs (06)

**Programming Techniques**
Looping, Counting and Indexing, Additional Data Transfer and 16-Bit Arithmetic Instructions, Arithmetic Operations Related to Memory, Logic Operations. (06)

**Counters and Time Delays**
Counters and Time Delays, Hexadecimal Counter, Modulo Ten Counter, Generating Pulse waveforms (04)

**Stack and Subroutines**
Stack, Subroutine, Restart, Conditional Call and Return Instructions (04)

**PART-B**

**Interrupts**
The 8085 Interrupt, 8085 Vectored interrupts, Interfacing I/O Devices (03)

**Basic Interfacing Concepts**
Interfacing Output Displays, Interfacing Input Devices, Memory-Mapped I/O, Interfacing Data Converters, Digital-to-Analog (D/A) Converters, Analog-to-Digital (A/D) Converters (04)

**General –Purpose Programmable Peripheral Devices**
The 8255A Programmable Peripheral Interface- I/O Mode and BSR Mode (03)

**Serial communication**
Basic communication concepts in serial I/O, RS232C (02)

**8086 Microprocessor**
8086 CPU Architecture, Segmented memory, Addressing modes (04)

**Text books**
1. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”
2. John Uffenbeck, The 8086/8088 family Design, Programming & Applications

**Other books recommended**
4. Douglas V. Hall, “Microprocessors and Interfacing programming and Hardware” TMH.
Note: Practical should be covered based on the following directions:

List of Experiments:

1. Familiarization of 8085 kits.

2. Verification of arithmetic and logic operations using above kits. (At least 5 programs)


4. Applications of data movement instructions to develop relevant programs.

5. Development of interfacing circuits of various control applications based on 8085.
<table>
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<tr>
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<td>EE-551</td>
<td>Power Systems-II Lab</td>
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<td>EE-510</td>
<td>MicroControllers</td>
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<td>EE-507</td>
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<td>EE-508</td>
<td>Electromagnetic Filed Theory</td>
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<td>EE-509</td>
<td>Control Engineering-II</td>
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<td>EE-556</td>
<td>Vocational Training after Fourth Semester</td>
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<td>Principles of Designing and Engineering Processes</td>
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**Note:**
*marks refer to mid semester evaluation and end semester evaluation.
# Course Information

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<tr>
<td>Pre-requisites</td>
<td>Instrument transformers, Three phase transformers</td>
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<tr>
<td>Course Objectives</td>
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<td></td>
</tr>
<tr>
<td>1.</td>
<td>To understand the need of protection of power system.</td>
<td></td>
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<tr>
<td>2.</td>
<td>To understand the protection of transformer, generator, bus zone and transmission lines.</td>
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<tr>
<td>3.</td>
<td>To understand the construction, working and application of various types of circuit breakers.</td>
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<tr>
<td>4.</td>
<td>To understand the causes and protection of overvoltages.</td>
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<tr>
<td>5.</td>
<td>To understand the concept of grounding and various types of neutral grounding.</td>
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<tr>
<td>Course Outcome</td>
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<tr>
<td>1.</td>
<td>Students can outline the components of a power system protection.</td>
<td></td>
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<tr>
<td>2.</td>
<td>Students will be competent to design protection system for transformer, generator, bus zone and transmission lines.</td>
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<tr>
<td>3.</td>
<td>Students will be able to extend the construction and working of various circuit breakers for protection system.</td>
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<tr>
<td>4.</td>
<td>Students will be able to illustrate the concept of over-voltages of power system.</td>
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<tr>
<td>5.</td>
<td>Students will be able to demonstrate the importance of different types of neutral grounding.</td>
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</table>

## Note for Examiner
Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part

## PART-A

### 1. Introduction
Three phase short circuits, Sudden short circuit at the armature terminals of a three phase generator, Transients in R-L series circuits, Introduction to symmetrical components, sequence networks of synchronous machines and transformers.

(6 hours)

### 2. Power System Protection
Power System Protection Components, Instrument Transformers, Overcurrent Relays, Radial System Protection, Reclosers and Fuses, Directional Relays, Protection of Two-Source System with Directional Relays, Zones of Protection, Line Protection with Impedance (Distance) Relays, Differential Relays, Bus-bar arrangements, Bus Bar Protection using
Differential Relays, Transformer Protection with Differential Relays, Generator protection with differential relays, Introduction to static relays and Digital Relaying.    (13 hours)

PART B

3. **Circuit Breakers**
   Transient recovery voltage, resistance switching, first pole to clear factor, Transient recovery voltage, arc and arc extinction, volt ampere characteristics of arc, methods of arc extinction, construction, working and applications of air-break circuit breakers, oil circuit breakers, vacuum circuit breakers, air blast circuit breakers, SF6 circuit breakers, circuit breaker ratings.    (8 hours)

4. **Power System Overvoltages**
   Causes of Overvoltages: Internal and external, Protection against over voltages by shielding or ground wires and lightning arrestors, Location of lightning arrester, Selection of lightning arrester, Basic insulation level, insulation coordination.    (5 hours)

5. **Grounding**
   Grounding fundamentals, Ground resistance, step voltage, touch voltage and transferred voltage, tolerable step and touch voltages, ground resistance of a hemisphere and driven rod, Ground resistance, Step and Mesh voltages of a grounding grids

   Neutral grounding: ungrounded systems, resonant grounding, solid or effective grounding, reactance grounding, earthing transformer, neutral grounding practice.    (8 hours)

**Text books**


**Other recommended books**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Power Systems - II Lab</th>
<th>Credits</th>
<th>01</th>
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<tr>
<td>Course Code</td>
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<tr>
<td>P</td>
<td>03</td>
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</table>

**Note:** At least eight experiments / projects / technical reports relating to the following:

1. Measurement of soil resistivity and soil model evaluation
3. To study the characteristics of over current relay.
4. To study the characteristics of percentage differential relay.
5. To study the characteristics of distance relay.
6. To study current time characteristics of fuses.
7. To study current time characteristics of circuit breaker.
8. Technical visit to a substation/generating station, Load Dispatch Centre and preparation of a technical report for the same
9. Conventional and renewable energy sources
10. Distribution system design
11. Digital relaying
12. Reactive compensation of lines

**Add-on Experiments**

1. To study distribution board.
2. To study protection system of a distribution transformer.
### Course Title: Microcontrollers  
### Course Code: EE510  
#### Credits: 04  
#### L T P: 3 1 0  
#### Contact Hours: 40  
#### Elective: N  
#### Pre-requisites: Basic knowledge of Microprocessors

| Course Objectives (CO) |  
|------------------------|---------| 
| 1. To understand the architecture, instruction sets and various techniques to interface them with different real world I/O devices to accomplish certain tasks.  
2. To study the architecture, instruction set and programming of microcontrollers like 8051 and PIC.  
3. To know the techniques of interfacing them to the real world peripheral devices  
4. To impart practical knowledge of 8051, and PIC Microcontrollers.  
|  
| Course Outcome |  
|----------------|---------| 
| 1. Acquired knowledge about the architecture of microcontrollers.  
2. Acquired knowledge about instruction set and programming Concepts  
3. To understand peripheral interfacing to microcontrollers.  
4. To design the systems/models based on microcontrollers  
|  

**Note for Examiner** - Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 mark each or 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part

### PART A

**8051 Micro Controllers**  
Architecture, Pin configuration, SFR’s, Memory, 8051 Addressing modes  

(3 Hours)

**8051 Instructions:**  
Introduction to 8051 assembly language programming: JUMP, LOOP and CALL instructions, Arithmetic instructions: Unsigned addition and subtraction, unsigned multiplications and Division, signed number concepts and arithmetic operations, Logic And Compare instructions, I/O PORT.
**Input Output Programming:**
Single bit instruction programming, Single bit operations with CY, Reading Input Pins Vs Port latch, Programming 8051 timers, counter programming (4 Hours)

**8051 Serial Communication:**
8051 connection to RS 232, 8051 serial communications Programming (2 Hours)

**8051 Interrupts and interfacing:**
Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051, LCD and keyboard interfacing (6 Hours)

---

**PART-B**

**Programming model (08)**
PIC18F programming model, instruction set, instruction format. Data copy, arithmetic, branch, logical, bit manipulation and multiply-divide operations, Stacks, subroutines and macros, Role of Assembler. (8 Hours)

**PIC18F Family:**
The Architecture of PIC family of devices, PIC18F instructions and, assembly language. (4 Hours)

**Interrupts and Timers of PIC:**
Concepts of Interrupts and Timers, Interrupts and their implementation in PIC18, The PIC18 timers, The CCP, Use of Interrupts in applications. (5 Hours)
# RECOMMENDED BOOKS

<table>
<thead>
<tr>
<th>S. No</th>
<th>NAME</th>
<th>AUTHOR</th>
<th>PUBLISHER</th>
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<tbody>
<tr>
<td>1</td>
<td>The 8051 Microcontroller and Embedded System</td>
<td>Muhammad Ali Mazidi, Janice Gillespie Mazidi</td>
<td>Pearson Education</td>
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<tr>
<td>2</td>
<td>The 8051 Microcontrollers</td>
<td>Ayala</td>
<td>Penram Publications</td>
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<tr>
<td>3</td>
<td>PIC Microcontroller and Embedded Systems</td>
<td>Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The 8051 Microcontroller</td>
<td>Mackenzie</td>
<td>Pearson education</td>
</tr>
<tr>
<td>6</td>
<td>Designing with PIC Microcontrollers</td>
<td>John B Peatman</td>
<td>Pearson Education, 2004</td>
</tr>
</tbody>
</table>
List of Experiments:

**Note:** At least eight experiments to be done selecting at least two from the last experiment.

1. To study development tools/environment for 8051/PIC microcontroller programme and Architecture
2. Write an assembly language program to add, subtract, multiply, divide 8/16 bit data by 8051/PIC microcontroller.
3. Study and analyze the interfacing of LCD using 8051/PIC microcontroller
4. Study and analyze the interfacing of seven segment display using 8051/PIC microcontroller
5. Study of implementation of DC Motor control using 8051/PIC microcontroller.
6. To study implementation and programming of Temperature measurement using 8051/PIC microcontroller.
7. Study and analyze the interfacing of keypad matric using 8051/PIC microcontroller
9. Study and analyze the interfacing of buzzer using 8051/PIC microcontroller.
10. Study and analyze the interfacing of ADC using 8051/PIC microcontroller.
### Course Title
Communication Engineering

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Communication Engineering</th>
<th>Credits</th>
<th>04</th>
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<tbody>
<tr>
<td>Course Code</td>
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<td>3 1 2</td>
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<tr>
<td>Contact Hours</td>
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<td>Max Marks-50</td>
<td>Internal Assessment-50</td>
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<tr>
<td>Pre-requisites</td>
<td>Knowledge of Analog Electronics and digital electronics</td>
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</table>

#### Course Objectives

1. To develop students with solid foundation in mathematical, engineering fundamentals to solve communication engineering problems.
2. To provide students rigorous training to design and develop electronics systems, such as AM, FM transmitter used in real life.
3. To provide a platform to the students to get them acquainted with issues related to engineering technologies in communication engineering and their impact on global economy.

#### Course Outcome(s)

1. Students will understand various modulation techniques and would be able to generate IC based AM, FM signal.
2. Students will understand various demodulation techniques and will recover original information signal.
3. Students would also be capable to identify various modulation and demodulation techniques and able to solve communication engineering problems theoretically and practically.
4. Students will understand impact of various modulation techniques on resources such as bandwidth utilization and its effect on global economy.
5. Students will be capable to calculate bandwidth for AM, FM transmitter using modern instruments like digital storage oscilloscope.

---

**Note for Examiner** - Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 question of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Amplitude Modulation and Demodulation**
   Concept of modulation its merits & demerits, Principle and generation of AM, DSB-SC, SSB signals, Detection of AM, DSB-SC, and SSB signals, Noise in AM systems, Super heterodyne Receivers, Diversity reception. (12 hours)

2. **Frequency Modulation and Demodulation**
   Principle and generation of FM signals, Detection of FM signals, Foster Discriminator, Ratio and PLL detectors, Noise consideration in FM, Pre-emphasis and de-emphasis circuit. (10 hours)
PART-B

3. Pulse Modulation & Demodulation
   Principle, generation and detection of PAM, PWM, PPM & PCM signals, Bandwidth consideration, Companding, Delta modulation, Adaptive delta modulation systems. (10 hours)

4. Digital Modulation Techniques
   Coherent binary: Amplitude shift keying, Phase shift keying, Frequency shift keying, Quadrature phase shift keying. (8 hours)

Text Books:

Reference Books:
Course Title: Communication Engineering Lab

| Course Code | EE- 557 | Max Marks-50 | Credits | 01 |

List Of Experiments:

1. Study of amplitude modulation (AM).
2. Determine the modulation index of amplitude modulated (AM) wave.
4. Study of frequency modulated (FM) wave.
5. Study the demodulation of frequency modulated (FM) wave.
6. Study of pulse amplitude modulation (PAM) using natural and flat top sampling.
7. Study of pulse width modulation (PWM) and pulse position modulation (PPM).
8. Study of pulse code modulation (PCM) transmitter and receiver.
9. Study of delta modulation (DM) and adaptive delta modulation (ADM).
10. Study of ASK, FSK and PSK techniques.

Experiments beyond curriculum

i. To measure sensitivity, selectivity, fidelity and alignment arrangement for a communication receiver.
ii. Study of time division multiplexed and frequency division multiplexed signals.

Project work related to designing of communication transmitters and receivers.
Course Title | Electromagnetic Fields Theory | Credits | 04
---|---|---|---
Course Code | EE-508 | L T P | 3 1 0
Contact Hours | 40 | Max Marks-50 | Internal Assessment-50 | Elective | N
Pre-requisites | Basic knowledge of Coordinate systems, Electric and Magnetic fields

Course Objectives
1. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM fields.
2. To understand the boundary conditions for different materials/surfaces.
3. To get the basics of microwave, transmission lines and antenna parameters.

Course Outcome(s)
1. Students will apply knowledge of mathematics to solve numerical based on Coulombs law, Gauss law, Biot Savarts law, Amperes Circuital law etc.
2. Students will understand impact of the EM course in many engineering core subjects like optical fiber communication, microwave engineering, antenna engineering etc and its impact on the technology used by the society.

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. Static Electric Fields
Introduction to Coordinate System, Rectangular, Cylindrical and Spherical Coordinate System. Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient – Meaning of Stokes theorem and Divergence theorem, Coulomb’s Law, Electric Field Intensity, Electric Field due to several point charges ,Electric field due to volume charge, Electric Field due to charges distributed uniformly on an infinite and finite line , Electric Field due to a sheet of charge. Electric Flux Density, Gauss’s Law and its applications. (10 hours)

2. Poisson’s Equation and Laplace’s Equation
Laplace’s equation,solution of Laplace’s equation in rectangular coordinates,Cartesian solution in one dimension,laplace’s equation in cylindrical coordinates,Laplace’s equation in spherical coordinates, Uniqueness theorem,poisson’s equation,capacitor, capacitance of
parallel plate capacitor, capacitance of conducting spheres, capacitance of coaxial cable, current density, Ohm’s law, continuity equation. (10 hours)

PART-B

3. **Static Magnetic Fields**
   Magnetic Flux and magnetic Flux density, Biot-Savart Law, Magnetic field of a circular loop, Magnetic field of a solenoid, Magnetic Field intensity, Ampere’s circuital law and simple applications, Magnetic Vector Potential, Self inductances of some geometries, Magnetic boundary conditions. (10 hours)

4. **Time Varying Fields and Maxwell’s Equation**
   Displacement current, Modified form of Ampere’s circuital law, Maxwell’s Equation in differential form, Maxwell’s equation in integral form, Boundary conditions, Poynting Theorem and its applications, Poynting Vector, Poynting theorem in complex form. (10 hours)

**Text books**


**Other books recommended**

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each or 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

Part-A

1. **State Space Analysis:** Introduction, Features of state space models, State variables, State space representation, Transfer function, Solution of state equations, Concept of controllability and observability.

   (7 hours)

2. **Controllers:** Introduction, Time proportional ON/OFF controllers, Proportional controllers, Integral controllers, Derivative controllers, Proportional-integral controllers, Proportional-derivative controllers, PID controllers, Tuning of PID controllers-various methods: Ziegler Nichols method, Kuhn-Kohn method.

   (5 hours)

3. **Design of Control Systems:** Introduction, approaches to design, Cascade compensation network, Phase-lead design using bode diagram, Phase-lead design using root locus, Phase-lag design using bode diagram, Phase-lag design using root locus.

   (8 hours)

Part-B

4. **Digital Control Systems:** Introduction, Sampling process, Signal reconstruction, z-transform, z-transfer function, Inverse z-transform and response of linear discrete system, z-transform of sampled data control system, z and s-domain relationship, Stability analysis in z-plane, Applications of digital control systems: digital temperature control system, digital position control system, stepper motor and its control.

(10 hours)

**Recommended books:**

Course Title | Control Engineering-II Lab | Credits |
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<td>Max Marks-50</td>
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Note: At least eight experiments are to be performed out of the following nine experiments.

1. To study proportional controller characteristics for different parameters/constants using computer interfacing.
2. To study integral controller characteristics for different parameters/constants using computer interfacing.
3. To study derivative controller characteristics for different parameters/constants using computer interfacing.
4. To study proportional-integral-derivative controller characteristics for different parameters/constants using computer interfacing.
5. To study temperature measurement process using PID controller with computer interfacing.
6. To design different compensating networks for the given cut off frequency response.
7. To measure open loop response of lead-lag compensator with sine wave input and drawing bode plot.
8. To study PID tuning using Zeigler-Nichols first method.
9. To study PID tuning using Zeigler-Nichols second method.

**Recommended Experiments:**

10. Modelling and simulation of process control system using SIMULINK and observe different parameters/responses.
11. To study flow control loop using Process Control Trainer kit.
**Course Title**  
Principles of Design Engineering and Product Development

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**Pre-Requisites**  
Basic fundamentals and concepts of Electrical Engineering.

**Course Objectives**  
1. Conceptualisation and development of innovative, commercially important and socially sound decisions related to engineering products, processes and systems.
2. To train students to translate academic developments in electronics, computational, materials and energy engineering to real life applications of interest to industry for accelerated start of career.

**PART-A**

1. **Introduction to designing**
   Fundamentals of engineering designs and applications; social, economic, sustainability, environmental and aesthetic rationales in design engineering, design decisions related to customer focus, competitiveness of products, processes, services and systems. Impact of product design on business and market, product portfolio development through continuity in designing.

2. **Managing technologies and innovations**
   Technology road mapping, market and trend analyses for design decisions, managing technology and innovations, protecting designs by intellectual property rights, IPR gap analysis, creative thinking, technology sharing and transfer, founding start up companies, raising seed funding, challenges of conceiving, creating and growing a new venture.

3. **Design process**
   Principles, tools and strategies for conceptualising the need and presenting designs - product specifications, digital tools, analog drawings, design modeling: mathematical modeling, simulation using computers, and creation of 2D and 3D scale models. Engineering fundamentals
related to mechanical, electrical, electronic and computational concepts in designing; environmental, sustainability, life cycle analysis; upstream manufacturing economics and downstream assembly, distribution, recyclability, robustness, maintenance and safety aspects in design development; functional prototypes, iterations, validation of product concept, product development.

Part B

4. Challenges of Energy in Engineering Designs

Energy source, quality, costing, storage, utilisation, conservation and sustainability in engineering designs. Examples by case studies and minor projects on small energy capture, storage and management technologies.

Recommended Books:


2. Journal of Product Innovation Management, Wiley Online Library


## BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS) VI SEMESTER

<table>
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<td>Programmable Logic Controller and Distributed Control System</td>
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<td>EE-612</td>
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<td>Energy Management &amp; auditing</td>
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**Subjects offered by DIC (OPTIONAL)**

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<td>Dic-02</td>
<td>Sensors based Application Systems</td>
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**Note:**

*marks refer to mid semester evaluation and end semester evaluation.*
Course Title | Computer Aided Power Systems Analysis | Credits | 04
--- | --- | --- | ---
Course Code | EE-601 | L T P | 3 1 0
Contact Hours | 40 | Max Marks-50 | 50
Pre-requisites | Knowledge of Power System-I and Synchronous Machines | Internal Assessment-50 | 50
Elective | N
Pre-requisites | Knowledge of Power System-I and Synchronous Machines

Course Objectives
1. To learn about the power system analysis using power flow.
2. To understand the importance of per unit system in power system.
3. To be competent in understanding power system stability.
4. To learn about various types of faults and their analysis.

Course Outcome (s)
1. Students will be confident in solving power system load flow problems in real life.
2. Students will be able to analyze and design a power system.
3. Students will be competent to study power system response under sudden load change conditions.
4. Students will be competent to analyze power system under various fault conditions may be symmetrical or unsymmetrical.

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. Power Flow Studies
   Introduction to per unit system, advantages of per unit system, Power-Flow Problem, Power-Flow Solution by Newton-Raphson method, Power-Flow Solution by Gauss-Seidel Method, Control of Power Flow. (7-hours)

2. Power System Controls
   Generator-Voltage Control, Turbine-Governor Control, Load-Frequency Control (single area and two area case), Economic load Dispatch. (7-hours)

3. Transient Stability Studies
   Introduction of power system stability, The Swing Equation, Simplified Synchronous Machine Model and System Equivalents, Stead state stability, Transient stability, The Equal-Area Criterion for sudden change in mechanical input, sudden loss of one parallel lines, sudden short circuit on one parallel lines and effect of clearing time on stability, Numerical solution of Swing Equation, Design Methods for Improving Transient Stability. (10-hours)
PART B

4. **Symmetrical Faults**

   (8-hours)

5. **Unsymmetrical Faults Analysis**

   (8-hours)

**Text books recommended**


**Other recommended books**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Computer Aided Power Systems Analysis Lab</th>
<th>Credits</th>
<th>01</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>EE- 651</td>
<td>Max Marks-50</td>
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</table>

Note: At least five design / analysis projects relating to Sr. No 4-10 can be Performed while Sr. No. 1-3 are compulsory.

1. Introduction to MATLAB Software
2. Formulation of $Y_{bus}$ using MATLAB Software
3. Formulation of $Z_{bus}$ for a system using step-step algorithm using MATLAB Software
4. Symmetrical Fault analysis
5. Unsymmetrical Fault analysis
6. Power flow analysis.
7. Power flow control
8. Economic dispatch
10. Load frequency control
11. Fault analysis using power world simulator
Course Title: Programmable Logic Controller and Distributed Control System

<table>
<thead>
<tr>
<th>Course Code</th>
<th>EE-611</th>
<th>Credits</th>
<th>04</th>
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<td>Pre-requisites</td>
<td>Knowledge of basic electrical engineering and digital electronics.</td>
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</table>

Pre-requisites: Knowledge of basic electrical engineering and digital electronics.

Course Outcome(s):
1. Student will be able to identify logical process control in automation (PLC and DCS based automation).
2. Student will be able to connect the peripherals devices with the PLC for logical functioning.
3. Student will be able to develop PLC programmes and connect hardware for practical applications.

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each or 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

Part-A

1. Logical Process Control in Automation
   Introduction to process control, Continuous Process Control, Discrete-state Process Control, Composite Process Control, Data logger, DDC, SCADA, Scope of automation in industry. (4 hours)

2. PLC Architecture
   Introduction to PLC, Configuration of PLC(components for modularized PLC), Architecture of PLC, Working of PLC, PLC peripherals, PLC symbols, Selection criteria of PLC, Advantages and disadvantages of PLC, PLC applications. (5 hours)

3. PLC Peripherals and Wiring
   Analog input/output module, Digital input/output module, Switching devices (level, pressure, flow, temperature, timer, proximity switch), PLC input/output connection, PLC power connection (wiring), Isolated and non-isolated input/output wiring to PLC (6 hours)

Part-B

4. Basic PLC Programming
   Introduction to General PLC Programming Procedures, Programming equipment Hand held programmer, Programming sequence, PLC Ladder Diagrams, Process scanning consideration, PLC operational fault.
NOT, AND, OR, NAND, NOR, Ex-OR, Ex-NOR logic, PLC Programming languages, Boolean algebraic equation, Holding (latching relay) contact, Branching and complex branching ladder rung.

5. **PLC Applications to Industrial Problems**
   PLC programming using ladder logic for simple industrial applications--Temperature control, sorting a product, bottling plant, mixing two chemicals, level control. (10 hours)

6. **Distributed Control System (DCS)**
   Introduction to DCS, History of DCS, Concept of DCS, Hierarchy of DCS, Functions of each level of DCS, Network topology for DCS, Display organization (Monitoring facilities) for DCS. (7 hours)

**Recommended Books:**
1. Programmable logic Controllers Principles and John W. Webb, Ronald A Reis (PHI Learning)
2. Programmable Logic Controllers- Programming methods and applications, John R Hackworth Frederick D. Hackworth Jr (Pearson)
3. Process Control Principles and applications Surekha Bhanot (Oxford University press)
4. Industrial Electronics- Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls-- Thomas E Kissell, (PHI Pvt. Ltd.)
5. Instrumentation engineer’s handbook B.G Liptak (Chilton Book Co., Philadelphia)
6. Process control Instrumentation technology Curtis D Johnson (PHI Pvt. Ltd.)
Note: At least eight experiments are to be performed.

**List of Experiments:**

1. Introduction to the various modules and components of PLC hardware.
2. Study and implementation of NOT, AND, OR, NAND & EX-OR logic gates using ladder diagrams with the help of PLC.
3. Develop ladder diagram for given car parking system using PLC.
4. Develop ladder diagram for working of DC motor using PLC.
5. Develop ladder diagram for given DOL(Direct on line) starter reverse /forward system using PLC.
6. Develop ladder diagram for given traffic light control system using PLC.
7. Develop ladder diagram for water level indicator system using PLC.
8. Develop ladder diagram for resistance welding system using PLC.
9. Develop ladder diagram for piston movement system using PLC.
10. Develop ladder diagram for given star delta connection system using PLC.
11. Study and identify various levels of Distributed Control System.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Signals &amp; Systems</th>
<th>Credits</th>
<th>04</th>
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<tr>
<td>Pre-requisites</td>
<td>Basic knowledge of Mathematics</td>
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<tr>
<td></td>
<td>1. To understand different types of Signals, Systems and their examples in real life situations.</td>
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<tr>
<td></td>
<td>2. To study solution of differential and difference equations.</td>
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<td></td>
<td>3. To study Fourier Series and Fourier Transform of Continuous and Discrete time systems and using these tools to solve systems represented by differential and difference equations</td>
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<td>4. To study Laplace Transform, Z-transform, their properties and their use in finding the output of LTI systems.</td>
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<tr>
<td>Course Objectives (CO)</td>
<td>1. Ability to analyze different types of continuous and discrete time systems</td>
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<td>2. Ability to represent and analyze real world problems into differential and difference equations and solve them using Fourier series and Fourier transform</td>
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<td>3. Ability to use Laplace Transform, Z-transform and Hilbert Transform to analyze and solve LTI systems.</td>
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<tr>
<td>Course Outcome</td>
<td>1. Ability to analyze different types of continuous and discrete time systems</td>
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<td></td>
<td>2. Ability to represent and analyze real world problems into differential and difference equations and solve them using Fourier series and Fourier transform</td>
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<td></td>
<td>3. Ability to use Laplace Transform, Z-transform and Hilbert Transform to analyze and solve LTI systems.</td>
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</table>

**Note for Examiner** - Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each or 10 questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part

**PART A**

**Signals & Systems**
Classification of Signals, Dirac Delta function and properties, Transformations of independent variable, Elementary Signals, Continuous time and Discrete time systems, System Properties, Examples of Signals and Systems in Electrical, Mechanical, Hydraulic, Thermal, and Biomedical Systems. (5 Hours)
Linear Time Invariant Systems
Convolution sum and integral, Properties of LTI systems, Systems described by differential equations and difference equations, Singularity functions.

(4 Hours)

Fourier series Representation
Response of LTI systems to complex exponentials, Fourier series representation of continuous time periodic signals, Convergence of fourier series, Properties of continuous time Fourier series, Fourier series representation of discrete time periodic signals, Properties of discrete time Fourier series, Filtering, examples of filters described by differential and difference equations.

(5 Hours)

The Continuous Time Fourier Transform

(4 Hours)

Sampling
The sampling Theorem, Reconstruction using Interpolation, Aliasing

(2 Hours)

PART-B

The Discrete time Fourier Transform

(6 Hours)

The Laplace Transform

(6 Hours)

The Z-Transform

(5 Hours)

Hilbert Transform
Introduction to continuous-time and discrete-time Hilbert Transform

(3 Hours)
# RECOMMENDED BOOKS

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NAME</th>
<th>AUTHOR (S)</th>
<th>PUBLISHER</th>
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<tbody>
<tr>
<td>1</td>
<td>Signals and Systems</td>
<td>Oppenheim, A. V., Willsky, A.</td>
<td>Pearson</td>
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<tr>
<td>2</td>
<td>Principles of Linear Systems and Signals</td>
<td>B. P. Lathi</td>
<td>Oxford University Press</td>
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<td>3</td>
<td>Signals and Systems</td>
<td>Haykin, S., Van Veen, B.</td>
<td>Wiley; 2003</td>
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<td>4</td>
<td>Signal Processing &amp; Linear Systems</td>
<td>B. P. Lathi</td>
<td>Oxford University Press</td>
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<tr>
<td>5</td>
<td>Signals and Systems</td>
<td>A. Rajeshwari, V. Krishnaveni</td>
<td>Wiley India</td>
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<td>6</td>
<td>Signals and Systems</td>
<td>T. K. Rawat</td>
<td>Oxford University Press</td>
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<td>7</td>
<td>Schuam’s outline of Signals and System</td>
<td>Hsu, H.; Ranjan R</td>
<td>Tata McGraw Hill</td>
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<tr>
<td>Course Title</td>
<td>Energy Management and Auditing</td>
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<td>Pre-requisites</td>
<td>Power Plant Engineering, Electric Motors and Power Electronics and Drives</td>
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</table>
| Course Objectives            | 1. To understand the present Energy Scenario and Basics of various forms of Energy  
3. To understand the Energy Monitoring and Targeting system, the Power Supply System and Electric motors  
4. To understand the concept of Lighting System, Energy Efficient Technologies. |
2. Students will demonstrate an understanding of Energy Costs, Benchmarking.  
3. Student will be able to learn about Energy Audit: Types and Methodology, Energy Audit Reporting Format, Energy Audit Instruments  
4. Students will be able to demonstrate Financial Analysis Techniques, Sensitivity and Risk Analysis and other financing options. |

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**PART-A**

1. **Energy Scenario and Basics of Energy**  

2. **Energy Management and Audit**  
3. **Energy Action Planning and Financial Management**
   (5 hours)

4. **Energy Monitoring and Targeting**
   Definition, Elements of Monitoring & Targeting System, A Rationale for Monitoring, Targeting and Reporting, Data and Information Analysis, Relating Energy Consumption and Production, CUSUM, Case Study.  
   (5 hours)

**PART-B**

5. **Electrical System and Motors**
   (8 hours)

6. **Lighting System**
   (6 hours)

7. **Energy Efficient Technologies in Electrical Systems**
   (6 hours)

**Reference Books:**

3. Related journal and conference papers.
4. Website: [www.energymanagerstraining.com](http://www.energymanagerstraining.com)
Course Title | Energy Management and Auditing Lab | Credits |
---|---|---
Course Code | EE-663 | Max Marks-50 |
| | | P |
| | | 03 |

Note: At least four experiments and a case study are to be performed.

List of experiments:
1. To obtain polar curve of a lamp.
2. To measure harmonics and do the analysis for any 3-phase system.
3. To measure the currents, voltages and active and reactive powers in a three phase system using energy auditor.
4. To design a lighting system for any auditorium/building/hall.
5. To test a 3-phase machine of unknown rating.

Case Study:
To perform case study for energy audit of educational institute/industrial unit/administrative or commercial building and prepare a complete report suggesting the changes to be made.

- Education Institute
- Hostel
- Library
- Laboratories

Recommended Experiments (Beyond Curriculum):
1. To study energy auditor and its functions
2. To do the payback analysis of the recommendations of energy audit done.
3. To study the tariff policy of the state electricity board (UT)/Punjab/Haryana.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Power Electronics</th>
<th>Credits</th>
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<tr>
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<tr>
<td>Pre-requisites</td>
<td>Basic fundamentals of Analog and Semiconductor Electronics.</td>
<td></td>
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<tr>
<td>Course Objectives</td>
<td>1. To provide the electrical circuit concepts behind the different working modes of power converters so as to enable deep understanding of their operation.</td>
<td></td>
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<tr>
<td></td>
<td>2. To equip with required skills to derive the criteria for the design of power converters starting from basic fundamentals.</td>
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<td></td>
<td>3. To analyze and comprehend the various operating modes of different configurations of power converters.</td>
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<tr>
<td></td>
<td>4. To design different power converters namely AC to DC, and DC to DC converters</td>
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<tr>
<td>Course Outcome(s)</td>
<td>1. To be able to understand the thyristor and semiconductor power switching devices characteristics. And, also to understand concerned topics related to operation of thyristors useful for their industrial applications.</td>
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<td></td>
<td>2. To be able to understand the various thyristor commutation techniques.</td>
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<tr>
<td></td>
<td>3. To be able to understand the theory, operation and control of single-phase and three-phase controlled rectifier, in detail because of its widespread use.</td>
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<tr>
<td></td>
<td>4. To be able to understand the theory, operation and control of DC to DC converters, in detail and design of its commutating components.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note for Examiner-** Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each or 5 questions of 2 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Thyristor and Semiconductor Power Switching Devices**
   Devices of Thyristor family and their V-I characteristics: Thyristor, DIAC, TRIAC, GTO, MOSFET, IGBT, Principle of operation of SCR, two transistor model of SCR. Turn on methods of a Thyristor, Switching characteristics of Thyristor during turn-on and turn-off, Gate characteristics, Thyristor triggering.
Series and parallel operation of SCR’s, Thyristor specifications (latching current and holding current, dv/dt and di/dt etc.), Thyristor Protection circuits, UJT: characteristics and as a relaxation oscillator. 

(12 hours)

2. SCR Commutation Circuits

(06hours)

PART-B

3. Phase controlled Rectifiers

(12 hours)

4. DC-DC converters

(10 hours)

Text books recommended


Other books recommended

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Power Electronics Lab</th>
<th>Credits</th>
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<tr>
<td>Course Code</td>
<td>EE- 656</td>
<td>Max Marks-50</td>
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</table>

**Note:** At least eight experiments are to be performed.

1. To plot the V-I characteristics of the SCR.
2. To draw V-I characteristics of Triac.
3. Study of R and RC triggering circuits for SCR.
4. To study and perform the triggering of SCR circuit through UJT firing.
5. Study of SCR commutation circuits and check the performance of one commutation circuit.
6. Study of Jones chopper or any chopper circuit to check the performance.
7. Design and simulation of following of circuit in MATLAB / other software.
   a) Rectifier circuit with RL Load
   b) Three phase thyristor converter
8. To study the implementation of four quadrant operation of DC to DC converter in DC machines using MATLAB/SIMULINK environment.
9. To plot the load voltage and thyristor voltage of single wave and full wave phase controlled rectifier.
10. To study the voltage and current commutated choppers.
<table>
<thead>
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<th>Course Title</th>
<th>Sensor Based Application Systems</th>
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<td>Max Marks-50 Internal Assessment-50</td>
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</table>
| Course Objectives         | 1. Develop judgment of what sensors and modalities are appropriate for different applications  
2. Know how to electronically condition the sensor, hook it up to a microcomputer, and process the signal (at least basically)  
3. Have some idea of how/where these sensors were used before  
4. Have a reasonable idea of how different sensors work |
| Course Outcome(s)         | 1. An ability to apply knowledge of mathematics, science, and engineering.  
2. An ability to design and conduct experiments, as well as to analyze and interpret data.  
3. Students are assigned both individual and group projects, which require ability to conduct simulation, analyze and interpret results.  
4. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.  
5. An ability to function on multi-disciplinary teams.  
6. An ability to identify, formulate, and solve engineering problems. Students are presented with engineering problems, like designing sensors for biomedical, automotive applications.  
7. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each or 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**Part-A**

1. Basics: Sensors: examples and definitions, Introduction to Sensor Electronics and terminology (Fraden Ch. 2)  
2. Strain Gauges: Basics and Examples (Fraden Ch 3.5, 5.1, 5.2, 5.7, 9)  
3. Thermometers: Measurement Techniques and Examples, Flow Sensors (Fraden Ch. 16)  
4. Radiation Sensors: Overview of Types, Examples of Applications (Fraden Ch. 14)
5. IR Sensors and Demo: IR Motion
6. Capacitive sensors: Fundamentals, Applications and Examples (Fraden Ch. 3.2, 6.3, 7.3, 10.6)

**Part-B**

7. Accelerometers (Fraden Ch. 8)
8. Piezoelectric Sensors (Fraden Ch. 3.6, 5.2.4, 8.4)
9. Pressure sensors: Principles and Examples (Fraden Ch. 10)
10. Inductive and Magnetic Sensors (Fraden Ch. 3.3, 3.4, 7.4)
11. Active sounding: Methods for measurement, Examples
12. Chemical Sensors
13. Biosensors
14. RF sensors
15. Applications of sensors in Process Control, Biomedical Field, Automation, Transportation, Agriculture, Post-harvest supply chain and processing, Environment etc.

**Project work.**

Students will work on different problems from industries and come up with some practical solutions.

**Recommended Books:**


### BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS)

#### VII SEMESTER

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>SCHEDULE OF TEACHING</th>
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<td>EE708</td>
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<td>Minor Project</td>
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<td>EE-706</td>
<td>Seminar</td>
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**Elective-I**

- **a)** Optical Communication
- **b)** Wireless Communication
- **c)** Alternate Energy Sources and Energy Conservation
<table>
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<td>Pre-requisites</td>
<td>Power Plant Engineering, Electric Motors and Power Electronics and Drives</td>
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</table>
| Course Objectives      | 1. To understand the present Energy Scenario and Basics of various forms of Energy  
3. To understand the Energy Monitoring and Targeting system, the Power Supply System and electric motors  
4. To understand the concept of Lighting System, Energy Efficient Technologies. |
2. Students will demonstrate an understanding of Energy Costs, Benchmarking.  
3. Students will be able to learn about Energy Audit: Types and Methodology, Energy Audit Reporting Format, Energy Audit Instruments  
4. Students will be able to demonstrate Financial Analysis Techniques, Sensitivity and Risk Analysis and other financing options. |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Energy Scenario and Basics of Energy**  

2. **Energy Management and Audit**  
3. **Energy Action Planning and Financial Management**
   (8 hours)

4. **Energy Monitoring and Targeting**
   Definition, Elements of Monitoring & Targeting System, A Rationale for Monitoring, Targeting and Reporting, Data and Information Analysis, Relating Energy Consumption and Production, CUSUM, Case Study.  
   (6 hours)

**PART-B**

5. **Electrical System and Motors**
   (8 hours)

6. **Lighting System**
   (6 hours)

7. **Energy Efficient Technologies in Electrical Systems**
   (6 hours)

**Reference Books:**
3. Related journal and conference papers.
4. Website: [www.energymanagerstraining.com](http://www.energymanagerstraining.com)
Note: At least four experiments and a case study are to be performed.

List of experiments:

1. To obtain polar curve of a lamp.
2. To measure harmonics and do the analysis for any 3-phase system.
3. To measure the currents, voltages and active and reactive powers in a three phase system using energy auditor.
4. To design a lighting system for any auditorium/building/hall.
5. To test a 3-phase machine of unknown rating.

Case Study:

To perform case study for energy audit of educational institute/industrial unit/administrative or commercial building and prepare a complete report suggesting the changes to be made.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Power Plant Engineering</th>
<th>Credits</th>
<th>04</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>EE-703</td>
<td>L T P</td>
<td>3 1 0</td>
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<tr>
<td>Contact Hours</td>
<td>45</td>
<td>Max Marks-50</td>
<td>Internal Assessment-50</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Basics of Energy and Power</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Course Objectives | 1. To introduce Energy resources and their availability  
2. To introduce working, efficiency environmental impacts of conventional power plants. | | |
| Course Outcome(s) | 1. Students will understand availability of different Energy resources  
2. Students will be able understand the working and other important factors of available power plant. | | |

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. **Introduction**
   Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.
   
   (4 hours)

2. **Thermal Power Plants**
   Flow sheet and working of modern-thermal power plants, Site selection, Power plant boilers including critical and super critical boilers, Fluidized bed boilers, Boilers mountings and accessories, Different systems such as coal handling system, Pulverizers and coal burners, Combustion system, Draft, Ash handling system, Dust collection-mechanical dust collector and electrostatic precipitator system, Feed water treatment and condenser and cooling towers and cooling ponds, Prospectus and development of thermal plants in India.
   
   (11 hours)

3. **Diesel Power Plant**
   Outline of diesel power plant, Systems of diesel power plant like air intake system, Fuel system, Cooling system, Exhaust system, lubrication system, Engine starting and stopping system, Diesel plant operation and efficiency, Comparative study of diesel power plant with steam power plant.
   
   (6 hours)
PART-B

4. **Gas Turbine**
Classification, Open and closed cycle, Actual Brayton cycle, Methods of improving efficiency and specific output – open cycle with regeneration, Reheating and inter cooling, Combined steam and gas turbine plant.  

(7 hours)

5. **Hydro-Electric Power Plant**
Elements of hydro electric power plant, Site selection, Hydrology, storage and pondage, General arrangements and operation of hydro power plant, Hydraulic turbines, Turbine size, Pelton wheel turbine, Francis and Kaplan turbines, Selection of turbines, Dams, Spillways, gates, Intake and out take works, Canals and layout of penstocks, Water hammer and surge tank, Simple numerical on hydrographs and number of turbine required, Hydraulic electric power plants in India.  

(11hours)

6. **Nuclear Power Plant**
Nuclear fusion and fission, Chain reaction, Nuclear fuels, Components of nuclear reactor, Classification of reactors, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, CANDU reactor, Fast breeder reactor, Nuclear ash and its disposal, Nuclear power plants in India.  

(8 hours)

**Text books**


**Other recommended books**

**Course Title**: Digital Signal Processing  
**Credits**: 04  

<table>
<thead>
<tr>
<th>Course Code</th>
<th>EE708</th>
<th>L T P</th>
<th>3 1 0</th>
</tr>
</thead>
</table>

**Contact Hours**: 45  
**Elective**: N  

**Pre-requisites**: Basic knowledge of Mathematics

**Course Objectives**

1. To introduce the concept of different types of signals and systems.
3. To introduce the concept of various designing techniques for FIR and IIR filters.
4. To introduce the architecture, addressing mode and memory of TMS320C5X DSP processors.

**Course Outcome**

1. Familiarity with fundamental concepts such as 'linearity', 'time-invariance', 'impulse response', 'convolution', 'frequency response', 'z-transforms' and the 'discrete time Fourier transform', as applied to signal processing systems.
2. Understand the discrete Fourier transform (DFT), its applications and its implementation by FFT techniques.
3. Understand how FIR and IIR type digital filters: may be designed and implanted in software.
4. Specify the "real time" implementation of DSP operations using TMS320C5X DSP processors.

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART A**

1. **Introduction**
   Basic Elements of Digital Signal Processing Systems, Need and advantages of Digital Signal Processing; Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; Sampling Theorem, Practical sampling. (8 hours)

2. **Discrete Time System Analysis**
   Linear Time Invariant systems, Stability and Causality, Solution of Linear constant coefficient difference equations, Convolution, Correlation, Z-Transform and its
properties, Inverse Z transform, Solution of difference equation using Z-Transform (7 hours)

3. Frequency Domain Representation of Signals and Systems
Fourier series & Fourier Transform of Discrete time signals, Discrete Fourier Transform and its properties, Fast Fourier Transform, Decimation in time and Decimation in frequency algorithms. Frequency domain representation of discrete time systems. (8 hours)

PART B

4. Design of Digital Filters
Fundamentals of filter design, Design of FIR Filters: Window technique, Frequency sampling technique IIR Filters: Analog filter approximations - Butterworth, Chebyshev and Elliptic filter, Design of IIR Digital filters from analog filters, IIR Filter Design by Impulse Invariance & Bilinear transformation, Frequency transformation in analog and digital domain (12 hours)

5. Implementation of Discrete Time Systems
Block diagrams and signal flow graphs for FIR and IIR systems. Direct form, Cascade and Frequency Sampling Structures for FIR systems, Direct forms, Cascade and Parallel form realization of IIR systems, Finite Word Length Effects. (5 hours)

6. DSP Processors
Introduction to DSP architecture - Harvard architecture, TMS320C5X Architecture, Instruction set, Memory and Addressing Modes. (5 hours)

Text books recommended

Other books:
1. “Digital Signal Processing” by E C Ifeacher and B W Jervis
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Digital Signal Processing Lab</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-758</td>
<td>Max Marks - 50</td>
</tr>
</tbody>
</table>

List of Experiments:

1. Introduction to MATLAB.
2. Effect of noise on signals in MATLAB.
4. Convolution of sequences in MATLAB.
5. Correlation of sequences in MATLAB.
7. System Response to Arbitrary Inputs.
8. DFT & IDFT of two sequences.
9. FFT of two Sequences.
10. Circular Convolution.
11. overlap-add method and overlap-save methods.
12. FIR Filter Design in MATLAB.
13. IIR Filter Design in MATLAB.
15. Implementation of digital filter banks.
Course Title          | Optical Communication   | Credits | 04
Course Code          | EE709 (a)               | L T P   | 3 1 0
Contact Hours         | 45                      | Max Marks-50 | Internal Assessment-50 | Elective | N

Pre-requisites

Course Objectives
1. To impart knowledge of types, basic laws, and transmission characteristics of optical fibers.
2. To study various types of losses and non-linear effects.
3. To study and compare various types of basic components of optical communication i.e. sources and detectors.
4. To learn about various multiplexing and multiple access techniques like TDM, CDMA, Statistical multiplexing, WDM and its components and optical networks.

Course Outcome
1. Ability to demonstrate an understanding of optical fibre propagation characteristics and transmission properties, using the principles and knowledge developed throughout the course.
2. Capacity to demonstrate an understanding of light sources including the principles of laser action in semiconductors, the characteristics of optical transmitters based on semiconductor and external modulation techniques, and the characteristics of optical amplifiers.
3. Ability to describe the principles of optical networks.
4. Ability to demonstrate an understanding of fibre devices and multiple wavelength division multiplexing techniques to the extent of the material presented.

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. Introduction
Evolution of fiber optic system, Element of an Optical Fiber, Elements of basic communication system, communication system architecture, advantages and need of optical communication.

(7 hours)
2. **Optical Fiber Wave Guides**
   Ray Theory of Transmission: Total Internal reflection, Acceptance Angle, Numerical Aperture, Electromagnetic mode theory for optical communication of both types of fibers viz step index fiber and graded index fibers, Fiber materials, fiber fabrication, fiber to fiber joints, fiber splicing, optical fiber connectors (7 hours)

3. **Signal Degradation in Optical Fibers**

**PART-B**

4. **Optical Sources and Detectors**
   Sources: Basic Concepts: emission & absorption, p-n junctions, non-radiative recombination, semiconductor materials. LED: power-current characteristics, internal quantum efficiency, LED spectrum, modulation Response, LED structures. LASER Diode: optical gain, feedback and Laser threshold, internal quantum efficiency and Laser characteristics. Detectors: Basic Concepts: Detector responsivity, rise time bandwidth, common photodetectors: p-n photodiodes, p-i-n photodiodes, avalanche photodiode, MSM photodetector. (9 hours)

5. **Light Wave System**
   Coherent, homodyne and heterodyne keying formats, BER in synchronous – and asynchronous – receivers, Multichannel, WDM, multiple access networks, DM components, TDM, Subcarrier and Code division multiplexing (6 hours)

6. **Principles of Optical Networks**
   First and second generation optical networks: system network evaluation. SONET /SDH, MAN layered architecture-broadcast and select networks-MAC protocols, test beds, wavelength routing networks (7 hours)

**Text books**

**Other recommended books**
2. Govind P. Agrawal, "Fiber optic communication systems” third edition, Wiley India.
List of Experiments:

1. To study the propagation loss and bending loss in optical fiber.
2. To set up a fiber optic analog link.
3. To set up a digital fiber optic link.
4. Study of intensity modulation technique using analog and digital input signal.
5. To study the frequency modulation and demonstrate voice transmission through optic fiber using FM.
6. Measurement of optical power and propagation loss using optical power meter.
7. To determine the bit rate supported by the fiber optic link.
8. To study the characteristics of PIN diode.
9. To demonstrate the concept of WDM system.
<table>
<thead>
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<th>Course Title</th>
<th>Wireless Communication</th>
<th>Credits</th>
<th>04</th>
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<tr>
<td>Course Code</td>
<td>EE-709(b)</td>
<td>L T P</td>
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<tr>
<td>Contact Hours</td>
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</tr>
<tr>
<td>Pre-requisites</td>
<td>Knowledge of Communication Engineering</td>
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</tbody>
</table>

**Course Objectives**

1. To become familiar with the existing and emerging wireless communication systems and standards.
2. To introduce the concept of frequency reuse and understand various methods for improving coverage and capacity in wireless communication systems.
3. To understand different modulation schemes, multiple access techniques and diversity techniques used in wireless communications.
4. To understand functions and operational principles of the various components of wireless networks.

**Course Outcome(s)**

1. Understand the fundamentals as well as the new research developments in the field of wireless communication.
2. Gain insights into how diversity afforded by radio propagation can be exploited to improve performance.
3. Gain knowledge and awareness of the technologies used in Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Global system for Mobile (GSM) and WiFi Networks.
4. Gain the experience of working in a group towards a final project that will involve experiments, analysis and the design of exemplary wireless communication techniques and/or systems.

**Note for Examiner** - Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART A**

1. **Introduction**
   Evolution of Mobile Communication Systems, Paging systems, cordless telephone systems, cellular telephone systems, comparison of common wireless communication systems, 2G cellular networks, 2.5 G wireless network, HSCSD, GPRS, EDGE technology, 3G wireless network, UMTS, 3G CDMA2000, 3G TD-SCDMA, 4G
networks, WiMAX standard, LTE standard, Wireless Local Loop, Blue tooth and Personal Area Networks (8 hours)

2. **Cellular System Design Fundamentals**
   Frequency reuse, Channel alignment strategies, handoff strategies, interference and system capacity, Near for problems, power control, improving coverage and capacity in cellular systems, parameters for mobile multipath channel, Small scale fading. (7 hours)

3. **Modulation Techniques**
   Wireless Modulation technique and hardware, Characteristics of air interface, Path loss models, wireless coding techniques, Digital modulation techniques and Spread Spectrum Modulation techniques (8 hours)

   **PART B**

4. **Diversity Techniques for Mobile Radio Systems**
   Dispersive channels, space diversity, frequency diversity, Polarization diversity, Hybrid and quadruple diversity, RAKE receiver, Equalizer techniques. Fundamentals of channel coding. (5 hours)

5. **Overview of Multiple Access Techniques**
   Simplex, Duplex TDD and Time Division Duplex, Time Division Multiple Access (TDMA), FDMA , Orthogonal Frequency Division Multiplexing(OFDM) and CDMA . (5 hours)

6. **Wireless Networking**
   Difference between wireless and fixed telephone networks, Development of wireless networks, Common Channel signaling, Broad band ISDN & ATM, Signaling System No.7(SS-7). (5 hours)

7. **Wireless Systems and Standards**
   Global system for Mobile (GSM); Services, Features, System Architecture and Channel Types, Frame Structure for GSM, CDMA Digital standard (IS 95); Frequency and Channel specifications, Forward CDMA Channel and Reverse CDMA channel, CT2 Standard for Cordless Telephones, Personal Access Communication System (7 hours)

**Text books**


**Other books:**

2. Wireless Communication and Networking By Jon W Mark, PHI, Edition Latest
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Wireless Communication Lab</th>
<th>Credits</th>
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<tr>
<td>Course Code</td>
<td>EE- 757</td>
<td>Max Marks - 50</td>
<td>P 03</td>
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</table>

**List of Experiments**

1. To study the block diagram of mobile phone trainer kit.
2. To study and measure charging phenomena in mobile phone trainer kit.
3. To study and analyze vibrator in mobile phone trainer kit.
4. To study and analyze buzzer in mobile phone trainer kit.
5. To study the SIM card detection in mobile trainer kit
6. To study GSM trainer kit.
7. To study and perform AT commands in GSM trainer kit.
8. To prepare a project based on wireless communication
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Alternate Energy Sources and Energy Conservation</th>
<th>Credits</th>
<th>04</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>EE-709(c)</td>
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<td>L T P</td>
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<tr>
<td>Contact Hours</td>
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<tr>
<td>Elective</td>
<td>N</td>
<td></td>
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<tr>
<td>Pre-requisites</td>
<td>Knowledge of Power Plant Engineering</td>
<td></td>
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</tbody>
</table>
| Course Objectives    | 1. Recognize the place and importance of renewable energy and alternative fuels in the energy landscape.  
|                      | 2. Understand the technological basics of primary renewable electricity sources. |
| Course Outcome(s)    | 1. Calculate solar energy design parameters.  
|                      | 2. Select appropriate energy storage device.  
|                      | 3. Perform an economic analysis on energy projects.  
|                      | 4. Perform energy auditing and provide recommendations for energy savings |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART A**

**Basics**: Energy Demand and Supply, Environmental effects of energy use – necessity for alternative energy sources.

**Solar Energy**:  
I-V, P-V curves, electrical load matching, sun tracking, PV system component and peak power point operation. Processing and manufacturing of photovoltaic  
Design, sizing and sub-systems of PV system.

**Energy Storage**: Battery, performance characteristics, battery charging, charge regulators and battery management.

**Electrical Performance**: Harmonic, distortion, voltage sags, and national standards.

**Hybrid Systems**: Design of hybrid photovoltaic-wind-battery systems, Modelling of Hybrid
photovoltaic /thermal systems. Smart grid and PV systems, Urban and rural applications of solar energy.

PART-B

**Biomass/Bio-fuels:**

Biomass & Bio-fuels- Overview, Biogas - anaerobic digesters, dedicated bio-energy crops, Woody biomass, Bio-energy from wastes, Liquid bio-fuels

Ethanol - issues & future prospects. Biodiesel - uses, production, processes

**Fuel cells**

Transportation - fuel cells, Modelling and design.

**Energy Conservation and Auditing**

Energy auditing procedures and energy conservation retrofitting.

**Economics of Energy Projects:**

Evaluation of project cost, pay back analysis, optimization.

**Project Work:**

Students will work on different problems from industries and come up with some practical solutions.

**Recommended Books:**

BACHELOR OF ENGINEERING (ELECTRICAL & ELECTRONICS)  
VIII SEMESTER  

A student can exercise option I and Option II according to the following:

**Option-I**

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>Schedule Of Teaching</th>
<th>Scheme of Examination</th>
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<tr>
<td>EE-801</td>
<td>Non – Conventional Energy Sources</td>
<td>3</td>
<td>1</td>
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<tr>
<td>EE-807</td>
<td>Embedded System Design</td>
<td>3</td>
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<td>EE-857</td>
<td>Embedded System Design (Lab)</td>
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<tr>
<td>EE-808</td>
<td>Elective –II</td>
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<td>1</td>
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<tr>
<td>EE-805</td>
<td>Major Project</td>
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<td><strong>Total</strong></td>
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</table>

**Elective-II**

a) *Electrical Machine Design*
b) *High Voltage AC-DC*
c) *Advance Control Systems*
d) *Data Acquisition and Hardware Interfacing*

**Option II: Industrial Training**  
EE-850  
Total Marks-450

A student may opt for one semester training in lieu of subjects of 8th Semester. The marks for six months training will be equal to the total marks of 8th Semester study. A student can opt for six semester training under following conditions:-

c) The student got selected for job in campus placement and the employer is willing to take that student for the training.
d) The student got offer of pursuing training from reputed government research organization/govt. sponsored projects/govt. research institution provided that student should not be paying any money to get trained. For pursuing this training student needs the prior approval from the Chairperson/Coordinator of the respective branch.
Course Title | Non-Conventional Energy Sources | Credits | 04
---|---|---|---
Course Code | EE-801 | L T P | 3 1 0
Contact Hours | 45 | Elective | N
Pre-requisites | Power Plant Engineering and Energy Management and Auditing

Course Objectives
1. To understand the limitation of conventional energy sources, need and growth of alternative energy source.
2. To understand the thermoelectric generators, MHD generator, their applications and economic aspects.
3. To understand photovoltaic cells, fuel cells, their characteristics, solar batteries, solar collectors, solar furnaces and their applications.
4. To understand geothermal, hydro, wind and tidal energy resources

Course Outcome(s)
1. Students will understand about limitation of conventional energy sources, need and growth of alternative energy source, basic scheme and application of direct energy conservation.
2. Students will demonstrate an understanding of Basic principle of MHD generator, thermoelectric generators, their types, applications and economic aspects.
3. Students will be able to demonstrate photovoltaic effect, different types of photovoltaic cells, characteristics of photovoltaic cells, solar batteries, solar collectors, solar furnaces and their applications.
4. Students will understand about fuel cells, their types, characteristics and application.
5. Students will be able to demonstrate geothermal system, their characteristics, hydro-plants, wind energy and tidal energy.

Note for Examiner- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. Introduction
Limitation of conventional energy sources, need and growth of alternative energy source, basic scheme and application of direct energy conservation.

(4 hours)

2. MHD Generators
Basic principles, gaseous, conduction and hall effect, generator and motor effect, different types of MHD generator, types of MHD material, conversion effectiveness, analysis of
constant area MHD generator, practical MHD generator, application and economic aspects.

(8 hours)

3. **Thermo-Electric Generators**
   Thermoelectric effects, Seeback effect, Peltier effect, Thomson effect, thermoelectric converters, figures of merit, properties of thermoelectric material, brief description of the construction of thermoelectric generators, application and economic aspect.

(8 hours)

4. **Photo Voltaic Effect And Solar Energy**
   Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency, solar batteries, application, solar radiation analysis, solar energy in India, solar collectors, solar furnaces and applications.

(8 hours)

PART-B

5. **Fuel Cells**
   Principle of action, Gibb's free energy, general description of fuel cells, types, construction, operational characteristics and application.

(6 hours)

6. **Miscellaneous Sources**
   Geothermal system, characteristic of geothermal resources, choice of generator set, electric equipment precautions low hydro-plants, definition of low head hydrometer, choice of site, choice of turbine wind power, history of wind power, wind machines, theory of wind power, characteristic of suitable wind power site, tidal energy, idea of tidal energy, tidal electric generator.

(10 hours)

**RECOMMENDED BOOKS**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Embedded Systems</th>
<th>Credits</th>
<th>04</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>EE-807</td>
<td>L T P</td>
<td>3 1 0</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>45</td>
<td>Max Marks-50</td>
<td>Internal Assessment-50</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Introduction to Micro controllers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Course Objectives    | 1. To impart knowledge on embedded hardware and software.  
2. To learn about architecture, programming, application and interfacing of Cortex-M0 ARM processor.  
3. To study various types of software architectures and tools used in embedded system.  
4. To learn about RTOS, operating system and MCU peripheral services. | |
| Course Outcome(s)    | 1. Understand the fundamentals of embedded hardware and software  
2. Understand the fundamentals and programming of Cortex-M0 ARM processor which is a latest ARM® embedded processor with 32-bit performance.  
3. Gain the knowledge of designing RTOS such as RTOS using Keil RTX, Free RTOS,MC/OS-II.  
4. Gain the experience of working in a group towards a final project that will involve the use of Cortex-M0 (NU-LB-NUC140) learning board. | |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART A**

1. **Introduction to Embedded Hardware and Software**
   (8 hours)

2. **Cortex-M0 MCU Architecture and Programming**
   Cortex-M0 MCU (NUC140): Architecture ,Instruction Set, Thumb Instruction Set, Interrupt handling mechanism , Instruction cycle timings , Development tools and ‘C’compiler programming.
   (8 hours)
3. **Cortex-M0 MCU (NU-LB-NUC140) Application and Interfacing**
   GPIO, A/D converter, LCD Interfacing, SD card interface, keypad matrix USB and CAN 2.0
   (7 hours)

**PART B**

4. **Software Development and Tools**
   (8 hours)

5. **Introduction to Real Time Operating Systems**
   Task And Task States, Tasks and Data, Semaphores and shared data, Interrupt Routines in an RTOS Environment, Basic Design Using RTOS, RTOS using Keil RTX, Free RTOS, MC/OS-II
   (8 hours)

6. **Operating System and MCU Peripheral Services**
   Message queues, Mailboxes and Pipes, Timer Function, Events, Memory Management and peripheral services
   (6 hours)

Text books:


Other books:

3. Ramani Kalpathi : ARM Based system design, Sigma Publication, Chennai, 2013
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Embedded Systems Lab</th>
<th>Credits</th>
<th>01</th>
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</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-857</td>
<td>Max Marks-50</td>
<td>P</td>
</tr>
</tbody>
</table>

**List of Experiments**

1. Introduction to Cortex-M0 (NU-LB-NUC140) learning board.
2. To learn about embedded C programming using Keil µvision4.
3. LED interface using NU-LB-NUC140 learning board.
4. LCD interface using NU-LB-NUC140 learning board.
7. SD card interface using NU-LB-NUC140 learning board.
10. CAN 2.0 using NU-LB-NUC140 learning board.
Course Title  | Electrical Machine Design  | Credits  | 04
---|---|---|---
Course Code  | EE-808 (a)  | L T P  | 3 1 0
Contact Hours  | 45  | Max Marks-50  | Internal Assessment-50  | Elective  | Y
Pre-requisites  | Basic of transformer, Alternator and Induction motors.
Course Objectives  | 1. To understand the role of machine design for engineers.
2. To understand the steps of a transformer design.
3. To understand the steps of an induction motor.
4. To understand the steps of an alternator design.
Course Outcome(s)  | 1. Student will be able to design a transformer, induction motor and alternator while selecting its material and its various components for a given size.
2. Students can design transformer, alternator and induction motor for projects/real time applications.

Note for Examiner: Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. **Principles of design of Machines**
   
   Specific magnetic and electric loadings output, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines.

   (8hours)

2. **Heating cooling and ventilation**
   
   Cooling of machines, types of ventilation, continuous and intermittent rating.

   (4hours)

3. **Design of Transformers**
   
   General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, calculation of losses, efficiency and regulation, forces winding during short circuit.

   (10hours)
PART-B

4. **Three Phase Induction Motors**: General considerations, output equation, choice of specific electric and magnetic loadings, efficiency, power factor, number of slots in stator and rotor, elimination of harmonic torques, Design of stator and rotor winding, slot leakage flux, leakage reactance, equivalent resistance of squirrel cage rotor, magnetizing current, efficiency from design data.  

   (12 hours)

5. **Alternators**
   Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions.  

   (8hours)

6. **Introduction to Computer Aided Electrical Machine Design.**  

   (3hours)

**Books Suggested:**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>High Voltage AC-DC</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-808(b)</td>
<td>L T P</td>
<td>3 1 0</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>45</td>
<td>Max Marks-50</td>
<td>Internal Assessment-50</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Basics of Power Systems, Power Electronics and Basic Electronics</td>
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</tbody>
</table>
| Course Objectives  | 1. To introduce the need and concepts of HVDC.  
2. To understand the selection of various components in HVDC system.  
3. To understand the concept of generation of impulse voltage.  
4. To understand the HVDC measurement and testing. |         |    |
| Course Outcome(s)  | 1. Students can understand importance of HVDC and its components.  
2. Students can design circuits for impulse generation.  
3. Students can understand the testing of generated voltage. |         |    |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Introduction**
   Introduction of DC Power transmission technology – Comparison of AC and DC transmission-Application of DC transmission – Description of DC transmission system–Planning for HVDC transmission – Modern trends in DC transmission.  
   (7hours )

2. **Analysis of HVDC Converters**
   (10 hours)

3. **Harmonics And Filters**
   Sources of harmonics in HVDC systems – Smoothing reactors – Corona and radio interference effects – harmonic distortion factor, types of AC filters, DC filters.  
   (6hours)
PART-B

4. **Generation of Impulse Voltage And Current**
   Introduction to standard lightning and switching impulse voltages, analysis of single stage impulse generator, expression for output impulse voltage, multistage impulse generator, components of multistage impulse generator, generation of switching impulse voltage, generation of high impulse current. (8hours)

5. **Measurement Of High Voltages**
   Chubb for HVAC measurement. Standard sphere gap measurements of HVAC, HVDC and impulse voltages, Factors affecting the measurements, Surge current measurement, Klydanograph and magnetic links. (6hours)

6. **Non-Destructive Insulation Testing Techniques**
   Dielectric loss and loss angle measurements using Schering Bridge, transformer ratio Arms Bridge, need for discharge detection, factor affecting the discharge detection, discharge detection methods-straight and balanced methods. (8 hours)

**Text books recommended:**


**Other books:**

**Course Title** | **Advanced Control Systems** | **Credits** | **04**
---|---|---|---
**Course Code** | **EE-808(c)** | **L T P** | **3 1 0**
**Contact Hours** | **45** | **Max Marks-50** | **Internal Assessment-50** | **Elective** | **Y**
**Pre-requisites** | **Knowledge of Control Engineering**
**Course Objectives** | 1. To understand the introductory concepts of digital control systems and their illustrative examples.
2. To understand the state space techniques of control systems.
3. To study the concepts of robust control systems.
**Course Outcome (s)** | 1. Learn about the basic concepts of digital and robust control systems.
2. Learn about the various state space techniques.

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Review of Control Engineering**
   Time response and Frequency response methods, Root locus method; Compensation Techniques and Controllers: Design of feedback control system; Types of compensation: Series or cascade, feedback, state feedback, series feedback; Lead compensator; Lag compensator; Lag-lead compensator, Controllers: PI, PD, PID.
   
   (12 hours)

2. **State Space Techniques**
   Review of state space representation of systems by various methods. Solution of state equations-state transition matrix. Transfer function from state variable model; Controllability & observability of state variable model; optimal control systems; pole placement using state variable; limitations of state variable feedback.
   
   (10 hours)
PART-B

3. Digital Control Systems
   Introduction to sampled data control systems: Sampler and hold circuit; z-transform;
   Pulse transfer function; Stability analysis of discrete systems.
   (10 hours)

4. Robust Control Systems
   Robust control systems and system sensitivity analysis of robustness; Systems with
   uncertain parameters; Design of Robust control systems; Three term PID controller.
   (13 hours)

Recommended books:

1. Automatic Control Systems by B.C.Kuo, Prentice Hall of India
2. Modern Control Engineering by Ogatta, Prentice Hall of India.
3. Control Engineering: theory and Practice by M.N. Bandyopadhyay, Prentice Hall of
   India.
4. Modern Control Systems by Dorf and Bishop, Addison Wesley.
Course Title | Data Acquisition and Hardware Interfacing | Credits | 04  
---|---|---|---  
Course Code | EE-808(d) | L T P | 3 1 0  
Contact Hours | 45 | Max Marks-50 | Internal Assessment-50  
Pre-requisites | Elective | Y  
Course Objectives | To introduce various data acquisition systems and techniques and their application using different hardware interfacing mechanisms.  
Course Outcome(s) | 1. To understand the principles of operation and limitations of the data acquisition system (single and Multiple channels).  
2. To use Labview for analysing and generating reports of various acquired signals.  
3. To use different interface mechanism of devices for communication.  

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.  

**PART-A**  
Signal conditioning and data acquisition: Analog-to-digital and digital-to-analog converters; sampling rate, multiplexing, resolution, range, and code width; grounding, isolation and noise; single-ended and differential measurements; attenuation, amplification, and filtering; excitation and linearization; impedance mismatch and loading; digital signal conditioning; signal transmission (voltage vs. current loop); and hardware architecture of a modern multi-function data acquisition card. Various DAS Configurations, Single Channel DAS, Multi-Channel DAS, IC Based DAS, Data Acquisition, Data Acquisition in PLC  

Fundamentals of programming logic: Lab View: Virtual instruments; indicators and controls; front panel and block diagram; data types and data flow programming; case and sequence structures; arrays, loops, and clusters; graphs and charts; sub VIs; and file I/O.
Part-B

Instrument control: Components of an instrument control system (GPIB and RS-232); detecting and configuring instruments; and instrument drivers.

Instrumentation system design: Design specifications; functional block representation; design, debugging, and testing; interpretation and presentation of data; user interface; temperature control system design; motor speed control system design; and instrumentation project incorporating multiple sensors, signal interfacing electronics, data-acquisition hardware, instrument control


Project Work: Using Labview: Generation of signal (different function generators) on PC and acquiring the signal from sensor at PC again with different sampling rate and quantization level. Representations of different characteristics of acquired signals and their analysis and reporting.

Recommended Books:

6. Data acquisition technique using personal computers by Howard Austurlitz.