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**GYAN VIHAR SCHOOL OF ENGINEERING & TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**CURRICULUM FOR ACADEMIC SESSION 2018 - 2019 FOR THE FOLLOWING PROGRAMME**

1. B.Tech I year ( Common to all branches of Engineering)
2. B.Tech Electrical Engineering
3. M.Tech Power System
4. Dual Degree (B.Tech Electrical Engineering + M.Tech Energy Engineering)
5. Diploma in Electrical Engineering

|  |  |  |
| --- | --- | --- |
| S. No | Programs | Remarks |
| 1 | B.Tech I Year (Common to all branches of Engineering) | I Sem to II Sem |
| 2 | B.Tech Electrical Engineering | III Sem to VIII Sem |
| 3 | M.Tech Power System | I Sem to IV Sem |
| 4 | Dual Degree (B.Tech Electrical Engineering + M.Tech Energy Engineering)\* | III Sem to VIII Sem |
| 5 | Diploma Electrical Engineering | I Sem to VI Sem |

**\*Note: M.Tech Energy Engineering Courses to be conducted by RSES Department. The syllabi are not included here.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**HIGH LIGHTS OF THE SYLLABI**

**A. COURSE NUMBER CODING SCHEME**

Coding for all the papers has been done so as to make syllabi more systematic and easy to locate.

**1.** A course is identified by a course code designated by a string of six alphanumeric characters and a course title.

**2.** In a course code, first letter indicates the type of course whether CORE or ELECTIVE, next two letters of the string indicate the Department/School offering the course and the later three numerals designate a particular course number. The letters symbolizing various Academic Department offering a course are:

**CY Chemistry**

**EN English**

**HS Humanities and Social Sciences**

**MA Mathematics**

**PY Physics**

**CA Computer Application**

**CE Civil Engineering**

**CP Computer Engineering**

**EC Electronics and Communication Engineering**

**EE Electrical Engineering**

**IT Information Technology**

**ME Mechanical Engineering**

**BM Business Management**

**HM Hotel Management**

**PH Pharmacy**

**SC Sciences**

**3. Course number**

**a.** First Numerical digit denotes the level of the course that corresponds to the Year of Study.

**b.** Next two Numerical digits denote the number of the course, which will usually be odd for courses offered in the Odd Semester and even for

courses offered in the Even Semester.

**c.** Lower levels corresponds the UG courses, while higher level the PG courses. Suggested levels will be as follows:

|  |  |  |
| --- | --- | --- |
| **All UG Programmes** | **All PG programmes** | **PG Diploma** |
| Level 1 to 4 | Level 5 to 7 | Level 8, 9 |

**EXAMPLES:**

|  |  |
| --- | --- |
| **UG Programmes** | **PG programmes** |
| For e.g. EE 203  EE denotes Electrical Engineering  2 denoted second Year  03 represent Course | For e.g. EE 503  EE denotes Electrical Engineering  5 denoted Fifth Year of PG Programme  03 represent Course |

**B. CREDIT SYSTEM**

Each academic year consists of two semesters and a summer term. The education system is organized around a credit system, which ensures continuous evaluation of the student's performance and provides at an optimum pace suited to one's ability or of credits depending upon the class contact hours. A minimum number of credits are to be completed in order to qualify for the award of degree. A minimum level of performance is necessary for satisfactory progress. SGVU has revised its curriculum with effect from the academic session 2017 - 2018. The revised curriculum emphasizes on self-learning, project activity and laboratory work. It leaves sufficient time for the student to take part in other activities like sport and recreation as well as to think and to be creative and innovative.

Each course, except for a few special courses, has a certain number of credits assigned to it depending on its lecture, tutorial and laboratory work contact hours in a week. Each course is coordinated by a member of the faculty called the course coordinator. He/she has the full responsibility for coordinating the course, faculty involved in the course, holding tests and awarding grades. In case of any difficulty, students are expected to approach the course coordinator for advice and clarification.

A letter grade with a specified number of grade points is awarded in each course for which a student is registered. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average maintained by him/her. A minimum grade point average is necessary in order to qualify for the degree.

A total of minimum 180 credit points are necessary for the student enrolled to get B.Tech degree out of total 220 teaching credits offered overall in various courses.

**C. COURSE OUTLOOK:**

The course of B.Tech in Electrical Engineering is of 4 years. These 4 years are divided in 8 semesters, each of 6 months. After every semester an examination is conducted so that the teachers as well as students get to know their strengths and weakness and work on their weak points to have an overall development. Subjects are divided into two main categories- CORE and ELECTIVES, which are further classified as PROGRAM and UNIVERSITY.

**ELIGIBILITY**

Eligibility for Admission 10+2 with 70 % and AIEEE/RPET score Credit system based syllabi

**OBJECTIVES OF THE SYLLABI**

• To advance, evolve and enhance Electrical Engineering fundamentals

• To build the interest in students for research

• To guide students in the development of power system

* To create the ability in students for better hardware production

• Choice-based credit system

* To make the students up-to-date with the latest industrial advancements

**SIGNIFICANCE AND CARRER OPTIONS OF B. TECH. (Electrical Engineering)**

Electrical Engineering is one of the fastest growing branches of studies which are being carried out all over India. It is one of the most developing and in demand trades of engineering. B.Tech in Electrical Engineering includes study of various aspects of Electrical Engineering to meet the requirements of the various industries. The course contains study of the basic Electrical and its application, as well as the detailed study of the various aspects of its working.

Today Computers have not only assumed strategic importance in the corporate world, they are also being effectively used in almost every field of human endeavour, ranging from space exploration to food processing and banking to communication, power system etc. B.Tech (Electrical Engineering), a study of the theoretical foundations of information and computation, offers a foundation which permits the students to adapt new technologies and ideas. This branch of engineering has many sub-fields for e.g. Transmission and distribution, Network theory, Power system, Machines, Control Theory and much more. After doing B.Tech (Electrical Engineering) from the SGVU, an individual can find a good job in any renowned Electrical Engineering organization. He can work in various areas/companies such as given below.

**Career Options in B.Tech (Electrical Engineering):**

* Power Engineer
* Power Grid
* DRDO
* ISRO
* BEL
* BSNL
* NTPC
* HAL
* GAIL
* SAIL
* BHEL
* Railway
* Telecommunication
* Networking Engineer
* Software Developer
* SEB
* Consumer Electrical Company, etc. …………

**Program Outcomes**

On completion of the courses offered by the Department of Electrical Engineering, the following outcomes are expected.

1. Ability to apply knowledge of mathematics, science and engineering for the solution of electrical engineering problems.
2. Ability to formulate and analyse complex electrical engineering problems.
3. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, and public health.
4. Ability to design and conduct experiments, and to analyse and interpret data.
5. Ability to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.
6. Ability to include social, cultural, ethical issues with engineering solutions.
7. Ability to consider the impact of engineering solutions on environment and the need for sustainable development.
8. Ability to function effectively on multidisciplinary teams.
9. Ability to communicate effectively.
10. Knowledge and understanding of principles of management and finance in relation to engineering projects.
11. Appreciation of technological change and the need for independent lifelong learning.



**SUMMARY OF SYLLABUS UPDATION FOR 2018-19**

1. **LIST OF PROGRAMS WHO’s SYLLABUS HAVE BEEN SUBMITTED**
   1. B.Tech Electrical Engineering
   2. M.Tech Power Systems
   3. DD (B.Tech EE + M.Tech Enegy)
2. **CREDIT DISTRIBUTION**

The credit distribution for each program in the four categories of University Core, Program Core, University Elective and Program Elective are given as follows:

***Summary of Semester-wise Credit Distribution for B.Tech Electrical Engineering Program (Except PCA & Employability Skills)***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Semester** | **University Core** | **Program Core** | **Program Elective** | **University Elective** | **Total credits** |
| **I** | **Autumn** | 22 | 06 | 00 | 02 | 28 |
| **Spring** | 20 | 09 | 00 | 02 | 29 |
| **II** | **Autumn** | 07 | 15 | 04 | 01 | 26 |
| **Spring** | 05 | 17 | 04 | 01 | 26 |
| **III** | **Autumn** | 02 | 20 | 03 | 01 | 25 |
| **Spring** | 00 | 19 | 03 | 01 | 24 |
| **IV** | **Autumn** | 03 | 18 | 03 | 01 | 24 |
| **Spring** | 00 | 20 | 03 | 01 | 23 |
| **Program Total** | | | | | | **203** |

***Summary of Semester-wise Credit Distribution for M.Tech Power Systems Program***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Semester** | **University Core** | **Program Core** | **Program Elective** | **University Elective** | **Total credits** |
| **I** | **Autumn** | 10 | 10 | 03 | 01 | 23 |
| **Spring** | 06 | 13 | 03 | 01 | 22 |
| **II** | **Autumn** | 02 | 14 | 03 | 01 | 19 |
| **Spring** | 18 | 00 | 00 | 01 | 18 |
| **Program Total** | | | | | | **82** |

1. **No. of Total Courses Being offered (Semester wise):**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No.** | **Semester** | **Number of Courses** | **Credits** |
|  | B.Tech. III | 13 | 29 |
|  | B.Tech. IV | 13 | 29 |
|  | B.Tech. V | 13 | 28 |
|  | B.Tech. VI | 12 | 25 |
|  | B.Tech. VII | 10 | 24 |
|  | B.Tech. VIII | 8 | 20 |
|  | M.Tech. I | 10 | 22 |
|  | M.Tech. II | 9 | 21 |
|  | M.Tech. III | 6 | 19 |
|  | M.Tech. IV | 1 | 18 |

1. **No. & List of Courses whose syllabus has been updated partially or completely:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No.** | **Semester** | **Course Code** | **Name of Course** | **Updation Percentage** | **Reason for Change** |
| 1. | B.Tech III | EE 209 | Electrical Measurements and Instrumentation | 20% | Feedback from Industry |
| 2. | B.Tech III | EE 213 | Circuit Analysis-I | 20% | Feedback from Industry |

1. **No. and list of New Courses Being Introduced in 2017-18:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Semester** | **Course Code (Tentative)** | **Name of Course** | **Reason for Change** |
| 1. | M.Tech. III | EE 611 | Solar Radiation & Energy Conversion | Industry Person feedback |
| 2. | M.Tech. II | EE 512 | Smart Grid: Design & Applications | Industry Person feedback |
| 3. | B.Tech VI | EE 316 | Smart Grid Technologies | Feedback from Academician |
| 4. | B.Tech VI | EE 336 | Electrical & Hybrid Vehicle | Industry Person feedback |
| 5. | B.Tech VII | EE 417 | Industrial Electrical Systems | Industry Person feedback |
| 6. | B.Tech VIII | EE 422 | Energy Conservation & Auditing | Industry Person feedback |
| 7. | M.Tech I | FD 102 | Foundation Course | University Core |
| 8. | M.Tech II | FD 104 | Foundation Course | University Core |
| 9. | B.Tech VI |  | Disaster Management | Open Elective |
| 10. | B.Tech III |  | Swatch Bharat Abhiyan | Open Elective |
| 11. | B.Tech V |  | Consumer Affairs | Open Elective |
| 12. | B.Tech VII |  | Innovation & Entrepreneurship | Open Elective |

1. **No. and list of Courses Removed from Existing Scheme (Shifted from Program Core to University Elective)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Semester** | **Course Code** | **Name of Course** | **Reason for Change** |
| 1. | V | EECP (T) | Basic PLC | Technical support was not provided by BOSCH as per MOU. |
| 2. | V | EECP (L) | Basic PLC Lab |
| 3. | VI | EECAP (T) | Advanced PLC & Basics of SCADA |
| 4. | VI | EECAP (L) | Advanced PLC Lab |

1. **List of Alumni, Industry and Academic Institution, whose Feedback has been taken**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No.** | **Name of Industry** | **Details of Alumni/Industry Person** | **Remark/Suggestions** |
| 1. | Anchor Electricals Pvt. Ltd., Haridwar | Mr. Chhatrpal (Manager) 8791090390 | Addition of subject “Smart Grid Technologies” |
| 2. | J.En, Jawahar Nagar | Mr. Kamal Ved | Renewable Energy Sources & Smart Grid |
| 3. | J.En. STPS, Suratgarh | Ms. Nivedita B. Das | Energy Conservation & Auditing |
| 4. | Tech. Director, Doordarshan, Jaipur | Mr. U. N. Gupta | Industrial Electrical Systems |
| 5. | Deputy General Manager, Hitachi, ND | Mr. Mahesh Katare | Addition of New unit in CA-I |
| 6. | A.En, GENCO | Mr. Prahlad Kumar Sharma | Electrical & Hybrid Vehicle |

1. **Any other Major or Minor Information or Updation:**

|  |
| --- |
| * EE 314 Renewable Energy Sources (B.Tech VI Semester/Spring) has been added in Program Core in place of Program Elective. |
| * EE 214 Electrical Machines has been added in list of courses offered. (Suggestions received from Mechanical Department). |
| * EE 264 Electrical Machines Lab has been added in list of courses offered. (Suggestions received from Mechanical Department). |
| * Construction of CTs & PTs, Steady state ratio & Phase angle errors in CTs & PTs have been removed from EE 312 Switchgear & Protection. |
| * Syllabus of EE 503 Advanced Power Electronics (M.Tech I Semester) has been updated & new subject code EE 505 is generated for the same course. |

1. **All approvals at the department level to be taken to the University BoS meeting.**

**Signature Signature**

**Convener-BoS Dean/Principal/HoD**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Teaching and Examination Scheme for B.Tech./Dual Degree I Year (Common to all Branches of Engineering)**

**EFFECTIVE FROM ACADEMIC SESSION 2018-19**

**Year: I Semester: Autumn**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
|  | **MA 101** | Mathematics – I | 4 | 3 | 1 | 0 | 3 | 40 | 60 |
|  | EN 105 | Professional Communication I | 2 | 2 | 0 | 0 | 3 | 40 | 60 |
|  | CP-103 | Fundamentals of Computers & IT | 3 | 3 | 0 | 0 | 3 | 40 | 60 |
|  | CY 101 / PY 101 | Engineering Chemistry / Engineering Physics | 3 | 3 | 0 | 0 | 3 | 40 | 60 |
|  | FD 102 | Foundation Course-1 | 1.5 | 3 |  |  |  | 25 | 75 |
|  | FD 104 | Foundation Course-2 | 1.5 |  |  |  | 25 | 75 |
|  | ES 101 | Environmental Studies | 2 | 2 | 0 | 0 | 3 | 40 | 60 |
|  | HS 101 | Human Ethics & Value | 1 | 0 | 2 | 0 | - | - | 100 |
|  | **EN 151** | English Communication Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
|  | **CY 151/ ME 153** | Engineering Chemistry lab **/** Workshop Practice | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
|  | PC 101 | Proficiency in Co-curricular Activities | 2 | - | - | - | - | - | 100 |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
|  | EE 101/ ME 101 | Electrical & Electronics Engineering **/** Engineering Mechanics | 3 | 3 | 0 | 0 | 3 | 40 | 60 |
|  | **EE 151/ PY 151** | Electrical & Electronics Engineering Lab / Engineering Physics Lab | 2 | 0 | 0 | 3 | 3 | 60 | 40 |
|  | **ME 155** | Engineering Drawing Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
| **C** |  | **University Elective** |  |  |  |  |  |  |  |
|  |  | Remedial Mathematics | 0 | 0 | 0 | 0 | 0 | - | - |
|  |  | Remedial Physics | 0 | 0 | 0 | 0 | 0 | - | - |
|  |  | Foreign Language (German/French. Etc.) | 2 | 2 | 0 | 0 | 3 | 40 | 60 |
|  |  | History of Engineering & Science | 2 | 2 | 0 | 0 | 3 | 40 | 60 |
|  |  | **TOTAL (Credits of Core Courses)** | **28** | **20** | **3** | **9** |  |  |  |

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRONICS AND COMMMUNICATION ENGINEERING**

**Teaching and Examination Scheme for B.Tech./Dual Degree I Year (Common to all Branches of Engineering)**

**EFFECTIVE FROM ACADEMIC SESSION 2018-19**

**Year: I Semester: Spring**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in %)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
|  | MA 102 | Mathematics – II | 4 | 3 | 1 | 0 | 3 | 40 | 60 |
|  | EN 106 | Professional Communication-II | 2 | 2 | 0 | 0 | 3 | 40 | 60 |
|  | CP 104 | Computer Programming | 3 | 3 | 0 | 0 | 3 | 40 | 60 |
|  | PY 102 / CY 102 | Engineering Physics / Engineering Chemistry | 3 | 3 | 0 | 0 | 3 | 40 | 60 |
|  | FD 102 | Foundation Course-1 | 1.5 | 3 |  |  |  | 25 | 75 |
|  | FD 104 | Foundation Course-2 | 1.5 |  |  |  | 25 | 75 |
|  | **CP 152** | Computer Programming Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
|  | **ME 154 / CY 152** | Workshop Practice / Engineering Chemistry Lab | 1 | 0 | 0 | 2 | 2 | 60 | 40 |
|  | **EM 102** | Employability Skills–I | 1 | 0 | 2 | 0 | - | 60 | 40 |
|  | PC 102 | Proficiency in Co-curricular Activities | 2 | - | - | - | - | - | 100 |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
|  | ME 102/ EE 102 | Engineering Mechanics / Electrical & Electronics Engineering | 3 | 3 | 0 | 0 | 3 | 40 | 60 |
|  | **PY 152/ EE 152** | Engineering Physics Lab / Electrical & Electronics Engineering Lab | **2** | 0 | 0 | 3 | 3 | 60 | 40 |
|  | EC-102 | Basics of MATLAB | 3 | 3 | 0 | 0 | 3 | 40 | 60 |
|  | **ME-156** | AUTOCAD Lab | **1** | 0 | 0 | 2 | 2 | 60 | 40 |
| **C** |  | **University Elective** |  |  |  |  |  |  |  |
|  |  | Remedial Mathematics | 0 | 0 | 0 | 0 | 3 | - | - |
|  |  | Remedial Physics | 0 | 0 | 0 | 0 | 3 | - | - |
|  |  | Professional Ethics and Human Values | 2 | 2 | 0 | 0 | 3 | 40 | 60 |
|  |  | **TOTAL (Credits of Core Courses)** | **26** | **22** | **3** | **9** |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

Theory (18 Credit) + Lab (05 Credit) + Employability Skills (1 Credit) + Proficiency in Co-curricular Activities (2 Credit) = 26 Credit

**Note:** Remedial Courses are to be allotted on approval of Principal, Engineering for students who have not taken Prerequisites for Studying Engineering Mathematics/ Physics.

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for B.Tech./Dual Degree (Electrical Engineering 4 Year Course)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 - 2019**

**Year: II Semester: Autumn**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
| **1** | EM 201 | Employability Skills-II | 1 |  | 2 |  |  |  | 100 |
| **2** | PC 201 | Proficiency and Co-Curricular Activities-III | 2 |  |  |  |  | 100 |  |
| **3** | MA 201 | Integral Transforms and Complex Analysis | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **4** | HS 203 | Economics and Social Sciences | 3 | 3 |  |  | 3 | 40 | 60 |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| **1** | EE 213 | Circuit Analysis-I | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **2** | EE 209 | Electrical Measurements and Instrumentation | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EE 211 | Electrical Machines-I | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **4** | EE 255 | Electrical Engineering Drawing Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **5** | EE 259 | Electrical Machine Lab-I | 1 |  |  | 2 | 3 | 60 | 40 |
| **6** | EE 261 | Electrical Circuit Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **7** | EE 263 | Electrical Measurement Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **C** |  | **Program Elective (1 Subject & 1 Lab)** |  |  |  |  |  |  |  |
| **1** | EC 201 | Electronic Devices & Circuits | 3 | 3 |  |  | 3 | 40 | 60 |
| **2** | EC 221 | Basic Electronics | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EC 253 | Industry Oriented Electronics Devices & Circuits Project Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **D** |  | **University Elective** |  |  |  |  |  |  |  |
|  |  | Swatch Bharat Abhiyan | 2 |  |  |  |  |  |  |
|  |  | **TOTAL** | **31** | **18** | **5** | **10** |  |  |  |

**NOTE: The University Electives are apart from minimum credits required for award of degree.**

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for B.Tech./Dual Degree (Electrical Engineering 4 Year Course)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 – 2019**

**Year: II Semester: Spring**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
| **1** | MA 202 | Numerical Analysis and Statistics | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **2** | EM 202 | Employability Skills-III | 1 |  | 2 |  |  |  | 100 |
| **3** | PC 202 | Proficiency and Co-Curricular Activities-IV | 2 |  |  |  |  | 100 |  |
| **4** | CP 262 | Computer Programming Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| **1** | EE 206 | Generation of Electrical Power | 3 | 3 |  |  | 3 | 60 | 40 |
| **2** | EE 208 | Circuit Analysis-II | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **3** | EE 212 | Electrical Machines-II | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **4** | EE 258 | Power System Design Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **5** | EE 260 | Electrical Machine Lab-II | 1 |  |  | 2 | 3 | 60 | 40 |
| **6** | EC 204 | Digital Electronics | 3 | 3 |  |  | 3 | 40 | 60 |
| **7** | EC 254 | Digital Electronics Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **C** |  | **Program Elective (Any 1 Subject & 1 Lab)** |  |  |  |  |  |  |  |
| **1** | EC 202 | Analog Electronics | 3 | 3 |  |  | 3 | 40 | 60 |
| **2** | EC 212 | Advanced Electronics | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EC 252 | Industry Oriented Analog Electronics Project Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **D** |  | **University/Open Elective** | 1 |  |  |  |  |  |  |
|  |  | Opt from the list of University Electives |  |  |  |  |  |  |  |
|  |  | **Total** | **29** | **18** | **5** | **10** |  |  |  |

**NOTE: The University Electives are apart from minimum credits required for award of degree.**

***Industrial training for 45 days after 4th Semester Exams is compulsory.***

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for B.Tech./Dual Degree (Electrical Engineering 4 Year Course)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 – 2019**

**Year: III Semester: Autumn**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
| **1** | EM 301 | Employability Skills-IV | 1 |  | 2 |  |  |  | 100 |
| **2** | PC 301 | Proficiency and Co-Curricular Activities-V | 2 |  |  |  |  | 100 |  |
| **3** | PE 303 | Project Stage-I | 2 |  |  | 2+2 | 3 | 60 | 40 |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| **1** | EE 301 | Power Electronics | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **2** | EE 307 | Control Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EE 305 | Transmission and Distribution of Electrical Power | 3 | 3 |  |  | 3 | 40 | 60 |
| **4** | EE 311 | Power System Instrumentation | 3 | 3 |  |  | 3 | 40 | 60 |
| **5** | EE 353 | SCI Lab/MATLAB for Engineers | 1 |  |  | 2 | 3 | 60 | 40 |
| **6** | EE 357 | Power Electronics Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **7** | EC 309 | Microprocessor | 3 | 3 |  |  | 3 | 40 | 60 |
| **8** | EC 355 | Microprocessor Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **9** | PT 301 | Summer Practical Training Seminar-I | 1 |  |  | 2 | 3 | 60 | 40 |
| **C** |  | **Program Elective (any one)** |  |  |  |  |  |  |  |
| **1** | MA305 | Operation Research | 3 | 3 |  |  | 3 | 40 | 60 |
| **2** | EC 317 | Principle of Communication Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EC 325 | Embedded Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| **D** |  | **University/Open Elective** | 1 |  |  |  |  |  |  |
|  |  | Consumer Affairs |  |  |  |  |  |  |  |
|  |  | **Total** | **32** | **21** | **3** | **14** |  |  |  |

**NOTE: The University Electives are apart from minimum credits required for award of degree.**

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for B.Tech./Dual Degree (Electrical Engineering 4 Year Course)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 - 2019**

**Year : III Semester: Spring**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University core** |  |  |  |  |  |  |  |
| **1** | HS 302 | Employability skills IV – Technical Writing | 1 |  | 2 |  |  |  | 100 |
| **2** | PC 302 | Proficiency and Co-Curricular Activities-VI | 2 |  |  |  |  | 100 |  |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| **1** | EE 310 | Advanced Control Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| **2** | EE 304 | Modern Power Electronics | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EE 312 | Switchgear & Protection | 3 | 3 |  |  | 3 | 40 | 60 |
| **4** | EE 354 | Modern Power Electronics Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **5** | EE 358 | Control System Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **6** | EE 360 | Solar Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **7** | CP 320 | Data Structures in C | 3 | 3 |  |  | 3 | 40 | 60 |
| **8** | CP 358 | Data Structures lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **9** | EE 314 | Renewable Energy Sources | 3 | 3 |  |  | 3 | 40 | 60 |
| **C** |  | **Program elective (any one)** |  |  |  |  |  |  |  |
| **1** | EE 316 | Smart Grid Technology | 3 | 3 |  |  | 3 | 40 | 60 |
| **2** | EE 336 | Electrical Vehicle Technology | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EC 316 | Fundamentals of Digital Communication | 3 | 3 |  |  | 3 | 40 | 60 |
| **4** | EC 314 | Microprocessor and Computer Architecture II | 3 | 3 |  |  | 3 | 40 | 60 |
| **D** |  | **University/Open elective** |  |  |  |  |  |  |  |
|  |  | Disaster Management | 2 |  |  |  |  |  |  |
|  |  | Opt from the list of University Electives |  |  |  |  |  |  |  |
|  |  | **Total** | **27** | **16** | **2** | **11** |  |  |  |

**NOTE: The University Electives are apart from minimum credits required for award of degree.**

***Industrial training for 45 days after 6th Semester Exams is compulsory.***

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for B.Tech./Dual Degree (Electrical Engineering 4 Year Course)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 – 2019**

**Year : IV Semester: Autumn**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
| **1** | EM 401 | Employability Skills- VI | 1 |  | 2 |  |  |  | 100 |
| **2** | PC 401 | Proficiency and Co-Curricular Activities-VII | 2 |  |  |  |  |  | 100 |
| **3** | IT 457 | Information Technology Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **4** | PT 401 | Summer Practical Training Seminar-II | 2 |  |  | 3 | 3 | 60 | 40 |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| **1** | EE 401 | Power System Analysis | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **2** | EE 407 | Electrical Drives | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **3** | EE 413 | Power System Engineering | 3 | 3 |  |  | 3 | 40 | 60 |
| **4** | EE 415 | High Voltage Engineering | 3 | 3 |  |  | 3 | 40 | 60 |
| **5** | EE 459 | Electrical Drives and Control Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **C** |  | **Program Elective (any one)** |  |  |  |  |  |  |  |
| **1** | EE 417 | Industrial Electrical Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| **2** | EE 409 | Distribution of Electrical Power | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EE 411 | Power System Reliability | 3 | 3 |  |  | 3 | 40 | 60 |
| **4** | EC 407 | Electromagnetic Field Theory | 3 | 3 |  |  | 3 | 40 | 60 |
| **5** | CP 425 | Artificial Intelligence and Neural Networks | 3 | 3 |  |  | 3 | 40 | 60 |
| **6** | EE 403 | Electrical Machine Design | 3 | 3 |  |  | 3 | 40 | 60 |
|  | CP 423  CP 457 | Data Base Management System  Data Base Management System Lab | 2  1 | 3  - |  | -  2 | 3  3 | 40  60 | 60  40 |
| **D** |  | **University/Open Elective** |  |  |  |  |  |  |  |
|  |  | Innovation & Entrepreneurship | 3 |  |  |  |  |  |  |
|  |  | **Total** | **27** | **15** | **4** | **12** |  |  |  |

**NOTE: The University Electives are apart from minimum credits required for award of degree.**

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for B.Tech./Dual Degree (Electrical Engineering 4 Year Course)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 – 2019**

**Year : IV Semester: Spring**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| **1** | EE 404 | EHV AC/DC Transmission | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **2** | EE 414 | Protection of Power System | 4 | 3 | 1 |  | 3 | 40 | 60 |
| **3** | EE 418 | Power System Planning | 3 | 3 |  |  | 3 | 40 | 60 |
| **4** | EE 460 | MATLAB Simulation for Power System | 1 |  |  | 2 | 3 | 60 | 40 |
| **5** | EE 458 | High Voltage Engineering lab | 1 |  |  | 2 | 3 | 60 | 40 |
| **6** | PE 402 | Project Stage-II | 2 |  |  | 2+2 | 3 | 60 | 40 |
| **7** | SM 402 | B. Tech. Seminar | 2 |  |  | 3 | 3 | 60 | 40 |
| **C** |  | **Program Elective (any 1)** |  |  |  |  |  |  |  |
| **1** | EE 412 | Utilization of Electrical Power & Traction | 3 | 3 |  |  | 3 | 40 | 60 |
| **2** | EE 416 | Advanced Electrical Machines | 3 | 3 |  |  | 3 | 40 | 60 |
| **3** | EE 420 | FACTs Devices & Their Applications | 3 | 3 |  |  | 3 | 40 | 60 |
| **4** | EE 422 | Energy Conservation & Auditing | 3 | 3 |  |  | 3 | 40 | 60 |
| **D** |  | **University/Open Elective** |  |  |  |  |  |  |  |
|  |  | Opt from the list of University Electives |  |  |  |  |  |  |  |
|  |  | **Total** | **22** | **12** | **2** | **11** |  |  |  |

**NOTE: The University Electives are apart from minimum credits required for award of degree.**

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for M. Tech. FULL-TIME (Core) (Power System)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 - 2019**

**Year I Semester – Autumn**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University Core** |  |  |  |  |  |  |  |
| 1 | PC 501 | Proficiency in Co-curricular Activities-I | 2 |  |  |  |  |  | 100 |
| 2 | MA501 | Advanced Mathematics | 3 | 3 |  |  | 3 | 40 | 60 |
| 3 | HS 501 | Technical Writing for Engineering(Seminar) | 1 |  |  | 2 | 3 | 60 | 40 |
| 4 | EM 501 | Employability Skills | 1 |  | 2 |  |  |  |  |
| 5 | SM 501 | Review Seminar 1 | 2 |  |  | 3 |  | 60 | 40 |
| 6 | FD 102 | Foundation Course |  |  |  |  |  |  |  |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| 1 | EE 501 | Advanced Power System Analysis | 3 | 3 |  |  | 3 | 40 | 60 |
| 2 | EE 551 | MATLAB Programming Lab | 2 |  |  | 3 | 3 | 60 | 40 |
| 3 | EE 505 | Advanced Power Electronics | 3 | 3 |  |  | 3 | 40 | 60 |
| 4 | EE 553 | Power System Design using PSCAD | 2 |  |  | 3 | 3 | 60 | 40 |
| **C** |  | **Program Elective (any 1)** |  |  |  |  |  |  |  |
| 1 | ME 527 | Energy Conservation Technologies | 3 | 3 |  |  | 3 | 40 | 60 |
| 2 | ME 521 | Modelling & Planning of Energy Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| 3 | ME 523 | Wind Energy Utilization | 3 | 3 |  |  | 3 | 40 | 60 |
| 4 | ME 525 | Energy Management | 3 | 3 |  |  | 3 | 40 | 60 |
| **D** |  | **University/Open Elective** |  |  |  |  |  |  |  |
|  |  | Opt from the list of University Electives |  |  |  |  |  |  |  |
|  |  | **Total** | **22** | **12** | **2** | **11** |  |  |  |

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for M. Tech. FULL-TIME (Core) (Power System)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 - 2019**

**Year I Semester – Spring**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University core** |  |  |  |  |  |  |  |
| 1 | PC 502 | Proficiency in Co-curricular Activities-II | 2 |  |  |  |  |  | 100 |
| 2 | EM 502 | Employability Skills | 1 |  | 2 |  |  |  |  |
| 3 | SM 502 | Review Seminar 2 | 2 |  |  | 3 | 3 | 60 | 40 |
| 4 | FD 104 | Foundation Course |  |  |  |  |  |  |  |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| 1 | EE 502 | Advanced Power System Stability | 3 | 3 |  |  | 3 | 40 | 60 |
| 2 | EE 504 | HVDC Transmission | 3 | 3 |  |  | 3 | 40 | 60 |
| 3 | EE 508 | Advanced Power System | 3 | 3 |  |  | 3 | 40 | 60 |
| 4 | EE 552 | Power System Modelling and Simulation Lab | 2 |  |  | 3 | 3 | 60 | 40 |
| 5 | EE 554 | Power System Lab 2 | 2 |  |  |  |  |  |  |
| **C** |  | **Program elective (any 1)** |  |  |  |  |  |  |  |
| 1 | EE 512 | Smart Grid: Design & Applications | 3 | 3 |  |  | 3 | 40 | 60 |
| 2 | EE 506 | Power System Transients and Protection | 3 | 3 |  |  | 3 | 40 | 60 |
| 3 | EE 510 | Advanced Circuit Analysis and Design | 3 | 3 |  |  | 3 | 40 | 60 |
| **D** |  | **University/Open elective** |  |  |  |  |  |  |  |
|  |  | Opt from the list of University Electives |  |  |  |  |  |  |  |
|  |  | **Total** | **21** | **12** | **2** | **6** |  |  |  |

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for M. Tech. FULL-TIME (Core) (Power System)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 - 2019**

**Year II Semester – Autumn**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **University core** |  |  |  |  |  |  |  |
| 1 | PC 601 | Proficiency in Co-curricular Activities-III | 2 |  |  |  |  |  | 100 |
| **B** |  | **Program Core** |  |  |  |  |  |  |  |
| 1 | EE 601 | Power System Planning and Reliability | 3 | 3 |  |  | 3 | 40 | 60 |
| 2 | EE 653 | Advanced Computer Based Power System Design Lab | 2 |  |  | 3 | 3 | 60 | 40 |
| 3 | DI 601 | Pre-dissertation/ Minor Project | 5 |  |  | 6 | 3 | 60 | 40 |
| 4 | PE 601 | Industrial Training | 4 |  |  | 6 | 3 | 60 | 40 |
| **C** |  | **Program elective (any 1)** |  |  |  |  |  |  |  |
| 1 | EE 609 | **Restructured Power Systems** | 3 | 3 |  |  | 3 | 40 | 60 |
| 2 | EE 605 | Advanced Theory and Analysis of AC Machines | 3 | 3 |  |  | 3 | 40 | 60 |
| 3 | EE 607 | Excitation of Synchronous Machines & Control | 3 | 3 |  |  | 3 | 40 | 60 |
| 4 | EE 611 | Solar Radiation & Energy Conversion | 3 | 3 |  |  | 3 | 40 | 60 |
| 5 | EE 613 | Smart Grid: Technology & Applications | 3 | 3 |  |  | 3 | 40 | 60 |
| 6 | EE 603 | Operation and Control of Power System (moved to elective) | 3 | 3 |  |  | 3 | 40 | 60 |
| **D** |  | **University/Open elective** |  |  |  |  |  |  |  |
|  |  | Opt from the list of University Electives |  |  |  |  |  |  |  |
|  |  | **Total** | **19** | **6** | **0** | **15** |  |  |  |

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**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Teaching and Examination Scheme for M. Tech. FULL-TIME (Core) (Power System)**

**EFFECTIVE FROM ACADEMIC SESSION 2018 - 2019**

**Year II Semester – Spring**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **A** |  | **Practical & Sessional** | | | | | | | |
| 1 | DI 602 | Industry Major Project/Dissertation | 18 |  |  | 3 |  | 60 | 40 |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **Total** | **18** |  |  | **3** |  |  |  |
|  |  | **Total Teaching Load** | **3** |  |  |  |  |  |  |

**L= Lecture T=Tutorial CIE=Continuous Internal Evaluation**

**S= Seminar P= Practical ESE= End Semester Examination**

**Members of BoS, EE Convener, BoS Engg.**

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Effective from the academic session 2018-19**

**List of Offered Courses**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| **Course Code** | **Course Name** | | | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
| **ELECTRICAL ENGINEERING** | | | | | | | | | | |
| EE 201 | Circuit Theory I | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 202 | Circuit Theory II | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 203 | Machines I | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 204 | Machines II | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 205 | Measurements and Instrumentation | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 206 | Generation of Electrical Power | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 207 | Circuit Analysis-I | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 208 | Circuit Analysis-II | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 209 | Electrical Measurements and Instrumentation | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 211 | Electrical Machines-I | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 212 | Electrical Machines-II | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 213 | Circuit Analysis-I | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 251 | Industrial Project Oriented Measurement Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 252 | Machines II Laboratory | | | 2 |  |  | 2 | 3 | 60 | 40 |
| EE 253 | Machines I Laboratory | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 255 | Electrical Engineering Drawing Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 256 | Circuits Lab II | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 257 | Circuits Lab I | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 258 | Power System Design Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 259 | Electrical Machine Lab-I | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 260 | Electrical Machine Lab-II | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 261 | Electrical Circuit Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 263 | Electrical Measurement Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 301 | Power Electronics | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 302 | Advance Control Theory | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 303 | Control Theory | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 304 | Modern Power Electronics | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 305 | Transmission and Distribution of Electrical Power | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 306 | Power System Protection | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 307 | Control Systems | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 308 | High Voltage Engineering | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 310 | Advanced Control Systems | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 311 | Power System Instrumentation | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 312 | Switchgear & Protection | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 314 | Renewable Energy Sources | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 316 | Smart Grid Technology | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 336 | Electrical Vehicle Technology | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 351 | Industrial Project Oriented Power Electronics Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 352 | Advance Control Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 353 | MATLAB for Engineers | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 354 | Modern Power Electronics Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 356 | Simulation Based Power System Modelling Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 357 | Power Electronics Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 358 | Control System Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 360 | Solar Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 362 | Smart Grid Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EE 401 | Power System Analysis | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 403 | Electrical Machine Design | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 404 | EHV AC/DC Transmission | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 405 | Utilization of Electric Power and Traction | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 406 | Switch Gear and Protection | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 407 | Electrical Drives | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 408 | Power System Engineering | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 409 | Distribution of Electrical Power | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 410 | Electrical Engineering Materials | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 411 | Power System Reliability | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 412 | Utilization of Electrical Power & Traction | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 413 | Power System Engineering | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 414 | Protection of Power System | | | 4 | 3 | 1 |  | 3 | 40 | 60 |
| EE 415 | High Voltage Engineering | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 416 | Advanced Electrical Machines | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 417 | Industrial Electrical Systems | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 418 | Power System Planning | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 420 | FACTs Devices & Their Applications | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 422 | Energy Conservation & Auditing | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 454 | MATLAB Simulation for Electrical Engineers | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 456 | Electrical Drives and Control Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 457 | Electrical Circuit Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 458 | High Voltage Engineering lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 459 | Electrical Drives and Control Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 460 | MATLAB Simulation for Power System | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 461 | Computer Aided Electrical Machine Design Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 501 | Advanced Power System Analysis | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 502 | Advanced Power System Stability | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 503 | Advanced Power Electronics | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 504 | HVDC Transmission | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 505 | Advanced Power Electronics | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 506 | Power System Transients and Protection | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 508 | Advance Power System | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 510 | Advanced Circuit Analysis and Design | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 512 | Smart Grid: Design & Applications | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 551 | MATLAB Programming Lab | | | 2 |  |  |  | 3 | 60 | 40 |
| EE 552 | Power System Modeling And Simulation Lab | | | 2 |  |  |  | 3 | 60 | 40 |
| EE 553 | Power System Design Using PSCAD | | | 2 |  |  |  | 3 | 60 | 40 |
| EE 554 | Power System Lab 2 | | | 2 |  |  |  | 3 | 60 | 40 |
| EE 601 | Power System Planning and Reliability | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 603 | Operation And Control of Power System | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 605 | Advance Theory and Analysis of AC Machine | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE607 | Excitation of Synchronous Machine and Their Control | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 609 | **Restructured Power Systems** | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 611 | **Solar Radiation & Energy Conversion** | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 653 | Advanced Computer based Power System Design Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| **BOSCH REXROTH GROUP** | | | | | | | | | | |
| EECP (T) | Basic PLC | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EECP (L) | Basic PLC Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EECAP (L) | Advanced PLC Lab | | | 2 |  |  | 3 | 3 | 60 | 40 |
| EECAP (T) | Advanced PLC & Basics of SCADA | | | 3 | 3 |  |  | 3 | 40 | 60 |
| **PROJECT** | | | | | | | | | | |
| PE 301 | Industrial Summer Project | | | 2 |  |  | 3 | 3 | 60 | 40 |
| PE 303 | Project Stage-I | | | 2 |  |  | 3 | 3 | 60 | 40 |
| PE 403 | Industrial Summer Internship Project | | | 2 |  |  | 3 | 3 | 60 | 40 |
| PE 601 | Industrial Training | | | 2 |  |  | 3 | 3 | 60 | 40 |
| PE 402 | Project Stage – II | | | 2 |  |  | 3 | 3 | 60 | 40 |
| **DISSERTATION** | | | | | | | | | | |
| DI 601 | Pre Dissertation/ Minor Project | | | 5 |  |  |  |  |  |  |
| D1 602 | M.Tech Dissertation / Thesis | | | 16 |  |  |  | 3 | 60 | 40 |
| **SEMINAR** | | | | | | | | | | |
| SM 402 | | B. Tech Seminar | | 2 |  |  | 3 | 3 | 60 | 40 |
| PT 301 | | Summer Practical Training Seminar-I | | 1 |  |  | 2 | 3 | 60 | 40 |
| PT 401 | | Summer Practical Training Seminar-II | | 2 |  |  | 3 | 3 | 60 | 40 |
| SM 501 | | Review Seminar 1 | | 2 |  |  | 3 | 3 | 60 | 40 |
| SM 502 | | Review Seminar 2 | | 2 |  |  | 3 | 3 | 60 | 40 |
| EE 651 | | M.Tech Seminar | | 2 |  |  | 3 | 3 | 60 | 40 |
| **DISCIPLINE** | | | | | | | | | | |
| PC 201 | Proficiency and Co-Curricular Activities – III | | | 2 |  |  |  |  | 100 |  |
| PC 202 | Proficiency and Co-Curricular Activities – IV | | | 2 |  |  |  |  | 100 |  |
| PC 301 | Proficiency and Co-Curricular Activities – V | | | 2 |  |  |  |  | 100 |  |
| PC 302 | Proficiency and Co-Curricular Activities – VI | | | 2 |  |  |  |  | 100 |  |
| PC 401 | Proficiency and Co-Curricular Activities – VII | | | 2 |  |  |  |  | 100 |  |
| PC 501 | Proficiency and Co-Curricular Activities – I | | | 2 |  |  |  |  | 100 |  |
| PC 502 | Proficiency and Co-Curricular Activities – II | | | 2 |  |  |  |  | 100 |  |
| PC 601 | Proficiency and Co-Curricular Activities – III | | | 2 |  |  |  |  | 100 |  |
| **BUSSINESS MANAGEMENT** | | | | | | | | | | |
| BM 402 | | Entrepreneurship and Management | | 3 | 3 |  |  | 3 | 40 | 60 |
| **COMPUTER ENGINEERING** | | | | | | | | | | |
| CP 262 | Computer Programming Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| CP 320 | Data Structures in C | | | 3 | 3 |  |  | 3 | 40 | 60 |
| CP 358 | Data Structures lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| CP 423 | Data Base Management system | | | 3 | 3 |  |  | 3 | 40 | 60 |
| CP 425 | Artificial Intelligence and Neural Networks | | | 3 | 3 |  |  | 3 | 40 | 60 |
| CP 457 | Data Base Management system Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| CP 607 | AI Applications to Power Systems | | | 3 | 3 |  |  | 3 | 40 | 60 |
| **ELECTRONICS AND COMMUNICATION** | | | | | | | | | | |
| EC 201 | Electronic Devices & Circuits | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 202 | Analog Electronics | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 212 | Advanced Electronics | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 204 | Digital Electronics | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 221 | Basic Electronics | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 252 | Industry Oriented Analog Electronics Project Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EC 253 | Electronics Devices and Circuits Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EC 254 | Digital Electronics Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EC 309 | Microprocessor | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 314 | Microprocessor and Computer Architecture II | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 315 | Micro Processor and Computer Architecture | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 316 | Fundamentals of Digital Communication | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 317 | Principle of Communication Systems | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 355 | Microprocessor Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| EC 325 | Embedded Systems | | | 3 | 3 |  |  | 3 | 40 | 60 |
| EC 407 | Electromagnetic Field Theory | | | 3 | 3 |  |  | 3 | 40 | 60 |
| **INFORMATION TECHNOLOGY** | | | | | | | | | | |
| IT 304 | Web Technology | | | 3 | 3 |  |  | 3 | 40 | 60 |
| IT 457 | Information Technology Lab | | | 1 |  |  | 2 | 3 | 60 | 40 |
| **MATHEMATICS** | | | | | | | | | | |
| MA 201 | | | Integral Transforms & Complex Analysis | 4 | 3 | 1 |  | 3 | 40 | 60 |
| MA 202 | | | Numerical Analysis and Statistics | 4 | 3 | 1 |  | 3 | 40 | 60 |
| MA502 | | | Simulation and Modeling | 3 | 3 |  |  | 3 | 40 | 60 |
| MA 305 | | | Operation Research | 3 | 3 |  |  | 3 | 40 | 60 |
| MA 501 | | | Advanced Mathematics | 3 | 3 |  |  | 3 | 40 | 60 |
| **MECHANICAL ENGINEERING** | | | | | | | | | | |
| ME 521 | | | Modeling & Planning of Energy Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| ME 523 | | | Wind Energy Utilization | 3 | 3 |  |  | 3 | 40 | 60 |
| ME 525 | | | Energy Management | 3 | 3 |  |  | 3 | 40 | 60 |
| ME 527 | | | Energy Conservation Technologies | 3 | 3 |  |  | 3 | 40 | 60 |
| ME 318 | | | Strength of Materials | 3 | 3 |  |  | 3 | 40 | 60 |
| **SOFT SKILLS** | | | | | | | | | | |
| HS 201 | Communication Skill | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS 202 | Cognitive Skill | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS 203 | Economics and Social Sciences | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS 301 | Verbal Non-Verbal Reasoning | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS 302 | Employability Skills-IV: Technical Writing | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS 401 | Technical Aptitude | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS 501 | Soft Skills Training I | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS-502 | Soft Skills Training II | | | 3 | 3 |  |  | 3 | 40 | 60 |
| HS 503 | Technical Writing for Engineering | | | 1 |  |  | 2 | 3 | 60 | 40 |
| HS-601 | Soft Skills Training III | | | 3 | 3 |  |  | 3 | 40 | 60 |

**LIST OF OFFERED UNIVERSITY ELECTIVE COURSES**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
|  |  |  |  |  |
| EE 213/ EE 214 | Fundamentals of Electrical Engineering | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 315/ EE 316 | Non-conventional Energy Systems | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 215/ EE 216 | Household Electric Wiring | 2 | 2 |  |  | 3 | 40 | 60 |
| EE 421/ EE 422 | Introduction to the Smart Grid | 2 | 3 |  |  | 3 | 40 | 60 |
| EECP (T) | Basic PLC | 3 | 3 |  |  | 3 | 40 | 60 |
| EECP (L) | Basic PLC Lab | 1 |  |  | 2 | 3 | 60 | 40 |
| EECAP (L) | Advanced PLC Lab | 2 |  |  | 3 | 3 | 60 | 40 |
| EECAP (T) | Advanced PLC & Basics of SCADA | 3 | 3 |  |  | 3 | 40 | 60 |
| EE 214 | Electrical Machines | 3 | 3 |  |  | 3 | 60 | 40 |
| EE 264 | Electrical Machine Lab | 1 |  |  | 2 | 3 | 60 | 40 |
|  | Disaster Management | 2 |  |  |  |  |  |  |
|  | Swatch Bharat Abhiyan | 2 |  |  |  |  |  |  |
|  | Innovation and Entrepreneurship | 3 |  |  |  |  |  |  |
|  | Consumer Affairs | 2 |  |  |  |  |  |  |

**New University Open Elective Subjects (added in 2018-19)**

1. Disaster Management (2 Credits) - Coordinator Dr. Suraj Kr. Singh

2   Innovation and Entrepreneurship (3 Credits) - Coordinator  Dr. T. K .Jain

3. Swatch Bharat Abhiyan (2 Credits) - Dr. Swati Mishra

4. Consumer Affairs (2 Credits) - Coordinator Dr. Renu Pareek

**Note: The University Elective Courses are to be offered both semesters (Autumn and Spring).**

**EMPLOYABILITY SKILLS**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Name** | **Credits** | **Contact Hrs/Wk.** | | | **Exam Hrs.** | **Weightage (in%)** | |
| **L** | **T/S** | **P** | **CIE** | **ESE** |
|  |  |  |  |  |
| EM 201 | Employability Skills-II | 1 |  | 2 |  | 3 | 40 | 60 |
| EM 202 | Employability Skills-III | 1 |  | 2 |  | 3 | 40 | 60 |
| EM 301 | Employability Skills-IV | 1 |  | 2 |  | 3 | 40 | 60 |
| EM 302 | Employability Skills-V | 1 |  | 2 |  | 3 | 40 | 60 |
| EM 401 | Employability Skills-VI | 1 |  | 2 |  | 3 | 40 | 60 |
| EM 402 | Employability Skills-VII | 1 |  | 2 |  | 3 | 60 | 40 |
| EM 501 | Employability Skills | 1 |  | 2 |  | 3 | 40 | 60 |
| EM 502 | Employability Skills | 1 |  | 2 |  | 3 | 60 | 40 |

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**GYAN VIHAR SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Effective from the academic session 2018-19**

**DETAILED SYLLABUS**

|  |  |
| --- | --- |
| Course Title: **ENGINEERING MATHEMATICS – I** | Course Code : MA 101 |
| Semester : **I** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) **: 3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech (All)** | |

**Pre-requisites:**

Knowledge of Mathematics up to Senior Secondary School level.

**Course Objectives:**

1. Students will be exposed to computational techniques and applications of differentiation and integration . This course concludes with an introduction of the basic concepts and techniques of first and second order differential equations . The objective is to develop a competent working knowledge of the main concepts and methods introduced.

2. The course contain the main ideas of calculus that are often encountered in the formulation and solution of practical problems.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **UNIT 1:DIFFERENTIAL CALCULUS** | 10 | 20 |
| * Curvature, Concavity and Convexity and Point of inflexion (Cartesian Coordinates only) * Partial Differentiation, Euler’s Theorem on Homogeneous Functions |  |  |
| **UNIT 2:DIFFERENTIAL CALCULUS** | 10 | 20 |
| * Maxima and Minima of Two and more Independent Variables. Lagrange’s method of undetermined multipliers. * Asymptotes (Cartesian coordinates only), Intersection of the curve and its asymptotes. * Multiple points, Curve tracing of simple curves (Cartesian and Polar) including cardioids, Lemniscates of Bernoulli, Limacon, Equiangular Spiral, Folium of Descartes |  |  |
| **UNIT 3: INTEGRAL CALCULUS** | 8 | 20 |
| * Double integral, Change of order of integration, Triple integral * To find areas by using double integrals. * Beta function and Gamma function. To find areas by using double integrals. |  |  |
| **UNIT 4: DIFFERENTIAL EQUATIONS** | 10 | 20 |
| * Differential Equations of first order and first degree. * Linear Differential Equations of Higher Order with Constant Coefficients. * Homogeneous Linear Differential Equations. |  |  |
| **UNIT 5:DIFFERENTIAL EQUATIONS** | 10 | 20 |
| * Linear Differential Equations of Second Order with Variable Coefficients: * Exact differential equations. Method of Change of Dependent and Independent Variables. * Method of Variation of Parameters. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

**Text Book :**

1. Engg. Mathematics-1 by Y.N. Gaur & C.L. Koul
2. Advanced Mathematics for Engineers by Erwin Kreszig.
3. Advanced Mathematics for Engineers by B.S. Griwal
4. Advanced Mathematics for Engineers by Chandrika Prasad
5. Engg. Mathematics Book 2 by Y.N. Gaur & C.L. Koul
6. Engg. Mathematics I by RBD Publication
7. Engg. Mathematics II by RBD Publication

**Course outcomes:**

*On successful completion of the course:*

1. Find applications of the topics covered, in Physical Sciences and Engineering.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S | S | S | S | S | S | S | S | S | S | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 8 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 7 to 9 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 6 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 9 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

**B.TECH /M.TECH DUAL DEGREE**

**ENGINEERING MATHEMATICS - I (MA-101)**

**Time: 3 Hours Maximum Marks: 60**

***Instructions to candidates:*** Attempt over all 5 questions selecting one question from each unit. All questions carry equal marks.

UNIT-I

Q.1 (a) Prove that for the cycloid , the radius of curvature at point

*‘t’* is

(b) Find the points of inflexion of the curve

**OR**

Q.2 (a) If prove that

(b) If then prove that

UNIT-II

Q. 3 (a) Show that the volume of the greatest rectangular parallelepiped that can be inscribed in the

ellipsoid is .

(b) Show that the asymptotes of the curve ,

cut the curve in three points which lie on the line

**OR**

Q.4 (a) Trace the curve :

(b) Trace the curve :

UNIT-III

Q.5 (a) Evaluate :

(b) Evaluate over the region in the positive quadrant for which

**OR**

Q.6 (a) Evaluate the following double integral by changing the order of integration

(b) Evaluate :

UNIT-IV

Q.7 Solve the following differential equations :

(a)

(b)

**OR**

Q.8 (a) Solve :

(b) Solve :

UNIT-V

Q.9 (a) Solve the following differential equation :

(b) Solve the following differential equation :

**OR**

Q.10 (a) Solve the following differential equation :

(b) Solve following differential equation by the method of variation of parameters :

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to

* The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
* Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
* Student shall be given Internal choice in every Unit.

1. Questions should not be set from the recapitulation topics.

|  |  |
| --- | --- |
| Course Title: **ENGINEERING PHYSICS** | Course Code: **PY 101/PY 102** |
| Semester : **I/II** | Core / Elective: **Program Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : 3 **Credits** |
| Type of course: **Lecture + Tutorials + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **Common to all B. Tech. Engineering Programmes** | |

**Pre-requisites:**

Basics of Optics, Electrostatics, Current Electricity, Magnetism, Particle and Wave nature, Nuclear Physics, Differential and Integral Calculus up to higher Secondary Level.

**Course Objectives:**

1 .Apply the concept of optics and their applications to solve the Interference and diffraction problems in engineering field.

2. Apply the Schrodinger wave equation to explain particle in a box and establish particle nature.

3. Analyse the new concepts of LASER, Holography, Optical Fibre & Nano technology and apply in everyday life.

4. Evaluate the special theory of relativity and understand complicated real life problems.

5. Apply and detect Electromagnetic, nuclear radiations and their harmful hazards in daily life.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Interference and Diffraction of light** | 8 | 12 |
| **Interference of light**  Newton’s Rings: Theory and determination of diameters of dark and bright rings.  Michelson’s interferometer: Construction and working, Determination of wavelength of light and wavelength separation of two nearby wavelengths.  **Diffraction of Light :**  Fraunhofer’s diffraction due to single Slit,  Theory of plane transmission grating and determination of wavelength of light | 4  4 | 6  6 |
| UNITS-2: **Quantum Physics** | 6 | 12 |
| **Quantum Mechanics:**cle in three-dimensional box,  Derivation of time dependent and time independent Schrodinger’s wave equation  Degeneracy, barrier penetration and tunnel effect, tunneling probability  Alpha decay, Sommerfeld’s free electron gas model postulates  Density of energy states, Fermi energy level. | 6 | 12 |
| UNITS-3: **Lasers , Holography and Optical fiber** | 8 | 12 |
| **Lasers:** Theory , design and application of Ruby, He- Ne and semiconductor lasers  **Holography:** Construction and Reconstruction of Hologram  **Optical fiber:** Introduction of optical fiber as wave guide, Numerical Aperture of an optical fiber  **Nano Technology:** Basic principle of nanotechnology, creation and use of buckyballs | 2  2  2  2 | 12 |
| UNIT-4: **Special Theory of Relativity** | 8 | 12 |
| **Special Theory of Relativity:** Postulates of special theory of relativity, Lorentz Transformations, Relativity of length, mass, and time. Relativistic velocity addition , Mass- Energy relation | 8 | 12 |
| UNIT 5:**Electricity, Magnetism & Nuclear Radiation Detectors:** | 6 | 12 |
| **Electricity & Magnetism**: Scalar and Vector Fields, Concept of Gradient, Divergence and Curl, Maxwell’s electromagnetic Equations.  **Nuclear Radiation Detectors:** Construction, Working and principles of proportional, Geiger Muller Counter | 6 | 12 |
| **TOTAL** | **36** | **60** |

**Reference:**

1. Optics by A.K. Ghatak (Tata McGraw-Hill)

2. Introductory Quantum Mechanics by Liboff (Pearson’s Publication)

3. Quantum Mech. by A.Ghatak & S. Lokhathan (Tata McGraw-Hill

4. A textbook of Optics : Brijlal and Subramanium, S . Chand Co. Ltd.

5. Introduction to Modern Optics by G R Fowels

6. An introduction to Fiber Optics by R . Allen Shotweel, PHI

7. Elements of Electromagnetic Fields : S P Seth, Dhanpat Rai & company.

8. Laser Theory and Applications by Thyagarajan and Ghatk Macmillin India Ltd.

9. Elements of Electromagnetic By Mathew N. O. Sadiku, Oxford University Press

10. Engineering Physics (as per SGVU syllabus) by Agnihotri, Agrawal, Bhardwaj (in Press)

11. Nuclear Physics by Burchem(Addison Weisly)

**Course outcomes:**

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

1. To help students understand the role of Physics in science and society and to see the connections between science, current events and physical phenomena.

2. To give students the information and instincts needed to apply principles to new and unfamiliar problems.

3. To give students the skills needed to apply Physics principles to new and unfamiliar problems.

4. To give students the skills needed to work with modern electronic equipment to acquire data and the ability to analyze the results obtained.

5. To equip students with the skills and confidence to be life-long learners.

**Programme outcomes:**

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

1. To apply knowledge from one or more areas of Physics to make appropriate intellectual connections or solve problems in another area of Physics

2. Be familiar with important historical experiments and what they revealed about our understanding of the world.

3. A working knowledge of fundamental concepts in the basic areas of physics.

4. An understanding of the physical principles required to analyze a physical question or topic

5. An understanding of the importance of basic physical laws and their limitations

6. Solve problems competently and confidently

7. An understanding of the physical principles required to analyze a physical question or topic.

8. Analyze problems to determine what is being asked and develop the best approach to provide a solution

9. Present physical concepts, sound mathematical reasoning and the results of laboratory experiments through effective writing skills and effective oral presentations.

10. Collaborate with peers to solve physics problems or laboratory experiments

11. Think creatively about scientific problems and their solutions

12. Constructively question results presented by the scientific community and engage in a reasonable debate on the facts of the issue

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S | S | S | S | S | S | S | S | S | S | S |
| 2 | S | S | S | S | S | S | S | S | S | S | S | S |
| 3 | S | S | S | S | S | S | S | S | S | S | S | S |
| 4 | S | S | S | S | S | S | S | S | S | S | S | S |
| 5 | S | S | S | S | S | S | S | S | S | S | S | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 4 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 4 |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 5, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |
|  |  |  |

**Model Question Paper:**

Enrollment No……… Total no of pages: 02

CLUSTER-A

B. Tech/M. Tech. Dual Degree

**ENGINEERING PHYSICS (PY-101)**

**SEMESTER I**

MAIN/BACK EXAMS.NOV/DEC -2014

Time: 3 Hours Maximum Marks: -60

Instructions to Candidate:

Attempt overall 5 questions selecting one question from each unit.

All questions carry equal marks.

**Unit-I**

1. (a) Prove that the diameter of the bright fringes in Newton’s ring experiment are proportional to the square root of odd natural numbers.

(b) When the movable mirror of Michelson interferometer is moved through a distance of 0.05896 mm, a shift of 200 fringes is observed. Calculate the wavelength of light used. 6+6=12 Marks

**OR**

2. (a) Show that the Plane Polarized and circularly Polarized light are special case of elliptically Polarized light.

(b) What is Phase Retarding Plates? Mention the four properties of positive crystals. 6+6=12 Marks

**Unit-II**

3. (a) Define Spectral Resolving Power. What is meant by resolving power of a grating? (b) Derive an expression for the intensity of diffracted light in the Fraunhofer’s diffraction due to single slit. 6+6=12 Marks

**OR**

4. (a) Explain Rayleigh’s criteria of resolution.

(b) Show that the intensity of light diffracted from a Plane Transmission Grating is given by

I=I0 (sinα/α)2 (sin Nβ/sinβ)2 . Symbols carry their usual meanings. 6+6=12 Marks

**Unit-III**

5. (a) Explain the terms absorption, spontaneous emission and stimulated emission in reference to LASER ACTION.

(b)Explain construction and reconstruction of image in holography with diagrams. 6+6=12 Marks.

**OR**

6. (a) What do you mean by Total Internal Reflection and hence define critical angle. State the two necessary conditions for Total Internal Reflection.

(b) Derive expression for Numerical Aperture of Optical Fiber in terms of fractional change in refractive indices, Δ. 6+6=12 Marks.

**Unit-IV**

7. (a) Deduce Lorentz transformations between two inertial frames moving with uniform velocity with respect to each other.

(b) Obtain the relativistic law of velocities. 6+6=12 Marks.

**OR**

8. (a). Show that E2 –p2c2 is invariant under Lorentz Transformations

(b) Derive an expression for the variation of mass with velocity. 6+6=12 Marks.

**Unit-V**

9. Explain the differential and integral form of Maxwell’s Electromagnetic Equations. 6+6=12 Marks.

**OR**

10. Explain the construction and working of a Geiger- Muller Counter or Proportional Counter.

6+6=12 Marks.

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to

* The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
* Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
* Student shall be given internal choice in every Unit.

1. Questions should not be set from the recapitulation topics.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **CY 151/152** | **ENGINEERING CHEMISTRY LAB** | **C (L, T, P) = 2 (0, 0, 3)** |
|  |  |  |  |
| **S. No.** | **Name of Experiment** |  | **No. of** |
|  |  |  | **Practical** |
|  |  |  | **Turns** |
| **I** | **Physical Methods of** | **Analysis** |  |

1. Conduct metric Analysis

|  |  |  |
| --- | --- | --- |
| a. | Determination of strength Acid and Bases | 01 |
| b. | Determination of Solubility of Barium sulphate | 01 |
| c. | Determination of equivalent conductivity | 01 |

1. pH Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a. | Determination f | | strength of Acids and Bases | 01 |
| b. | Determination f | | PH of various Water Sample and its Analysis | 01 |
| 3. | Determination of Viscosity of a given sample of oil at various temperature by Redwood Viscometer | | | 01 |
|  | No.1 | |  |  |
| 4. | Determination of Flash and Fire point of a given sample using Pensky Marten apparatus | | | 01 |
| 5. | Determination of | | Cloud and Pour point of a sample | 01 |
| **II** | **Volumetric Analysis** | | |  |
| 1. | To study kinetics of acetone iodine reactions | | | 02 |
| 2. | Determination of | | available chorine in Bleaching Powder | 01 |
| 3. | Determination of free chlorine in a Water sample | | | 01 |
| 4. | To study hydrolysis of ester | | | 01 |
| 5. | Determination of B.O.D Value of Water sample | | | 01 |
| 6. | Determination of C.O.D Value of Water sample | | | 01 |
| 7. | Determination of hardness of water | | | 01 |
| 8. | Determination of Dissolved Oxygen or Ammonia or Carbon Dioxide | | | 02 |
| 9. | Determination of total suspended dissolved and fixed solids in Sewage and Water sample | | | 01 |
| **III** | **REDOX Titrations** | | |  |
| 1. | Determination of Copper sulphate Idometrically | | | 01 |
| 2. | Determine Potassium dichromate idometrically | | | 01 |
| 3. | Determination Potassium dichromate by retreating it against ferrous ammonium sulphate (Using | | | 02 |
|  | internal indictor) | |  |  |
| 4. | Estimation of Iron in plain Carbon steel | | | 01 |
| 5. | Estimation of Copper in brass | | | 01 |
| **IV** |  | **Gravimetric Analysis** | |  |
| 1. |  | Barium as Barium sulphate gravimetrically | | 02 |
| 2. |  | Silver as Silver Nitrate gravimetrically | | 02 |
| 3. |  | Copper as Copper thiocynate gravimetrically | | 02 |

 As per availability of experiment

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL AND ELECTRONICS ENGINEERING (Theory)** | Course Code: **EE 101/EE 102** |
| Semester : **I/II** | Core / Elective: **Program Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course: **Lecture + Tutorials + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **Common to all B. Tech. Engineering Programmes** | |

**Pre-requisites:** Basics of Mathematics of Higher Secondary Level to include Algebra, Geometry, Trigonometry, Differential and Integral Calculus. Magnetism, Electrostatics and Electromagnetism, Current, Voltage, Electricity, Basic knowledge of semiconductors. Particle and Wave nature of electromagnetic energy. Use of scientific calculator.

**Course Objectives:**

The subject aims to:-

1. Impart basic knowledge of electrical quantities such as D.C. and A.C. current, voltage, power, energy and frequency.
2. Provide working knowledge for the analysis of D.C. and A.C. circuits required for all branches of engineers.
3. Develop skills to identify the type of generators and motors required for practical application.
4. Highlight importance of transformers and transmission and distribution of electric power.
5. Provide knowledge of basic communication systems and different types of transducers.
6. Give knowledge to design simple electronic circuits.
7. Provide students with the basic theorems to understand and calculate voltages and currents across an electrical circuit.
8. Impart the basics about rotating machines, various semiconductor devices and communication systems.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **ELECTRICAL AND ELECTRONICS ENGINEERING** | | |
| UNIT-1**: Basic Concepts of Electrical Engineering** | 8 | 12 |
| Electric Current, Electromotive force, Electric Power, Ohm’s Law, Basic Circuit Components, Faraday’s Law of Electromagnetic Induction, Lenz’s Law, Kirchhoff’s laws, Network Sources, Resistive Networks, Series-Parallel Circuits, Node Voltage Method, Mesh Current Method, Superposition, Thevenin’s, Norton’s and Maximum  Power Transfer Theorems. |  |  |
|  | | |
| UNITS-2: **Alternating Quantities** | 7 | 12 |
| Introduction, Generation of AC Voltages, Root Mean Square and  Average Value of Alternating Currents and Voltages, Form Factor and Peak Factor, Power factor and Power in A.C. Phasor Representation of Alternating Quantities, Single Phase RLC Circuits, Introduction to 3-Phase  AC System. Power and power measurement in 3-Phase. |  |  |
| UNITS-3:**Rotating Electric Machines**  DC Machines: Principle of Operation of DC Machine as Motor and Generator, EMF Equation, Applications of DC Machines. AC Machines: Principle of Operation of 3-Phase Induction Motor, 3-Phase Synchronous Motor and 3- Phase Synchronous Generator (Alternator), Applications of AC Machines | 7 | 12 |
|  |  |
| UNIT-4: **Basic Electronics** | 7 | 12 |
| Conduction in Semiconductors, Conduction Properties of Semiconductor  Diodes, Behaviour of the PN Junction, PN Junction Diode, Zener Diode, Photovoltaic Cell, Rectifiers, L, C, & L-C filters, Bipolar Junction Transistor, Field Effect Transistor, Transistor as an Amplifier.  Digital Electronics: Boolean algebra, Binary System, Logic Gates and Their Truth Tables |  |  |
| UNIT 5:**Communication Systems** | 7 | 12 |
| Introduction, IEEE Spectrum for Communication Systems, Types of  Communication, Introduction to Mobile Communication, 3G and 4G. Amplitude and frequency Modulation, Basic concepts of Optical Fibre and Satellite Communication.  Instrumentation: Introduction to Transducers: Thermocouple, RTD, Strain Gauges, Load Cell and Bimetallic Strip.  Introduction and classification of ICs. |  |  |
| **TOTAL** | **36** | **60** |

**Reference:**

1. Electrical and Electronic Technology by Edward Hughes et al, Pearson Publication R.T.U., Kota Scheme and Syllabus B.Tech.
2. Basic Electrical & Electronics Engineering by V. Jagathesan, K. Vinod Kumar & R. Saravan Kumar, Wiley India
3. Basic Electrical & Electronics Engineering by Van Valkenburge, Cengage Learning Indian Edition
4. Basic Electrical and Electronics Engineering by Muthusubrmaniam, TMH
5. Fundamentals of Electrical Engineering by Leonard S. Bobrow, Oxford University Press
6. Fundamentals of Electrical and Electronics Engineering by Ghosh, Smarajit, PHI India
7. Basic Electrical & Electronics Engineering by Ravish Singh, TMH
8. Basic Electronics Engineering by Vijay Baru et al, Dream Tech, New Delhi

**Course outcomes:**

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

1. Appreciate the significance of electricity and electronics in different applications.
2. Understand electric circuits, analyze them and be able to design simple circuits like amplifier.
3. Understand functioning of electric motors and generators and be able to select them as per requirement.
4. Realize the requirement of transformers, electric power calculation and electric safety rules.
5. Differentiate between different types of modern communication systems and transducers.
6. Recognize the differences between AC and DC, and identify the electrical machines working on them.
7. Know about basic Analog and Digital Electronics, and about basic Communications systems.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |
| 7 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 4 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 5, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 30 |
| 2 | Applying the knowledge acquired from the course | 40 |
| 3 | Analysis and Evaluation | 30 |
|  |  |  |

**Model Question Paper:**



**Unit II**

**Q3.(a)** Briefly explain the difference between:- (6)

(i) Impedance and Reactance.

(ii)Power Factor and Form Factor.

(iii)Active Power and Reactive Power.

**(b )**A resistance of 12 Ω,an inductance of 0.15 H and a capacitance of 130 µF are connected in series across a 100 volt, 50 Hz a.c.suply. Find the impedance,current,phase angle and power factor. (6)

**OR**

**Q4.(a)**A balanced star connected load of (8 + j6) Ω in each phase is connected across a three phase,50hz,440V supply system. Calculate: (i)Line current (ii) Active Power (iii) Reactive Power (6)

**(b)**What are the advantages of a three phase system over a single phase system. (6)

**Unit III**

**Q5.(a)**What is a transformer? Derive the e.m.f. equation of a single phase a.c. transformer. (6)

**(b)** A lap wound DC shunt generator having 80 slots with 10 conductors per slot generates an e.m.f. of 400 V when running at 1000 rpm.At what speed should it be rotated to generate 220 V on open circuit. (6)

**OR**

**Q6(a).**What are the parts of a D.C. Machine ,explain function of each .Draw diagrams to support your explanation. (6)

**(b)**A 2000 kVA ,3300/240 volt,50 hz single phase transformer has 80 turns on the secondary winding. Assuming an ideal transformer, calculate(i) primary and secondary currents on full load (ii)the maximum value of flux and (iii) number of primary turns. (6)

**Unit IV**

**Q7.(a)** What are α, β and γ as related to a transistor. Derive relationship between α and β. (6)

**(b)** What are Forward breakover voltage,Holding current and Gate Triggering in Thyristor? (6)

**OR**

**Q8.(a)** Explain working of Thyristor with a neat diagram with the help of characteristic curve. (6)

**(b)** Explain construction and working of a Uni- junction Transistor. What is intrinsic stand off ratio. (6)

**Unit V**

**Q9.** Write short notes on any two of the following:- (6+6)

(a) Satellite Communication

(b) Optical Fiber Communication.

(c) Modulation.

**OR**

**Q10**.(a) What is modulation? What is its necessity? What are the types of modulation? Explain A.M. and F.M. with wave diagrams. (6+6)

(b) Write short notes on any two of the following:-

(i) Cellular communication.

(ii)Multiplexing and its types (iii) Basic communication system with block diagrams.

|  |  |
| --- | --- |
| Course Title:  **ELECTRICAL AND ELECTRONICS ENGINEERING LAB (Practical)** | Course Code:  **EE 151/EE 152** |
| Semester : **I/II** | Core / Elective: **Program Core** |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **2** **Credits** |
| Type of course: **Lecture + Tutorials + Assignments** | Total Contact Hours : **30** |
| Continuous Internal Evaluation : **40 Marks** | Project + End Semester Practical exam : **60 Marks** |
| Programmes: **Common to all B.Tech. Engineering Programmes** | |

**Pre-requisites:**

EE 101/102: Electrical and Electronics Engineering (Theory)

**Course Objectives:**

1. Help the learner to understand basic laws and theorems governing electrical circuits.
2. Understand the methods to measure power and power factor in basic electrical circuits.
3. Understand the phenomenon of Resonance in RLC series circuit.
4. Learn about testing of single phase transformer to find out its parameters.
5. Learn about speed control of DC motor using different methods.
6. Make students familiar with basic analog devices like BJT, p-n junction diode and transistors.
7. Make students familiar with basic digital devices like logic gates (TTL) and OPAMP.
8. Learn about working with basic lab instruments like CRO and function generator.
9. Learn about basic house wiring circuits.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Verification of Kirchhoff’s laws | | 2 |  |
|  | Verification of   1. Superposition theorem 2. Thevenin’s Theorem 3. Maximum Power Transfer Theorem. | | 2 |  |
|  | Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor | 2 | |  |
|  | Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency. | | 2 |  |
|  | Measurement of power in a 3-phase circuit by two wattmeter method. | | 2 |  |
|  | Determination of parameters of ac single phase series RLC circuit. | | 2 |  |
|  | Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer. | | 2 |  |
|  | To study speed control of dc shunt motor using (i) armature voltage control (ii) field flux control. | | 2 |  |
|  | Determination of efficiency of a dc shunt motor by load test. | | 2 |  |
|  | To study input/output characteristics of a BJT. | | 2 |  |
|  | To measure energy by a single phase energy meter and determine error. | | 2 |  |
|  | To study P-N diode characteristics. | | 2 |  |
|  | To study full wave and half wave rectifier circuits with and without capacitor and determine ripple factors. | | 2 |  |
|  | To study various logic gates (TTL). | | 2 |  |
|  | To study Operational Amplifier as Adder and Subtractor. | | 2 |  |
|  | To study transistor as a switch. | | 2 |  |
|  | To study Function generator and CRO. | | 2 |  |
|  | House Wiring with electric safety measures. | | 2 |  |
|  | **Project:** To fabricate a functional electrical/electronic project with a given circuit diagram, using various components soldered on a PCB/Zero PCB. Students should submit project report in a file with headings: objective, principle of working, list of components with cost, circuit diagram, difficulties experienced and conclusion. The project will be evaluated after a presentation given by the students. | |  |  |
|  | **TOTAL** | | **30 (Any 15)** |  |

**Reference:**

1. Electrical and Electronic Technology by Edward Hughes et al, Pearson Publication R.T.U., Kota Scheme and Syllabus B.Tech.
2. Basic Electrical & Electronics Engineering by V. Jagathesan, K. Vinod Kumar & R. Saravan Kumar, Wiley India
3. Basic Electrical & Electronics Engineering by Van Valkenburge, Cengage Learning Indian Edition
4. Basic Electrical and Electronics Engineering by Muthusubrmaniam, TMH
5. Fundamentals of Electrical Engineering by Leonard S. Bobrow, Oxford University Press
6. Fundamentals of Electrical and Electronics Engineering by Ghosh, Smarajit, PHI India
7. Basic Electrical & Electronics Engineering by Ravish Singh, TMH
8. Basic Electronics Engineering by Vijay Baru et al, Dream Tech, New Delhi

**Course outcomes:**

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

1. Measure basic electrical quantities, like voltage, current, resistance, power etc. using different network theorems.
2. Test various static and rotating electrical machines to find out their parameters.
3. Find out the characteristics of various electronic devices like BJT, p-n diode, logic gates, OPAMP and transistors.
4. Work on basic lab devices like function generator and CRO.
5. Combine various types of electrical and electronic devices to make complex circuits designed for some specific purpose.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ENGINEERING MATHEMATICS – II** | Course Code : MA 102 |
| Semester : **II** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech (All)** | |

**Pre-requisites:**

Knowledge of Mathematics up to Senior Secondary School level.

**Course Objectives:**

1. Students will be exposed to implications of matrices in solving simultaneous linear equations. Vector differentiation & integration will find application in finding Line, Surface and volume integrals. This course concludes with an introduction of the basic concepts and techniques of first order Partial differential equations of first order and first degree . The objective is to develop a competent working knowledge of the main concepts and methods introduced.
2. The course contain the main ideas of calculus that are often encountered in the formulation and solution of practical problems.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **UNIT 1:Algebra :** | 10 | 20 |
| * Convergence and Divergence of infinite series: Comparison test, Cauchy’s nth root test, D’alemberts ratio test, logarithmic ratio test, Raabi’s test, De’Morgan and Bertrand’s test, Gauss test (without proof) * Fourier Series: Expansion of simple function’s in Fourier Series, Fourier Series of even and odd functions. Half range series, change of intervals, Harmonic Analysis. |  |  |
| **UNITS 2: MATRICES** | 10 | 20 |
| * Rank of a matrix, inverse of a matrix by elementary transformations. * Solution of simultaneous linear equations by matrix method. * Eigen values and Eigen vectors, Cayley- Hamilton theorem (without proof). * Diagonalization of matrix. |  |  |
| **UNIT 3: COORDINATE GEOMETRY OF THREE DIMENSIONS** | 8 | 20 |
| * Double integral, Change of order of integration, Triple integral. * To find areas by using double integrals. * Beta function and Gamma function. To find areas by using double integrals. |  |  |
|  | | |
| **UNIT 4: VECTOR CALCULUS** | 10 | 20 |
| * Scalar and vector point functions, differentiation & integration of vector functions. * Gradient, Divergence, Curl and Differential Operator. * Line, Surface and volume integrals. |  |  |
| **UNIT 5: PARTIAL DIFFERENTIAL EQUATIONS** | 10 | 20 |
| * Partial Differential Equations of the First Order. L * Non-linear Partial Differential Equations of order one: Standard forms. * Charpit’s method. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

**Text Book : Engg. Mathematics-1 by Y.N. Gaur & C.L. Koul**

1.Advanced Mathematics for Engineers by Erwin Kreszig.

2. Advanced Mathematics for Engineers by B.S. Griwal

3. Advanced Mathematics for Engineers by Chandrika Prasad

4. Engg. Mathematics Book 2 by Y.N. Gaur & C.L. Koul

5. Engg. Mathematics I by RBD Publication

6. Engg. Mathematics II by RBD Publication

**Course outcomes:**

*On successful completion of the course:*

1. Students will find applications of the topics covered, in Physical Sciences and Engineering.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S | S | S | S | S | S | S | S | S | S | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 8 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 7 to 9 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 6 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 9 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

**B.TECH /M.TECH DUAL DEGREE**

**ENGINEERING MATHEMATICS - II (MA-102)**

**Time: 3 Hours Maximum Marks: 60**

***Instructions to candidates:*** Attempt over all 5 questions selecting one question from each unit. All questions carry equal marks.

UNIT-I

1. (a) Test the convergence of the series :

(b) Test the convergence of the series :

OR

2. (a) Find the Fourier series for in the interval (-where

( b) Express the function in 0 by a cosine series and hence deduce that

UNIT-II

3. (a) Find the rank of the following matrix :

(b) Examine for consistency of the following equations and solve them if they are consistent:

OR

4. (a) Find the Eigen values and Eigen vectors of the matrix :

( b) Find the characteristic equation of the matrix : A

by using Cayley-Hamilton theorem, find .

UNIT-III

5. (a) A sphere of constant radius passes throw the origin and meets the axes in *A ,B ,C* .

Show that locus of the centroid of the tetrahedron OABC is the sphere

(b) Find the equation of the surface of revolution generated by revolving the curve

, about the – axis.

OR

6. (a) Find the equation of the sphere that passes through the circle

and cuts orthogonally the sphere .

(b) Find the equation of the right circular cylinder whose guiding curve is the circle

UNIT-IV

7. (a) Find the directional derivative of at in the

direction .

(b) If , find so that is

irrotational. Find the scalar potential of .

OR

8. (a) Evaluate , where , and *C* is the curve

varying from -1 to 1.

(b) Evaluate where and *S*  is the surface of the

plane in the first octant.

UNIT-V

9. (a) Solve the following partial differential equation :

(b) Solve :

10. (a) Solve :

(b) Solve the following partial differential equation by Charpit’s method :

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to

* The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
* Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
* Student shall be given Internal choice in every Unit.

1. Questions should not be set from the recapitulation topics.

|  |  |
| --- | --- |
| Course Title: **INTEGRAL TRANSFORMS AND COMPLEX ANALYSIS** | Course Code :  **MA 201** |
| Semester : **3rd Semester** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 1,2** | |

**Pre-requisites:**

**Course Objectives:**

1. To introduce Laplace transform analysis, this is central to many applications in engineering apart from its use in solving boundary value problems.

2. To develop Z transform techniques for discrete time systems

3. To acquaint the student with Fourier transform techniques used in wide variety of situations.

4. To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **BOUNDARY VALUE PROBLEMS** | 10 | 20 |
| Method of sepeartion of variables in the solution of Boundary VALUE Problems (Wave equation, Diffusion and Laplace equation) |  |  |
| UNITS-2: **LAPLACE TRANSFORM** | 08 | 20 |
| Laplace transform with its simple properties, applications to the solution of ordinary and partial differential equations having constant co-efficients with special reference to the wave and diffusion equations. |  |  |
| UNITS-3: **FOURIER TRANSFORM** | 08 | 20 |
| Complex form of Fourier Transform and its inverse, Fourier sine and cosine transform and their inversion. Applications of Fourier Transform to solution of partial differential equations having constant co-efficient with special reference to heat equation and wave equation. |  |  |
| UNIT-4: **COMPLEX VARIABLES I** | 16 | 20 |
| Analytic functions, Cauchy-Riemann equations, Elementary conformal mapping with simple applications, Line integral in complex domain, Cauchy;s theorem. Cauchy’s integral formula |  |  |
| UNIT 5: **COMPLEX VARIABLES II** | 06 | 20 |
| Taylor’s series Laurent’s series poles, Residues, Evaluation of simple definite real integrals using the theorem of residues. Simple contour integration |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. Advanced Mathematics for Engineers by Chandrika Prasad
2. Higher Engineering Mathematics by BS Grewal
3. Higher Engineering Mathematics by YN Gaur

**Course outcomes:**

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

1. Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

2. understand the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S |  |  |  |  |  |  |  |  |  |  |
| 2 | S | S |  |  |  |  |  |  |  |  |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 8 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 7 to 9 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 6 |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 9 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ECONOMICS & SOCIAL SCIENCES** | Course Code :  **HS 203** |
| Semester : **3rd Semester** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **M.Tech Power System & Dual Degree (B.Tech Electrical +M.Tech Power System)** | |

**Pre-requisites:**

**Course Objectives:**

1. To learn about the history of India in brief.

2. To learn law and concepts of economics.

3. To understand the psychology of various kind of industries.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Introduction: Definition meaning, nature and scope of economics.** | 10 | 20 |
| UNITS-2: **Micro Economics** | 08 | 20 |
| Definition, meaning and scope of Micro Economics. Importance and limitations. |  |  |
| UNITS-3: **Concept of Demand and supply** | 08 | 20 |
| Utility Analysis, Law of Demand, Demand determinants, Demand Distinctions. Law of Supply, Elasticity |  |  |
|  | | |
| UNIT-4: **Introduction to social Sciences** | 16 | 20 |
| Impact of British rule on India(Economic Social and Cultural). Indian National movement, Physiography of India. |  |  |
| UNIT 5: **Political Economy** | 06 | 20 |
| Agriculture, Socio-Economic development, Challenges to Indian Democracy, Political Parties and pressure groups. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Advanced Microeconomics by M.L. Shingham
2. Microeconomics by M. L. Sethi

**Course outcomes:**

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

1. Prepare himself for various kind of responsibilities and duties related to his society.

2. Apply the law and concepts of economics on his job place.

3. Interact with various kinds of industries and various kinds of communities.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S |  |  |  |  |  |  |  |  |  |  |
| 2 | S | S |  |  |  |  |  |  |  |  |  |  |
| 3 | S | S |  |  |  |  |  |  |  |  |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 8 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 7 to 9 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 6 |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 9 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL MEASUREMENT AND INSTRUMENTATION** | Course Code : EE 209 |
| Semester : III | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes:  **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Torque equation and impedances of inductor and capacitor

**Course Objectives:**

1. Help the learner to understand basic principle and operation of electrical measuring instruments
2. Understand the construction and operation of wattmeter, current transformer and potential transformer.
3. Understand the construction and operation of AC and DC potentiometer
4. Learn about different type of resistances and their measurement methods
5. Learn about different types of bridges.

**Course Contents:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **Unit 1** | 6 | 20 |
| **Principles of Measurement:**Moving coil, moving iron, electrodynamics and induction instruments-construction, operation, torque equation and errors. Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy. Errors in wattmeter and energy meter and their compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading. |  |  |
| **Unit 2** | 6 | 20 |
| **Polyphase Metering:**Blondel's Theorem for n-phase, p-wire system. Measurement of power and reactive kVA in 3-phase balanced and unbalanced systems: One-wattmeter, two-wattmeter and three-wattmeter methods. 3-phase induction type energy meter. Instrument Transformers: Construction and operation of current and potential transformers. Ratio and phase angle errors and their minimization. Effect of variation of power factor, secondary burden and frequency on errors. Testing of CTs and PTs. Applications of CTs and PTs for the measurement of current, voltage, power and energy. |  |  |
| **Unit 3** | 8 | 20 |
| **Potentiometers:**Construction, operation of Compton potentiometers. Use of potentiometer for measurement of resistance and voltmeter and ammeter calibrations. Volt ratio boxes. Construction, operation and standardization of AC potentiometer – in-phase and quadrature potentiometers. Applications of AC potentiometers.  **Measurement of Resistances:** Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method, substitution method, Measurement of low resistances – Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Price's Guard-wire method. Measurement of earth resistance. |  |  |
| **Unit 4** | 8 | 20 |
| **Bridge Measurements:**Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge and Anderson bridge for self-inductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge for capacitance measurement. Wien's bridge for capacitance and frequency measurements. Sources of error in  bridge measurements and precautions. Screening of bridge components. Wagner earth device. |  |  |
| **Unit 5** | 8 | 20 |
| **Computer Measuring Systems:**Introduction, Input Circuits of the Measuring Systems, Circuits for data conditioning and acquisition, The sensors with built-in interface intelligent sensors , Analogue and digital transmitters , Data loggers, – smart sensors, Data Acquisition Circuits, Plug-in data acquisition board , External data acquisition board Data Communication in Computer Measuring Systems. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Principles of Electrical Measurement  Slawomir Tumanski CRC Press
2. Electrical Measurements and Measuring Instruments by [E.W Golding](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=E.W+Golding&search-alias=stripbooks) , [F.C Widdis](https://www.amazon.in/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=F.C+Widdis&search-alias=stripbooks) Wheeler Publication
3. Electrical & Electronic Measurements and Instrumentation Prithwiraj Purkaith,Santanu das McGraw Hill
4. Electrical and Electronics measurements and measuring instruments. A.K.SAWHNEY- Dhanpat Rai and Sons
5. Electrical measurements and measuring instruments by Rajendra Prasad- Khanna Publishers
6. A course in Electronics and Electrical measurements and instrumentation by J.B.GUPTA- Kataria Publications
7. Electrical measurements and measuring instruments by Rajendra Prasad- Khanna Publishers

**Course outcomes:**

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

1. Student will be able to measure the AC and DC electrical quantities(voltage, current and energy)
2. Measurement of single and three phase ac power
3. Calibrate the voltmeter, ammeter by the help of potentiometer
4. Measurement of earth resistance
5. Measure the value of capacitance and inductance by the help of different type of bridges
6. Identify the appropriate type of measuring instrument to be used in each case, and how to make the measurements more accurately

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

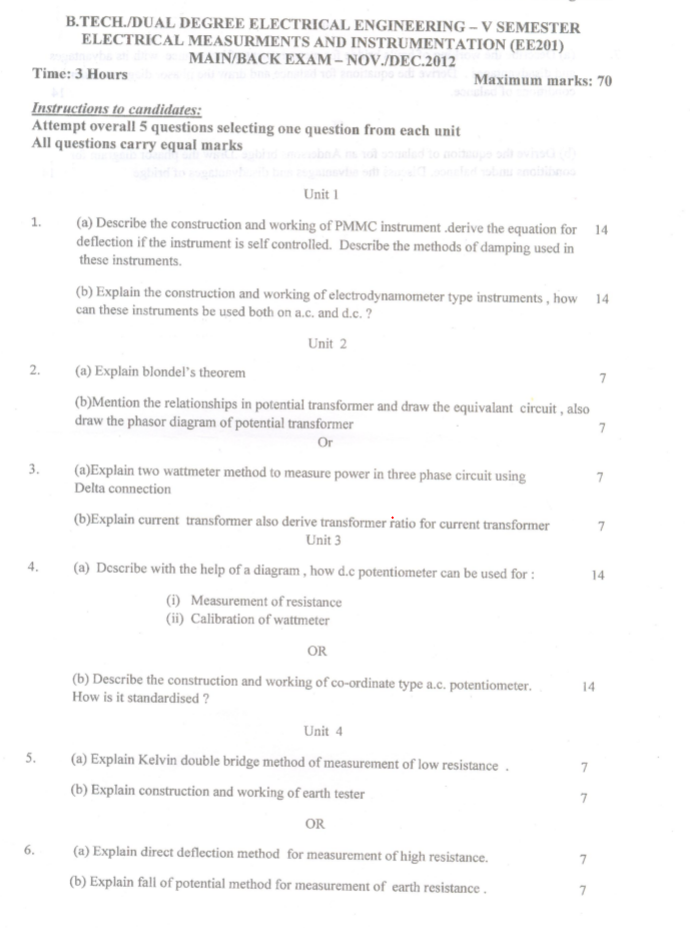
**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

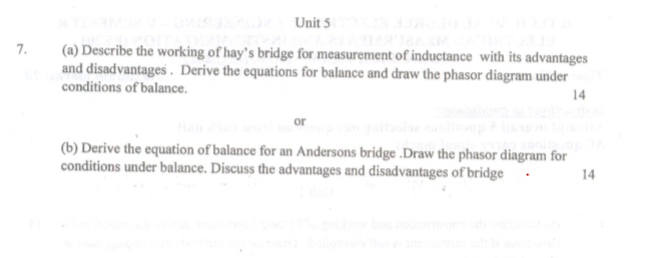
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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**





|  |  |
| --- | --- |
| Course Title: **ELECTRICAL MEASUREMENT LAB** | Course Code : EE 263 |
| Semester : III | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes:  **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

EE 209: Electrical Measurement and Instrumentation

**Course Objectives:**

1. Help the learner to understand basic principle and operation of electrical measuring instruments
2. Understand the construction and operation of wattmeter, current transformer and potential transformer.
3. Understand the construction and operation of AC and DC potentiometer
4. Learn about different type of resistances and their measurement methods
5. Learn about different types of bridges
6. To make students familiar with the different types of measuring instruments, and how to use them to measure various electrical quantities accurately and efficiently.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. and (ii) C.R.O. Probes | | 2 |  |
|  | Study working and applications of Meggar, Tong-tester, P.F. Meter and Phase Shifter. | | 2 |  |
|  | Measure power and power factor in 3-phase load by (i) Two-wattmeter method and (ii) One wattmeter method. | 2 | |  |
|  | Calibrate an ammeter using DC slide wire potentiometer. | | 2 |  |
|  | Calibrate a voltmeter using Crompton potentiometer. | | 2 |  |
|  | Measure low resistance by Crompton potentiometer. | | 2 |  |
|  | Measure Low resistance by Kelvin's double bridge. | | 2 |  |
|  | Measure earth resistance using fall of potential method. | | 2 |  |
|  | Calibrate a single-phase energy meter by phantom loading at different power factors. | | 2 |  |
|  | Measure self-inductance using Anderson's bridge. | | 2 |  |
|  | **TOTAL** | | **20** |  |

**Reference:**

1. Electrical and Electronics measurements and measuring instruments. A.K.SAWHNEY- Dhanpat Rai and Sons
2. Electrical measurements and measuring instruments by Rajendra Prasad- Khanna Publishers
3. A course in Electronics and Electrical measurements and instrumentation by J.B.GUPTA- Kataria Publications
4. Electrical measurements and measuring instruments by Rajendra Prasad- Khanna Publishers

**Course outcomes:**

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

1. Student will be able to measure the AC and DC electrical quantities(voltage, current and energy)
2. Measurement of single and three phase ac power
3. Calibrate the voltmeter, ammeter by the help of potentiometer
4. Measurement of earth resistance
5. Measure the value of capacitance and inductance by the help of different type of bridges
6. Identify the error in any measurement done and how to minimize it.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **CIRCUIT ANALYSIS-I** | Course Code : EE 213 |
| Semester : III | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes:  **B.Tech Electrical Engineering + Dual Degree (3,5)** | |

**Pre-requisites:**

Basic Electrical and Electronics.

**Course Objectives:**

1. Help the learner to understand basic principles and working of continuous time signals & systems.

2. Understand the application of Laplace transforms.

3. Understand the use and application of network theorems.

4. Learn about two port networks.

5. Learn about positive real functions.

6. Make students capable of analysing various simple and complex electrical circuits, and then solving those circuits with the theorems and techniques taught to them in the course.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **Unit 1 Network classification and Introduction to continuous time signals and systems** | 8 | 20 |
| Unit Step, ramp and impulse signals, Example of each signal, Differential Equation Formulation of linear time invariant continuous system, Responses for unit ramp, square pulse and impulse function. |  |  |
| **Unit 2 Review of Laplace Transform** | 10 | 20 |
| Initial value and Final Value Theorem, Properties and solution of differential equation using LT, Time domain analysis of LTI network using Laplace transform, Waveform Synthesis, LT of Complex waveforms, Concept of Transform Impedance, voltage ratio, transfer function, Relation between impulse response and system function |  |  |
| **Unit 3 Network Theorems** | 10 | 20 |
| Maximum power transfer Theorem, Superposition, Tellegen’s, Millman’s, Thevenin’s and Norton’s Theorem, Concept of poles and zeros, Relation between location of poles, time response and stability.. |  |  |
| **Unit 4 Transient analysis** | 10 | 20 |
| Natural response-Forced response – Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources – Complete response of RC, RL and RLC Circuits to sinusoidal excitation. |  |  |
|  | | |
| **Unit 5 Positive real function** | 10 | 20 |
| Definition and properties, Synthesis of LC, RL and RC circuits using Cauer and Foster’ s first and second form. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. A Chakrabarti and S. Bhadra, ‘Networks and Systems’ Dhanpat Rai and Co

2. M.E. Van Valkenberg, ‘Network Analysis’ Prentice Hall

3. D. Roy Choudhary, ‘Networks and Systems’

4. W. H. Hayt and J. E. Kemmerly, Engineering circuit Analysis, TATA MCGRAW HILL

**Course outcomes:**

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

1. Student will be able to analyse continuous time signals & systems
2. Apply Laplace transforms techniques.
3. Apply network theorems practically.
4. Evaluation of two port networks
5. Analyse positive real functions
6. Solve most simple and some complex circuits for their parameters (Voltage, current, power, etc.) using different network theorems and transforms

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | Analysis of learning of 1-5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | Analysis of learning of 1-5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | Analysis of learning of 1-5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

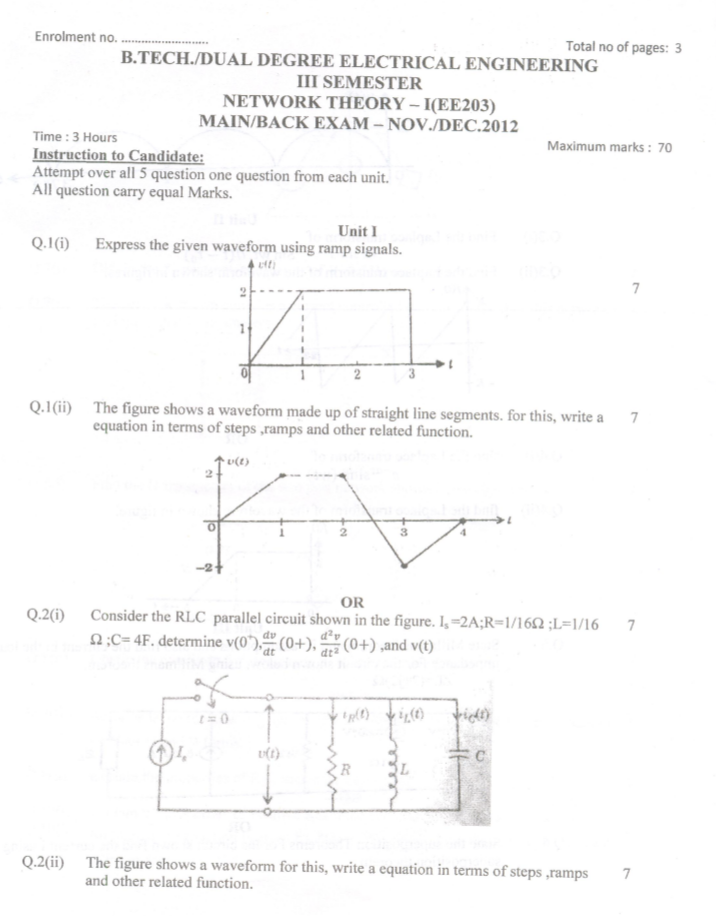
**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

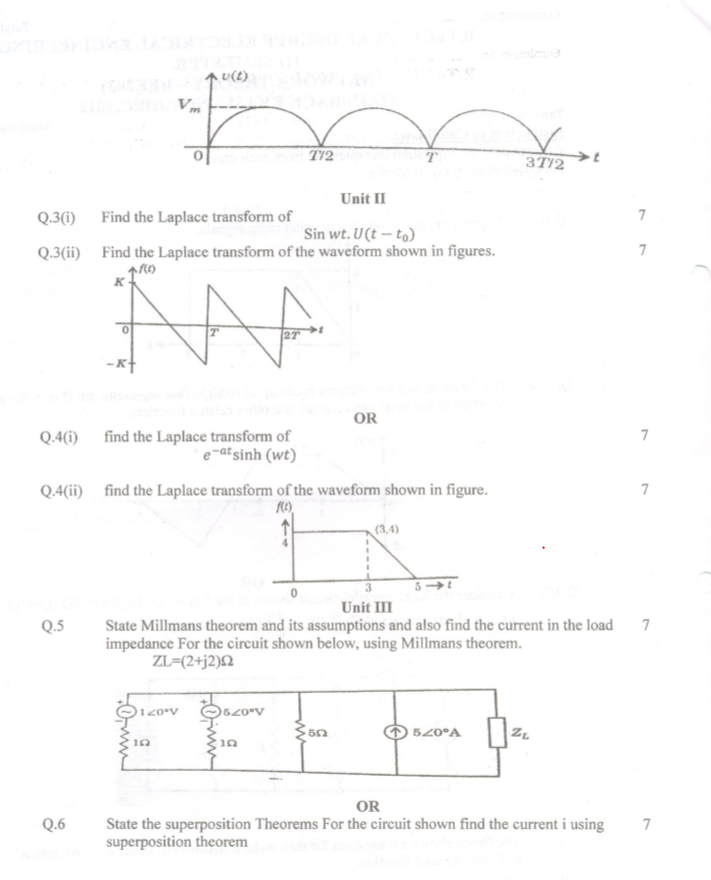
|  |
| --- |
| **Composition of Educational Components:** |

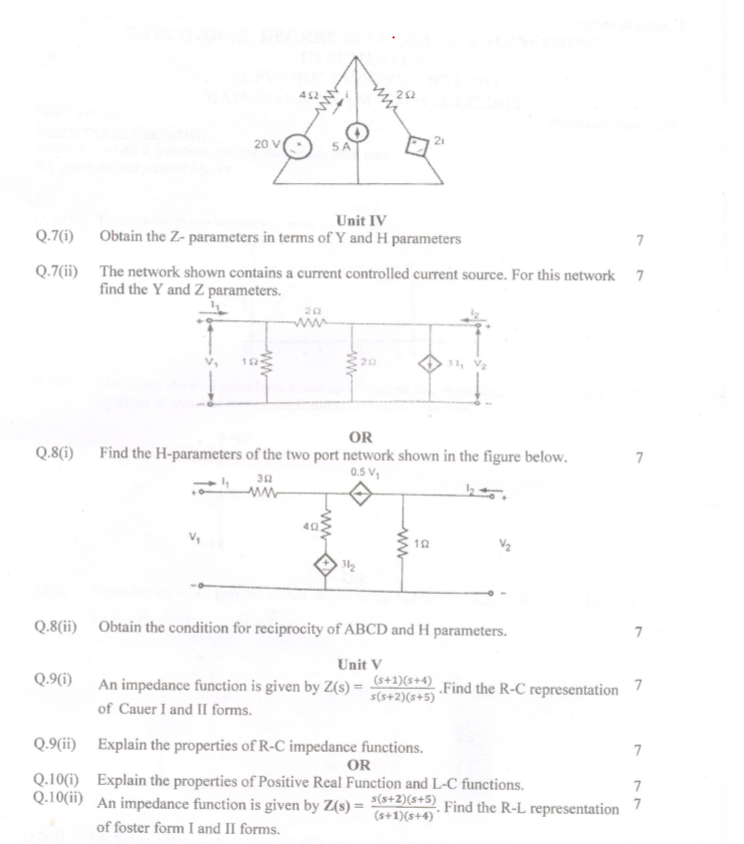
Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**







|  |  |
| --- | --- |
| Course Title: **ELECTRICAL** **MACHINES – I** | Course Code :  **EE 211** |
| Semester : **III** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree (3,5)** | |

**Pre-requisites:**

Basic Electrical Theorems.

**Course Objectives:**

1. Help the learner to understand basic principle and operation of energy conversion principle.
2. Understand the DC machines: Construction, armature windings; EMF and torque equations, starting, speed control and braking of DC motor.
3. Understand the generator and motor mode of operations; armature reaction, commutation; characteristics of DC motors
4. Understand the principle of operation of transformer.
5. Learn about different type of connection in poly-phase transformer.
6. Make students familiar with the DC electromagnetic conversion devices, their structures and working, such that students can use them easily in the industry afterwards.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Electromechanical Energy Conversion** | 8 | 20 |
| Basic principles of electromechanical energy conversion. Basic aspects and physical phenomena involved in energy conversion. Energy balance. |  |  |
| UNITS-2: **DC generators** | 10 | 20 |
| Construction, Types of DC generators, EMF equation, lap and wave windings, equalizing connections, armature reaction, commutation, methods of improving commutations, demagnetizing and cross magnetizing MMF, inter-poles, characteristics, parallel operation. Rosenberg generator. |  |  |
| UNITS-3: **DC Motors** | 10 | 20 |
| Principle, back EMF, types, production of torque, armature reaction and inter-poles, characteristics of shunt, series and compound motor, DC motor starting. Speed Control of DC Motor: Armature voltage and field current control methods, Ward Leonard method. Braking, losses and efficiency, direct and indirect test, Swinburne’s test, Hopkinson test, field and retardation test, single-phase series motor. |  |  |
| UNIT-4: **Transformers** | 12 | 20 |
| Construction, types, EMF equation. No load and load conditions. Equivalent circuits, Vector diagrams, OC and SC tests, Sumpner’s back-to-back test, efficiency. Voltage regulation, effect of frequency, parallel operation, autotransformers, switching currents in transformers, separation of losses. |  |  |
| UNIT 5: **Poly-phase Transformers** | 8 | 20 |
| Single unit or bank of single-phase units, poly-phase connections, Open delta and V connections, Phase conversion: 3 to 6 phase and 3 to 2 phase conversions, Effect of 3-phase winding connections on harmonics, 3-phase winding transformers, tertiary winding |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. P.S.Bimbhra, Electrical Machinery, 2000, Khanna publishers New Delhi.

1. J.Nagrath and D.P.Kothari, Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

2. GopalK.Dubey, Fundamental of Electrical Drives, 2001 Narosa Publishing House, New Delhi

3. Fitzrald,Kingsley and Umans Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

4. Advance Electrical Technologies by H.Cotton

5. Alexander S. Langsdorf, “Theory of Alternating current Machinery” Second Edition, TATA McGRAW-HILL, 1983.

**Course outcomes:**

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

1. Explain principles of electromechanical energy conversion
2. Armature reaction, commutation
3. parallel operation of generators
4. Speed Control of DC Motor: Armature voltage and field current control methods
5. Voltage regulation, effect of frequency, parallel operation of transformers
6. Use various types of DC electrical machines in the industry

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

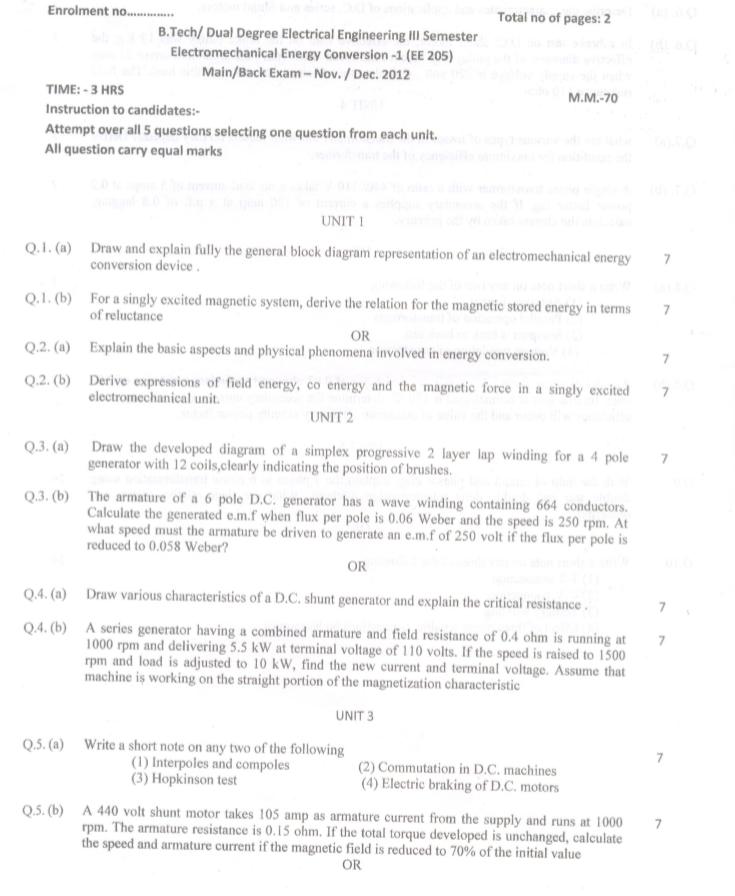
**Model Question Paper:**

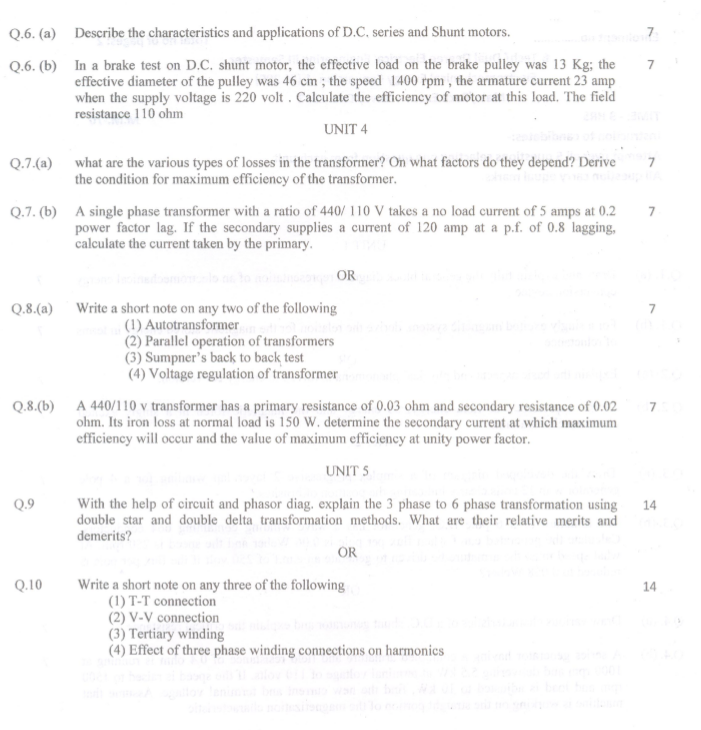
**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to

* The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
* Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
* Student shall be given Internal choice in every Unit.

1. Questions should not be set from the recapitulation topics.





|  |  |
| --- | --- |
| Course Title: **ELECTRICAL** **MACHINE LAB-I** | Course Code : EE 259 |
| Semester : III | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |
|  | |

**Pre-requisites:**

EE 211: Electrical Machines.

**Course Objectives:**

1. Help the learner to understand basic principles, operation and design of electrical drives.
2. Understand the connection of voltmeter, ammeter and wattmeter and use of tacho-generator
3. Understand practical use of starters and speed control methods
4. Understand losses occurring at various stages
5. Impart learning about various speed control methods for DC electrical machines.
6. Learn about various tests done on transformers to obtain their parameters.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. No.** | **Topic and Contents** | | **Hours** | **Marks** |
|  | Speed control of D.C. shunt motor by (a) Field current control method and plot the curve for speed vs field current. (b) Armature voltage control method and plot the curve for speed vs armature voltage. | | 2 |  |
|  | Speed control of a D.C. Motor by Ward Leonard method and to plot the curve for speed vs applied armature voltage. | | 2 |  |
|  | To determine the efficiency of D.C. Shunt motor by loss summation (Swinburne’s) method | 2 | |  |
|  | To determine the efficiency of two identical D.C. Machine by Hopkinson’s regenerative test.. | | 2 |  |
|  | To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency. | | 2 |  |
|  | To perform back-to-back test on two identical 1-phase transformers and find their efficiency and parameters of the equivalent circuit. | | 2 |  |
|  | To perform parallel operation of two 1-phase transformers and determine their load sharing. | | 2 |  |
|  | To perform the load test on single phase D.C. generator. | | 2 |  |
|  | To perform OC and SC test on a 3-phase transformer and find its efficiency and parameters of its equivalent circuit | | 2 |  |
|  | To perform parallel operation of two 3-phase transformers and determine their load sharing | | 2 |  |
|  | **TOTAL** | | **20** |  |

**Reference:**

1. Electrical and Electronics measurements and measuring instruments. A.K.SAWHNEY – Dhanpat Rai and Sons
2. Electrical measurements and measuring instruments by Rajendra Prasad - Khanna Publishers
3. A course in Electronics and Electrical measurements and instrumentation by J.B.GUPTA - Kataria Publications
4. Electrical measurements and measuring instruments by Rajendra Prasad – Khanna Publishers

**Course outcomes:**

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

1. Student will be able to measure the AC and DC electrical quantities(voltage, current and energy)
2. Measurement of power loss in motors and find efficiency
3. Determine the parameters of its equivalent circuit its voltage regulation and efficiency of machines
4. Determine the load, speed and current characteristics
5. Perform parallel operation of transformers and DC machines
6. Work on basic transformers and DC electrical machines, and obtain their parameters and do their speed control.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **ELECTRICAL ENGINEERING DRAWING LAB** | Course Code : EE 255 |
| Semester : III | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Basic units of electrical components, their uses.

**Course Objectives:**

1. Implement various Electrical components and analyse their performance
2. Implement various Electrical wiring and understand the effect of various joints.
3. Observe the performance of various Electrical Wiring through AUTOCAD software.
4. Make students familiar with AUTOCAD software and its various applications in Electrical Engineering.

**Course Content:**

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** | **Marks** |
| **I** | Explain and draw different types of wiring manually or/and using AUTOCAD software. | 8 | 20 |
| **II** | Explain and draw different types of joints used in electrical wiring manually or/and using AUTOCAD software | 8 | 20 |
| **III** | Explain and draw different types of winding (of DC generator) manually or/and using AUTOCAD software | 8 | 20 |
| **IV** | Explain and draw different types of cores of transformer manually or/and using any software. | 8 | 20 |
| **V** | Make estimation and costing of a new building of shopping mall/installation from electrical point of view. | 8 | 20 |

**Reference:**

Lab Manuals

**Course outcomes:**

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

1. Understand the practical response of various Electrical components.
2. Understand the practical response of various Electrical wiring Systems when working together.
3. Through project development, students will be able to design, develop and implement Electrical wiring.
4. Use AUTOCAD for various applications in Electrical Design.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

1. The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL CIRCUITS LAB** | Course Code : EE 261 |
| Semester : III | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech. Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Basic circuit analysis

**Course Objectives:**

1. Understand the practical application of theorems studied in Circuit Theory Course
2. Help the learner to understand basic principle and working of continuous time signals & systems.
3. Understand the application of Laplace transforms.
4. Understand the use and application of network theorems.
5. Learn about two port networks.
6. Learn about positive real functions.
7. Make students familiar with the various types of simple electrical circuits, and use network theorems and transform techniques to solve them.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Introduction to basics of equipment and components used in Circuits Lab | | 2 | 4 |
|  | Introduction to AC and DC power supply equipment. | | 2 | 4 |
|  | Analysis and recognition of various electrical components –  Capacitors, Inductors, Transformers |  | | 4 |
|  | Analysis and recognition of various electrical components –  Relays, Solder wire, Soldering iron | | 2 | 4 |
|  | Verification of KCL using two networks. | | 2 | 4 |
|  | Verification of KVL using two networks. | | 2 | 4 |
|  | Verification of Thevenin’s Theorem using physical components. | | 2 | 4 |
|  | Verification of Norton’s Theorem using physical components. | | 2 | 4 |
|  | Verification of Superposition Theorem using physical components. | | 2 | 4 |
|  | Verification of Maximum Power Transfer Theorem | | 2 | 4 |
|  | **TOTAL** | | **20** | **40** |

**Reference:**

1. A Chakrabarti and S. Bhadra, ‘Networks and Systems’ Dhanpat Rai and Co
2. M.E. Van Valkenberg, ‘Network Analysis’ Prentice Hall
3. D. Roy Choudhary, ‘Networks and Systems’
4. W. H. Hayt and J. E. Kemmerly, Engineering circuit Analysis, TATA MCGRAW HILL

**Course outcomes:**

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

1. Analyse continuous time signals & systems

2. Apply Laplace transforms techniques.

3. Apply network theorems practically.

4. Evaluation of two port networks

5. Analyse positive real functions

6. Solve some simple and some complex electrical circuits with the help of network theorems and transform techniques.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title**: ELECTRONIC DEVICES AND CIRCUITS** | Course Code : EC 201 |
| Semester : III | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Basic Electronic Parameters.

**Course Objectives:**

1. Explain the basic knowledge representation, problem solving, and learning methods Semiconductor Devices.
2. Asses the applicability, strength, and weakness of the basic knowledge representation ,problem solving and learning methods on BJT.
3. Develop intelligent system by assembling solutions of FET.
4. Develop an interest in the Advantage of Small Signal Amplifiers at Low Frequency.

**Course Content:**

|  |  |
| --- | --- |
| UNIT-1: **REVIEW** | 7 |
| Mobility and conductivity, Conductors, semiconductors, and insulators; Drift and diffusion currents; p-n junction; junction under forward and reverse bias charge densities in a semiconductor, Fermi Dirac distribution, carrier concentrations and Fermi levels in semiconductor, Generation and recombination of charges, diffusion and continuity equation, Mass action Law, Hall effect.. |  |
| UNITS-2: **SEMICONDUCTOR DIODES** | 7 |
| Introduction to Junction diodes, Diode as a ckt. Element, load line concept, Zener diode regulator, clipping and clamping circuits, Voltage multipliers |  |
| UNITS-3: **BIPOLAR JUNCTION TRANSISTOR** | 7 |
| Transistor characteristics, Current components, Current gains: alpha and beta. Operating point. Hybrid model, h-parameter equivalent circuits. CE, CB and CC configuration. DC and AC analysis of CE, CC and CB amplifiers. Ebers-Moll model. Biasing and stabilization techniques. Thermal runaway, Thermal stability |  |
| UNIT-4: **FIELD EFFECT TRANSISTORS** | 7 |
| JFET, MOSFET, Equivalent circuits and biasing of JFET's and MOSFET’s. Low frequency CS and CD JFET amplifiers. FET as a voltage variable resistor. |  |
| UNIT 5: **SMALL SIGNAL AMPLIFIERS AT LOW FREQUENCY** | 8 |
| Analysis of BJT and FET, DC and RC coupled amplifiers. Frequency response, midband gain, gains at low and high frequency. Analysis of DC and differential amplifiers, Miller's Theorem. Cascading Transistor amplifiers, Darlington pair. Emitter follower, source follower. |  |

**Reference:**

1. Electronic Devices and Circuits–II, R.Tiwari, Genius publications 2013

2. M. H. Rashid, Microelectronic Circuits Analysis and Design, Cengage Learning 2010

**Course outcomes:**

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

1. Explain the basic knowledge representation, problem solving, and learning methods Semiconductor Devices.
2. Asses the applicability, strength, and weakness of the basic knowledge representation ,problem solving and learning methods on BJT.
3. Develop intelligent system by assembling solutions of FET.
4. Develop an interest in the Advantage of Small Signal Amplifiers at Low Frequency.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S | S |  |  |  |  |  |  |  |  |  |  |
| 3 | S |  |  |  |  |  |  | M |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  | M |  |  |  |
| 5 | S |  | S |  |  |  |  |  |  |  |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 40 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 35 |

|  |  |
| --- | --- |
| Course Title:  **Industry Oriented Electronic Devices And Circuits Project Lab** | Course Code : EC 253 |
| Semester : III | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Electronic Devices And Circuits

**Course Objectives:**

1. Understand the practical application of theorems studied in Electronics Device And Circuit Course
2. .Help the learner to understand basic principle and working of continuous time signals & systems.
3. Understand the application of laplace transforms.
4. Understand the use and application of network theoroms.
5. Learn about positive real functions.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **List of Experiments** | **Hours** |
| 1. | Study the following devices: | 2 |
|  | (a) Analog and digital multimeters |  |
|  | (b) Function/ Signal generators |  |
|  | (c) Regulated d. c. power supplies (constant voltage and constant current operations) |  |
|  | (d) Study of analog CRO, measurement of time period, amplitude, frequency and phase angle using Lissajous figures. |  |
| 2. | Plot V-I characteristic of P-N junction diode and calculate cut-in voltage, reverse saturation current and static and dynamic resistances. | 2 |
| 3. | Plot V-I characteristic of zener diode and study of zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator. | 2 |
| 4. | Plot frequency response curve for single stage amplifier and to determine gain bandwidth product. | 2 |
| 5. | Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of Idss and Vp | 2 |
| 6. | Application of Diode as clipper and clamper | 2 |
| 7. | Plot gain- frequency characteristic of two stage RC coupled amplifier and calculate its bandwidth and compare it with theoretical value. | 2 |
| 8. | Plot gain- frequency characteristic of emitter follower and find out its input and output resistances. | 2 |
| 9. | Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h parameters. | 2 |
| 10. | Study half wave and bridge rectifier and effect of filters on wave. Also calculate theoretical and practical ripple factor. | 2 |
|  | **Total** | 20 |

**Reference:**

Lab Manual

**Course outcomes:**

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

1. Student will be able to analyse continuous time signals & systems

2. Apply Laplace transforms techniques.

3. Apply network theorems practically.

4. Evaluation of Electronic Devices.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | M | M | S | S | M |  |  | M |  |  | M |
| 2 | S | M | S | M |  |  |  | S | M |  | M |
| 3 | S | M | S | S |  |  |  |  |  |  | M |
| 4 | S | S | M | S |  | M |  | S |  |  | M |
| 5 | S | S |  | S | S |  | S |  |  | S | M |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **SWACHH BHARAT ABHIYAN** | Course Code : |
| Semester : **III** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : | Credits : 2 **Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : |
| Continuous Internal Evaluation : | ESE : |
| Programmes: **B.Tech. Electrical Engineering** | |

|  |  |  |
| --- | --- | --- |
| Unit-1 | Introduction to Health, Hygiene, and Sanitation ; The Need for Health, Hygiene, and Sanitation Education ; Related International projects on Health and Hygiene; Overview of the Swachh Bharat ; Qualities of Healthy Living. |  |
| Unit-2 | Hygiene - Understanding of Hygiene; Desired Definition of Hygiene; The Hygiene Practices of the different categories of family in India; Role of Family, Institutions and Corporations and government in Developing Hygiene consciousness. |  |
| Unit-3 | Sanitation ; Understanding the importance of sanitation; The facilities developed for sanitation; Means adopted to promote the use of Sanitation Facilities; Sanitation Facilities provided by government under Swachh Bharat Abhiyaan. |  |
| Unit-4 | Water Storage Methods; Water Contamination ; Prevention of Water Contamination ; The Health Risks, especially due to Water Borne Diseases; Water Purification ; Importance of Safe water use; Government’s role and actions taken for awareness generation for consumption of pure water and preventing contamination of Water. |  |
| Unit-5 | Waste Management – Introduction, importance and need; Action Plans for Healthy Living introduced under Swachh Bharat Abhiyaan; Means adopted for Waste Management under Swachh Bharat Abhiyaan. |  |

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| --- | --- |
| Course Title:  **NUMERICAL ANALYSIS AND STATISTICS** | Course Code :  **MA 202** |
| Semester : **IV** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : 3**:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: **B.Tech. Electrical Engineering** | |

**Pre-requisites:**

NUMERICAL ANALYSIS AND STATISTICS

**Course Objectives:**

1. To learn the different method of numerical analysis using finite differences
2. To learn the different method of numerical analysis using integration differences.
3. To aware and learn about the Bessels function of various kind and use of them.
4. To acquire knowledge about Probability and Random variables

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Numerical Analysis** | 10 | 20 |
| Finite differences - Forward backward and central difference. Newton’s forward and backward differences interpolation formulae. Sterling’s formulae, Lagrange’s interpolation formula. Solution of non-linear equations in one variable by Newton Raphson and Simultaneous algebraic equation by Gauss and Regula Falsi method. Solution of simultaneous equations by Gauss elimination and Gauss Seidel methods. Fitting of curves (straight line and parabola of second degree) by method of least squares. |  |  |
| UNITS-2: **Numerical Analysis** | 10 | 20 |
| Numerical differentiation, numerical integration trapezoidal rule, Simpson’s one-third and one eighth rule. Numerical Integration of ordinary differential equations of first order, Picard’s method, Euler’s and modified Euler’s methods. Miline’s method and Runga Kutta fourth order method. Simple linear difference equations with constant coefficients |  |  |
| UNITS-3: **Special Functions** | 10 | 20 |
| Bessel’s function of first and second kind, simple recurrence relations, orthogonal property of Bessel functions, Transformation, Generating functions, Legendre’s function of first kind, simple recurrence relations, orthogonal property, Generating functions. |  |  |
| UNIT-4: **Statistics and Probability-I** | 10 | 20 |
| Elementary theory of probability, Baye’s theorem with simple applications, Expected value. Theoretical probability distributions – Binomial, Poisson and Normal distributions. |  |  |
| UNIT 5: **Statistics and Probability-II** | 08 | 20 |
| Lines of regression, co-relation and rank correlation. **Transforms**: Z-transforms, its inverse, simple properties and application to difference equations. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. Advanced Engg. Mathematics, Irvin Kreyszig, Wiley .(2007)
2. Datta – Mathematical methods of science & engineering, Cengage learning 2012
3. O’neil – Advanced Engineering mathematics, Cengage learning 2007

**Course outcomes:**

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

1. Apply these various numerical analysis methods for complex problems.
2. Apply the various functions in various problems. Also able to short out these problems.
3. Solve the complex problem of Probability and Random variables using the concepts of this course.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | S | S |  | S | S |  |  |  |  |  | M |
| 2 | S | S |  | S | S |  |  |  |  |  | M |
| 3 | S | S |  | S | S |  |  |  |  |  | M |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSESSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 8 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 7 to 9 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 6 |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 9 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **Computer Programming Lab** | Course Code : CP 262 |
| Semester : IV | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : 0**:0:3** | Credits : 1 **Credits** |
| Type of course : **Practical** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: B. Tech. Electrical Engineering | |

**Pre-requisites:**

C Programming

**Course Objectives:**

1. Understanding concept of basic commands used in the UNIX operating system
2. Implementation of shell how we make a program in shell, pipeline and I/O redirection
3. Implementation of array using shell
4. Implementation of commands and formation of result using shell
5. Implementation of file system and the directories of UNIX system

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **List of Experiments** |  | **Hours** |
|  | UNIX Use of advanced vi commands. | 2 |
|  | Sorting of files containing records using sort command | 2 |
|  | Searching patterns in files. | 2 |
|  | Use of bc, expr, factor commands. | 2 |
|  | Use of head, tail, compress commands | 2 |
|  | Memory management commands, dfspace, du, ulimitetc | 2 |
|  | JAVA | 2 |
|  | Programs based on matrix: addition, multiplication, transpose, check if matrix is symmetric / upper triangular / lower triangular / unit matrix. | 2 |
|  | Representation of complex numbers and their operation: add, multiply; divide, subtraction, magnitude (mod) etc. | 2 |
|  | Complex matrix representation and operation: add, subtract, multiply. | 2 |
|  | Defining packages for sorting algorithms. | 2 |
|  | File handling operations: input from file, output to file, file copy, file concatenation. | 2 |
|  | Mouse and keyboard event handling programs. | 2 |
|  | Programs based on string operations. | 2 |
|  | Drawing in applet and use of buttons check boxes, text fields and labels in applets. | 2 |
|  | **Total** | 20 (Any 10) |

**Reference:**

Lab manual

**Course outcomes:**

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

1. Get knowledge of importance of the shell in UNIX platform
2. How we configure the LINUX platform
3. How we implement shell script in vi-editor
4. Get knowledge of shell commands.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S |  |  |  |  |  |  |  |  |  |  |
| 2 | S |  | S |  |  |  |  |  |  |  |  |  |
| 3 | S | S |  |  |  |  |  |  |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  | M |  |  |  |
| 5 | S |  |  |  |  |  |  |  |  |  | M |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Attendance | Student | Every lab | 10 | Attendance Register |  |
| Performance+ Record+ viva | Every lab | 30 | Lab Record |  |
| Project | Every lab | 20 | Project Report |  |
| **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 30 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 45 |

|  |  |
| --- | --- |
| Course Title: **CIRCUIT ANALYSIS II** | Course Code : EE 208 |
| Semester : IV | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes:  **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Basics of circuits, KVL, KCL, Ohm’s law.

**Course Objectives:**

1. To understand complex frequency and pole-zero behaviour in networks.
2. Analyse the Hurwitz polynomials and Cauer - Foster method.
3. Evaluate two port parameters of networks.
4. To understand the working of active and passive filters.
5. Understand the basic concept of coupled circuits.
6. Make students familiar with basic electrical networks and their parameters like impedance, admittance etc.
7. Impart knowledge about two-port networks and their characteristics.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Impedance and Admittance Functions Network Functions** | 8 | 20 |
| The concept of complex frequency, transform impedance and admittance, series and parallel combinations.  Terminals and terminal pairs, driving point impedance transfer functions, poles and zeros. Restrictions on pole and zero location in s-plane. Time domain behaviour from pole and zero plot. Procedure for finding network functions for general two terminal pair networks |  |  |
| UNITS-2 **Network Synthesis** | 10 | 20 |
| Hurwitz polynomial, positive real functions, reactive networks. Separation property for reactive networks. The four-reactance function forms, specification for reactance function. Foster form of reactance networks. Cauer form of reactance networks. Synthesis of R-L and R-C networks in Foster and Cauer forms |  |  |
| UNITS-3: **Two Port General Networks** | 12 | 20 |
| Two port parameters (impedance, admittance, hybrid, ABCD parameters) and their inter relations. Equivalence of two ports. Transformer equivalent, inter connection of two port networks. The ladder network, image impedance, image transfer function, application to L-C network, attenuation and phase shift in symmetrical T and **π** networks |  |  |
| UNIT-4: **Two Port Reactive Network (Filters)** | 8 | 20 |
| Constant K filters. The m-derived filter. Image impedance of m-derived half (or L) sections, composite filters. Band pass and band elimination filters. The problem of termination, lattice filters, Barlett’s bisection theorem. Introduction to active filters.. |  |  |
| UNIT 5 **Coupled Circuits** | 10 | 20 |
| Conductively coupled circuits. Mutual impedance, magnetic coupling, mutual inductance, co-efficient of magnetic coupling, circuit directions and sign of mutual inductance, mutual inductance between portions of the same circuit, mutual inductance between parallel branches, transferred impedance. Transformer equivalent inductively and conductively coupled circuits; Resonance in Single tuned and Double tuned circuits, effect of coefficient of coupling. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1) M.E. Van Valkenberg, ‘Network Analysis’ Prentice Hall

2) D. Roy Choudhary, ‘Networks and Systems’

3) W. H. Hayt and J. E. Kemmerly, Engineering circuit Analysis, TATA MCGRAW HILL

4) A Chakrabarti and S. Bhadra, ‘Networks and Systems’ Dhanpat Rai and Co

**Course outcomes:**

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

1. Understand complex frequency and pole-zero behaviour in networks.
2. Analyse the Hurwitz polynomials and Cauer-Foster method.
3. Evaluate two port parameters of networks.
4. Understand the working of active and passive filters.
5. Understand the basic concept of coupled circuits.
6. Do network analysis and synthesis using the techniques taught in course.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 5, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL MACHINES II** | Course Code : EE 212 |
| Semester : IV | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Engineering Physics & Circuit Theory

**Course Objectives:**

1. Understand the basic principle construction, operation rotating machine
2. Understand the basic principle construction, operation performance characteristics and steady state and transient analysis of induction machines
3. Understand the basic principle construction, operation performance characteristics and steady state and transient analysis of synchronous machines
4. Understand the principle, construction, operation, control and applications of special electric motors
5. To make the students familiar with different types of AC rotating electrical machines, and how to test, operate and control (speed, voltage, etc.) them.

**Course Content:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic and Contents** | | **Hours** | **Marks** |
|  | | | |
| **Unit 1 Introduction** | | 8 | 20 |
| General equation of inducted EMF, AC armature windings: concentric and distributed winding, chording, skewing, effect on induced EMF. Armature and field MMF, effect of power factor and current on armature MMF, harmonics. Rotating fields | |  |  |
|  | | | |
| **Unit 2 Induction Motors** | 10 | | 20 |
| Construction of squirrel cage and slip ring induction motor, basic principles, flux and MMF waves, induction motor as a transformer. Equivalent circuits, torque equation, torque-slip curves, no load and block rotor tests, circle diagram, performance calculation. Effect of rotor resistance. Cogging, Crawling. Double cage squirrel cage induction motor, induction generator, induction regulator. | |  |  |
|  | | | |
| **Unit 3 Starting and Speed Control of Induction Motors** | | 10 | 20 |
| Various methods of starting and speed control of squirrel cage and slip ring motor, cascade connection, braking. **Single-Phase Induction Motor:** Revolving field theory, starting methods, equivalent circuits | |  |  |
|  | | | |
| **Unit 4 Synchronous Generator** | | 10 | 20 |
| Construction, types, excitation systems, principles. Equation of induced emf, flux and emf waves, theory of cylindrical rotor and salient pole machines, tworeactance theory, phasor diagrams, power developed, voltage regulation, OC and SC tests, zero power factor characteristics, potier triangle and ASA method of finding voltage regulation, synchronization, parallel operation, hunting and its prevention | |  |  |
|  | | | |
| **Unit 5 Synchronous Motors** | | 10 | 20 |
| types, construction, principle, phasor diagrams, speed torque characteristics, power factor control, V-curves, starting methods, performance calculations, applications, synchronous condenser, synchronous induction motor | |  |  |
| **TOTAL** | | **48** | **100** |

**Reference:**

1. 1. Electrical Machine, Dr P.K. Mukherjee and S. Chakravarti - Dhanpat Rai & Co
2. P.S. Bimbhra, Electrical Machinery, 2000, Khanna publishers New Delhi
3. J. Nagrath and DP Kothari, Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.
4. Gopal K. Dubey, Fundamental of Electrical Drives, 2001, Narosa Publishing House, New Delhi
5. Fitzrald, Kingsley and Umans Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.
6. Advance Electrical Technologies by H. Cotton
7. Alexander S. Langsdorf, “Theory of Alternating current Machinery” Second Edition, TATA McGRAW HILL, 1983.

**Course outcomes:**

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

1. Understand principle, construction, laying of armature and field windings, types, generation of EMF, methods of starting, steady state and transient behaviour of induction motors.
2. Understand steady state and transient behaviour, synchronization and parallel operation of synchronous generators.
3. Understand principle, construction, methods of starting of synchronous motors, steady state and transient behaviour and application of synchronous motor, its operation with variable load operation with variable excitation, performance evaluation.
4. Work on AC rotating electrical machines in industry, and will also be able to test and design them.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 4 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 4 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 2,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **GENERATION OF ELECTRICAL POWER** | Course Code : EE 206 |
| Semester : IV | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes:  **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Basic electrical engineering, Basic economics

**Course Objectives:**

1. Understand structure and mass flow of various conventional power plants.
2. Impact of conventional power plants on environment.
3. Study and awareness of India and world energy scenario
4. Application and calculation of power factor and tariff.
5. Calculate the various economic parameters of power plants.
6. Study and understand new and renewable energy sources
7. To impart knowledge to the students about various types of power plants in a power system and the energy sources used in them.
8. To make students familiar with various aspects of Power System Economics, like load factor, power factor, energy cost selection, energy tariff and optimum selection of plants for generation.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Conventional Energy Generation Methods**: | 6 | 20 |
| 1. **Thermal Power plants:** Basic schemes and working principle. 2. **Gas Power Plants:** open cycle and closed cycle gas turbine plants, combined gas & steam plants – basic schemes. 3. **Hydro Power Plants:** Classification of Hydroelectric plants. Basic schemes of hydroelectric and pumped storage plants. 4. **Nuclear Power Plants:** Nuclear fission and nuclear fusion. Fissile and fertile materials. Basic plant schemes with boiling water reactor, heavy water reactor and fast breeder reactor. Efficiencies of various power plants. |  |  |
| UNITS-2: **New Energy Sources** | 06 | 20 |
| Impact of thermal, gas, hydro and nuclear power stations on environment. Green House Effect (Global Warming). Renewable and non-renewable energy sources. Conservation of natural resources and sustainable energy systems. Indian energy scene. Introduction of electric energy generation by wind, solar and tidal. |  |  |
| UNITS-3: **Load and power factor** | 08 | 20 |
| 1. **Loads and Load curves:** Types of load, chronological load curve, load duration curve, energy load curve and mass curve. Maximum demand, demand factor, load factor, diversity factor, capacity factor and utilization 2. **Power factor improvement**: Causes and effects of low power factor and advantages of power factor improvement. Power factor improvement using shunt capacitors and synchronous condensers. |  |  |
| UNIT-4: **Power Plant Economics:** | 8 | 20 |
| 1. Capital cost of plants, annual fixed and operating costs of plants, generation cost and depreciation. Effect of load factor on unit energy cost. Role of load diversity in power system economics. 2. Calculation of most economic power factor when (a) kW demand is constant and (b) kVA demand is constant. 3. **Energy cost reduction:** off peak energy utilization, co-generation, and energy conservation. |  |  |
| UNIT 5: **Tariff and plant selection** | 08 | 20 |
| **(i) Tariffs:** Objectives of tariffs. General tariff forms. Flat demand rate, straight meter rate, block meter rate. Two part tariff, power factor dependent tariffs, three-part tariff. Spot (time differentiated) pricing.  **(ii) Selection of Power Plants:** Comparative study of thermal, hydro, nuclear and gas power plants. Base load and peak load plants. Size and types of generating units, types of reserve and size of plant. Selection and location of power plants. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Generation of Electric Energy B.R. Gupta, S. Chand Publishers

2. Power Plant Engineering Dom Kundwar.

3. Generation of Electric power S.N. Singh.

4. Power System Engineering A. Chakrabarti, M. L. Soni, P. V. Gupta, U.S. Bhatnagar.

**Course outcomes:**

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

1. Solve the problems on power plant economics
2. Solve the problems on power factor and tariff.
3. Evaluate the need of new of renewable energy
4. Prepare base for further study in power engineering.
5. Enable students to solve real life problems of power factor and tariff.
6. Work in industry on power system grids, knowing the various factors guiding the power system generation and economy.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 3 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 30 |
| 2 | Applying the knowledge acquired from the course | 30 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL MACHINES LAB II** | Course Code : EE 260 |
| Semester : IV | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Electrical Machines.

**Course Objectives:**

1. To understand the starting, speed control and braking of AC rotating electrical machines.
2. To develop an ability to find heating and cooling characteristics of electric motors.
3. To learn the various tests done on transformers to find out its parameters.
4. To learn the various tests done to find out the parameters of an AC rotating electrical machine.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Separation of transformer core losses and to determine the hysteresis and eddy current losses at rated voltage and frequency | | 2 |  |
|  | To plot the O.C.C. and S.C.C. of an alternator and to determine its regulation by synchronous impedance method. | | 2 |  |
|  | To synchronize an alternator across the infinite bus (RSEB) and summarize the effects of variation of excitation on load sharing | 2 | |  |
|  | To plot the V-curve for a synchronous motor for different values of loads | | 2 |  |
|  | To perform Sumpner’s back-to-back test on 3 phase transformers, find its efficiency and parameters for its equivalent circuits | | 2 |  |
|  | To perform the load test on a 3-phase induction motor and determine its performance characteristics (a) Speed vs load curve (b) pf vs load curve (c) Efficiency vs load curve (d) Speed vs torque curve | | 2 |  |
|  | To perform the heat run test on a delta/delta connected 3-phase transformer and determine the parameters for its equivalent circuit | | 2 |  |
|  | Determination of losses and efficiency of an alternator | | 2 |  |
|  | To perform no load and blocked rotor test on a 3 phase induction motor and to determine the parameters of it equivalent circuits. Draw the circle diagram and compute the following (i) Max. Torque, (ii) Current, (iii) slip, (iv) pf, (v) Efficiency. | | 2 |  |
|  | To find Xd and Xq of a salient pole synchronous machine by slip test. | | 2 |  |
|  | **TOTAL** | | **20** |  |

**Reference:**

Lab Manual

**Course outcomes:**

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

1. Determine the parameters of a three-phase transformer using Sumpner’s back-to-back test or Heat Run test.
2. Find out the parameters of an alternator using O.C.C., S.C.C. and V-curve.
3. Calculate the parameters of a three-phase induction motor through no-load and blocked-rotor tests, and determine its various characteristics.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **Power System Design Lab** | Course Code : EE 258 |
| Semester : IV | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Practical knowledge is important with the subject GPE.

**Course Objectives:**

1. Make students familiar with the design considerations and basic schemes of different power plants.
2. Help the learner to understand the basic principles and working of Power System components like power plants, feeders, distributors, transmission lines, substations, CTs, PTs, etc.
3. Instruct about the various types of load forecasting.
4. Understand the calculation and transmission of power in Power Systems.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Generating station design: Design considerations and basic schemes of hydro power plant. | | 2 |  |
|  | Generating station design: Design considerations and basic schemes of thermal power plant. | | 2 |  |
|  | Generating station design: Design considerations and basic schemes of nuclear power plant. | 2 | |  |
|  | Generating station design: Design considerations and basic schemes of gas power plants. | | 2 |  |
|  | Study of Electrical equipment for power stations. | | 2 |  |
|  | Auxiliary power supply scheme for thermal power plant. | | 2 |  |
|  | Distribution system Design: Design of feeders & distributors. Calculation of voltage drops in distributors. Calculation of conductor size using Kelvin’s law. | | 2 |  |
|  | Sending end and receiving end power circle diagrams. | | 2 |  |
|  | Instrument Transformers: Design considerations of CTs & PTs for measurement and protection. | | 2 |  |
|  | Substations: Types of substations, various bus–bar arrangements. | | 2 |  |
|  | Methods of short term, medium term and long term load forecasting. | | 2 |  |
|  | **TOTAL** | | **20(Any 10)** |  |

**Reference:**

Lab Manual.

**Course outcomes:**

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

1. Identify and work on different types of power plants.

2. Make complex calculations for determining various electrical quantities in the Power System, like – Sending end voltage, receiving end voltage, load forecasting, etc.

3. Work in Power Sector industry with the knowledge of different power system components and theorems.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title**: ANALOG ELECTRONICS** | Course Code : EC 202 |
| Semester : IV | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Basic Electronic Parameters.

**Course Objectives:**

1. Explain the basic knowledge representation, problem solving, and learning methods Semiconductor Devices.
2. Asses the applicability, strength, and weakness of the basic knowledge representation, problem solving and learning methods on Feedback Amplifier.
3. Develop intelligent system by assembling solutions of Oscillator.
4. Develop an interest in the Advantage of Small Signal Amplifiers at Low Frequency.

**Course Content:**

|  |  |
| --- | --- |
| UNIT-1: **FEEDBACK AMPLIFIERS** | 7 |
| Concept of feedback; Topologies: Voltage-voltage, current voltage, voltage-current, current-current; Stability and compensation. Transfer gain with feedback, General characteristics of negative feedback amplifiers. |  |
| UNITS-2: **OSCILLATORS** | 07 |
| Classification. Barkhausen criterion, damped oscillations in LC circuits, audio and rf oscillators. Tuned collector, Hartley, Colpitts, RC Phase shift, Wien bridge and crystal oscillators, Blocking oscillators. |  |
| UNITS-3: **HIGH FREQUENCY AMPLIFIERS** | 07 |
| High frequency models of BJT and FET, hybrid-π model, Gummel Poon model, generalized high frequency response of CE amplifier, gain-bandwidth product. Emitter follower at high frequencies. |  |
| UNIT-4: **TUNED AMPLIFIER** | 7 |
| Band Pass Amplifier, Parallel resonant Circuits, Band Width of Parallel resonant circuit. Analysis of Single Tuned Amplifier, Primary and Secondary Tuned Amplifier with BJT and FET. Double Tuned Transformer Coupled Amplifier. Stagger Tuned Amplifier. Pulse Response of such Amplifier. Shunt Peaked Circuits for Increased Bandwidth. |  |
| UNIT 5: **POWER AMPLIFIERS** | 08 |
| Power amplifier circuits, Class A output stage, class B output stage and class AB output stages, class C amplifiers, pushpull amplifiers with and without transformers. Complementary symmetry and quasi complimentary symmetry amplifiers |  |
| **Total** | 36 |

**Reference:**

1. Electronic Devices and Circuits–II, R.Tiwari, Genius publications 2013

2. M. H. Rashid, Microelectronic Circuits Analysis and Design, Cengage Learning 2010

**Course outcomes:**

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

1. Explain the basic knowledge representation, problem solving, and learning methods Semiconductor Devices.
2. Asses the applicability, strength, and weakness of the basic knowledge representation ,problem solving and learning methods on Feedback Amplifier.
3. Develop intelligent system by assembling solutions of Oscillator.
4. Develop an interest in the Advantage of Small Signal Amplifiers at Low Frequency.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S | S |  |  |  |  |  |  |  |  |  |  |
| 3 | S |  |  |  |  |  |  | M |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  | M |  |  |  |
| 5 | S |  | S |  |  |  |  |  |  |  |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 40 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 35 |

|  |  |
| --- | --- |
| Course Title**: DIGITAL ELECTRONICS** | Course Code : EC 204 |
| Semester : IV | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Basic Electronic Parameters.

**Course Objectives:**

|  |
| --- |
| 1. To provide an overview of the different number systems, their representation, basic logic gates & Boolean algebra. |
| 2.To provide the method of implementation of different logic families and comparison on basis of their characteristics |
| 3.To demonstrate the SOP/POS representation of Boolean functions. The minimization of these functions can be done by using various properties or using Kmap approach. |
| 4.To provide basis of the designing of various combinational circuits using basic gates. |
| The student will be able to |
| 1.Students will be able to know the basics of digital electronics which are used in digital system applications and determine the philosophy of number systems and codes. |
| 2. Students will understand the implementation of different gates. |
| 3. Students will be able to simplify the logic expressions using Boolean laws and postulates and design them by using logic gates and minimize the logic expressions using map method and tabular method. |
| 4. Students will be able to design combinational logic circuits using conventional gates |

**Course Content:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit -1 (7 Hours)** | |  | | --- | | **NUMBER SYSTEMS, BASIC LOGIC GATES and BOOLEAN ALGEBRA** | | Introduction to Boolean algebra, Boolean identities; Basic logic functions, combinational logic, standard forms of logic expressions. Features of logic algebra. Boolean function. Derived logic gates: Exclusive-OR, Nand, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and vica-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion. | |
| **Unit -2 (7 Hours)** | **MINIMIZATION TECHNIQUES**  Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic functions with K-map, conversion of truth tables in POS and SOP form. Incomplete specified functions. Variable mapping. Quinn-Mc Klusky minimization techniques |
| **Unit -3 (7 Hours)** | |  | | --- | | **COMBINATIONAL SYSTEMS** | | Multiplexers, demultiplexers and their use in logic synthesis; Arithmetic circuits like half and full adder, subtractor. Binary serial and parallel adders. BCD adder. Binary multiplier. Decoder: Binary to Gray code decoder, BCD to decimal, BCD to 7-segment decoder. Encoder- Octal to binary, BCD to excess-3 encoder. Diode switching matrix. | |
| **Unit -4 (8 Hours)** | |  | | --- | | **SEQUENTIAL SYSTEMS** | | Operation and excitation tables of RS, JK, Master Slave, D, and T flip flops; Latch, shift register; Counters: Ripple, synchronous, ring and up-down; Design of counters, design of other sequential circuits. | |
| **Unit -5 (7 Hours)** | |  | | --- | | **DIGITAL LOGIC GATE CHARACTERISTICS** | | Transistor as a switch, Schottky transistor; Logic gate characteristics: Propagation delay, speed, noise margin, fan-out and power dissipation.Analysis and characteristics of standard TTL, Schottky TTL, advanced TTL and ECL logic; MOS inverter and gate, CMOS logic, operation and characteristics of MOS and CMOS logic.Comparison of logic families, interfacing of various logic families; Tri-state logic. | |
| **Total (36 Hours)** |  |

**Reference:**

|  |
| --- |
| 1. Herbert Taub, Donald L. Schilling , “Digital integrated electronics”, TMH (2004) |
| 2 Ghoshal, “Digital Electronics”, Cengage Learning(2012) |
| 3 Millman Taub, “Pulse and digital Switching waveforms” ,TMH(1984) |

**Course outcomes:**

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

|  |
| --- |
| 1.Students will be able to know the basics of digital electronics which are used in digital system applications and determine the philosophy of number systems and codes. |
| 2. Students will understand the implementation of different gates. |
| 3. Students will be able to simplify the logic expressions using Boolean laws and postulates and design them by using logic gates and minimize the logic expressions using map method and tabular method. |
| 4. Students will be able to design combinational logic circuits using conventional gates |

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S | S |  |  |  |  |  |  |  |  |  |  |
| 3 | S |  |  |  |  |  |  | M |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  | M |  |  |  |
| 5 | S |  | S |  |  |  |  |  |  |  |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 40 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 35 |

|  |  |
| --- | --- |
| Course Title:  **DIGITAL ELECTRONICS LAB** | Course Code : EC 254 |
| Semester : IV | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Basic Electronics.

**Course Objectives:**

|  |
| --- |
| 1. To familiarize students with the fundamental concepts of basic logic gates and universal logic gates and their realization. |
| 2. To make students aware about the SOP & POS and digital combinational circuits and their realization using universal logic gates. |
| 3. To make students aware about ripple adder/ Subtractor, multiplexer and demultiplexer and their realization using basic logic gates. |
| 4. To make students aware about the seven segment displays. |
| 5. To make students aware about the sequential circuits like flip flops, counters and registers and their realization using basic logic gates. |

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **List of Experiments** | **Hours** |
| 1. | To study and perform experiment of Compound logic function and various combinational circuits based on AND/NAND and OR/NOR logic blocks. | 2 |
| 2. | To study and perform experiments based EX-NOR and EX-OR. | 2 |
| 3. | To study and perform experiment of BINARY to DECIMAL ENCODER. | 2 |
| 4. | To study and perform experiment of HALF ADDER and FULL ADDER using NAND gates. | 2 |
| 5. | To study and perform operation of MULTIPLEXER and DEMULTIPLEXER. | 2 |
| 6. | To study and perform the following experiment:-   1. Decimal to BCD encoder 2. Binary to Gray code Converter 3. BCD to Seven segment Decoder | 2 |
| 7. | To perform and verify truth table of various FLIP-FLOP. | 2 |
| 8. | To study and perform experiment:-   1. Digital to Analog Converter 2. Analog to Digital Converter | 2 |
| 9. | To study and perform various types of shift registers and counters. | 2 |
| 10. | To study and perform experiments of Interfacing of CMOS to TTL and TTL to CMOS ICs. | 2 |
|  | **Total** | 20 |

**Reference:**

Lab Manual.

**Course outcomes:**

|  |
| --- |
| The student will be able to |
| Design basic logic gates and their realization using universal logic gates(NOR & NAND) |
| Analyze SOP & POS and design digital combinational circuits like decoders, encoders, including arithmetic circuits (half adder, full adder, and multiplier. |
| 3. Design ripple adder/ Subtractor, multiplexer and demultiplexer and their realization using basic logic gates. |
| 4. Design the seven segment displays. |
| 5. Design sequential digital circuits like flipflops, registers, counters. |

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | M | M | S | S | M |  |  | M |  |  | M |
| 2 | S | M | S | M |  |  |  | S | M |  | M |
| 3 | S | M | S | S |  |  |  |  |  |  | M |
| 4 | S | S | M | S |  | M |  | S |  |  | M |
| 5 | S | S |  | S | S |  | S |  |  | S | M |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **Industry Oriented Analog Electronics Project Lab** | Course Code : EC 252 |
| Semester : IV | Core / Elective : Elective |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Practical knowledge of subject AE.

**Course Objectives:**

1. Understand the practical application of theorems studied in Electronics Device And Circuit Course
2. Help the learner to understand basic principle and working of continuous time signals & systems.
3. Understand the application of laplace transforms.
4. Understand the use and application of network theoroms.
5. Learn about positive real functions

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **List of Experiments** | **Hours** |
|  | Plot gain-frequency characteristics of BJT amplifier with and without negative feedback in the emitter circuit and determine bandwidths, gain bandwidth products and gains at 1kHz with and without negative feedback. | 2 |
|  | Study of series and shunt voltage regulators and measurement of line and load regulation and ripple factor. | 2 |
|  | Plot and study the characteristics of small signal amplifier using FET. | 2 |
|  | Study of push pull amplifier. Measure variation of output power and distortion with load. | 2 |
|  | Study Wein bridge oscillator and observe the effect of variation in R and C on oscillator frequency | 2 |
|  | Study transistor phase shift oscillator and observe the effect of variation in R and C on oscillator frequency and compare with theoretical value. | 2 |
|  | Study the following oscillators and observe the effect of variation of C on oscillator frequency: (a) Hartley (b) Colpitts | 2 |
|  | Study of a Digital Storage CRO and store a transient on it. | 2 |
|  | To plot the characteristics of UJT and UJT as relaxation. | 2 |
|  | To plot the characteristics of MOSFET and CMOS. | 2 |
|  | **Total** | 20 |

**Reference:**

Lab Manual.

**Course outcomes:**

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

1. Student will be able to analyse continuous time signals & systems

2. Apply Laplace transforms techniques.

3. Apply network theorems practically.

4. Evaluation of Electronic Devices.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | M | M | S | S | M |  |  | M |  |  | M |
| 2 | S | M | S | M |  |  |  | S | M |  | M |
| 3 | S | M | S | S |  |  |  |  |  |  | M |
| 4 | S | S | M | S |  | M |  | S |  |  | M |
| 5 | S | S |  | S | S |  | S |  |  | S | M |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **POWER ELECTRONICS** | Course Code : EE 301 |
| Semester : V | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Circuit analysis and basic electrical engineering.

**Course Objectives:**

1. Help the learner to understand basic principles of different power electronics components
2. Understand the SCR characteristics, control and protection
3. Understand various types of single-phase and three-phase converters
4. Understand the basic principles of chopper and dc-to-dc converter
5. Learn the various methods used for pulse width modulation and power factor improvement.
6. Understand the basic principles and working of Inverter (dc-to-ac converter), and its various modes of operation.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| **Unit 1 Power Semiconductor Devices** | 8 | 20 |
| 1. Characteristics of Power Transistor, Thyristor, GTO, Power MOSFET and IGBT. 2. Two-transistor model of Thyristor. |  |  |
| |  |  | | --- | --- | |  | | |  | | | |
| **Unit 2 SCR** | 10 | 20 |
| 1. Construction and characteristics, specification and ratings, pulse transformer, optical isolators, methods of turning on SCR: R, RC. 2. UJT relaxation oscillator, rating extension by series and parallel connections, string efficiency. 3. Protection of SCR – protection against overvoltage, overcurrent, dV/dt, dI/dt, Gate protection. |  |  |
| |  |  | | --- | --- | |  | | |  | | |  | | | |
| **Unit 3 Converters - I** | 12 | 20 |
| 1. Single-phase half and full-wave converters with RL load, single-phase Dual converters. 2. Three-phase half-wave converter, three-phase full converters with RL load, three-phase Dual converters. |  |  |
| |  |  | | --- | --- | |  | | |  | | | |
| **Unit 4 DC-DC Converters: Choppers** | 8 | 20 |
| 1. Step up/down Chopper, Chopper configurations, Analysis of type A Chopper, commutation of Choppers. 2. Switched Mode Regulators - Buck, Boost, Buck-Boost and Cuk converters. |  |  |
|  | | |
| **Unit 5 Converters - II** | 10 | 20 |
| 1. Single and three-phase semi-converters with RL load. 2. Power factor improvement - Extinction angle control, symmetrical angle control, pulse width modulation control and sinusoidal pulse width modulation control. 3. Inverter operation. 4. Effect of load and source impedances. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. M.H Rashid - Power Electronics, circuit devices and applications, PRENTICE HALL OF INDIA. ,1988
2. Subrahmanyam Power electronics, New Age Inc. Publishers, New Delhi, 1996
3. P.C. Sen - Power electronics Tata McGraw-Hill 1987
4. CW Lander - Power electronics,2nd edition, McGraw Hill 1987

**Course outcomes:**

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

1. Understand characteristics of different power electronic devices and differentiate between them
2. Understand how to trigger and protect SCR
3. Understand the applications of converters in industries
4. Understand the applications of pulse width modulation in industries
5. Understand the application of dc to dc converter in industries.
6. Make students familiar with various types of power converters, thus making them ready for work in industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

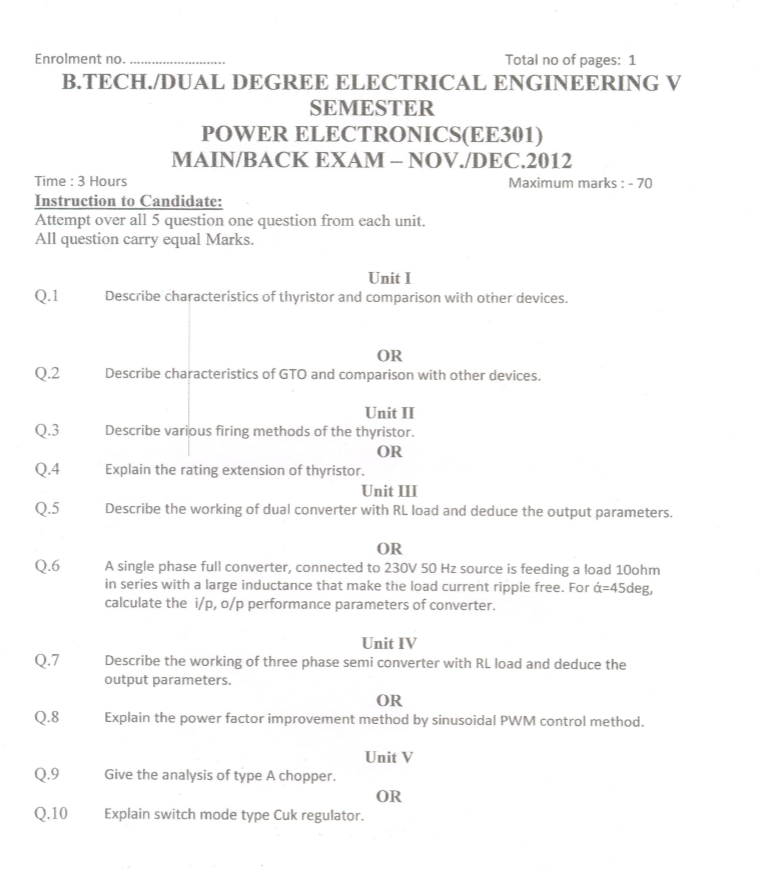
**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**



|  |  |
| --- | --- |
| Course Title:  **POWER ELECTRONICS LAB** | Course Code : EE 357 |
| Semester : V | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Power Electronics components and their uses.

**Course Objectives:**

1. Implement various Power electronic components and analyse their performance
2. Study of various firing circuits of electronic circuits.
3. Observe the performance of various Bridge converters and their uses.
4. Study of various waveforms of electronic circuits.
5. Make students familiar with different types of Power electronic devices, like Power Diode, Power Transistor, Thyristor, DIAC, TRIAC, GTO, MOSFET, MCT and SIT and different types of single-phase and three-phase converters, so that they can work with them in the industry.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** |
| **I** | Study the comparison of following power electronics devices regarding ratings, performance characteristics and applications: Power Diode, Power Transistor, Thyristor, DIAC, TRIAC, GTO, MOSFET, MCT and SIT. | 2 |
| **II** | Determine V-I characteristics of SCR and measure forward breakdown voltage, latching and holding currents. | 2 |
| **III** | Find V-I characteristics of TRIAC and DIAC. | 2 |
| **IV** | Find output characteristics of MOSFET and IGBT. | 2 |
| **V** | Find transfer characteristics of MOSFET and IGBT. | 2 |
| **VI** | Find UJT static emitter characteristics and study the variation in peak point and valley point | 2 |
| **VII** | Study and test firing circuits for SCR-R, RC and UJT firing circuits. | 2 |
| **VIII** | Study and test 3-phase diode bridge rectifier with R and RL loads. Study the effect of filters. | 2 |
| **IX** | Study and obtain waveforms of single-phase half wave controlled rectifier with and without filters. Study the variation of output voltage with respect to firing angle. | 2 |
| **X** | Study and obtain waveforms of single-phase half controlled bridge rectifier with R and RL loads. Study and show the effect of freewheeling diode. | 2 |
| **XI** | Study and obtain waveforms of single-phase full controlled bridge converter with R and RL loads. Study and show rectification and inversion operations with and without freewheeling diode | 2 |
| **XII** | Control the speed of a dc motor using single-phase half controlled bridge rectifier and full controlled bridge rectifier. Plot armature voltage versus speed characteristics. | 2 |
|  | **Total** | 20 (Any 10) |

**Reference:**

Lab Manuals

**Course outcomes:**

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

1. Understand the practical response of various Power electronic components.
2. Understand the practical response of various Electronic firing circuits when working together.
3. Through project development, students will be able to design, develop and implement Electrical wiring.
4. Use various single-phase and three-phase converters in different applications, one of them being “Speed Control of DC motor”.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

1. The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **CONTROL SYSTEMS** | Course Code : EE 307 |
| Semester : V | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Engineering Physics & Circuit Theory

**Course Objectives:**

1. Concept of Linear vector space Linear Independence
2. Modern Vs conventional control theory, concept of state, state variable state vector,
3. State space representation using canonical variables. Diagonal matrix. Jordan canonical form, Derivation of transfer function from state-model
4. Pole placement by state feedback, Ackerman’s formula.
5. The Z-transform, Z-Transfer Function. Block diagram analysis of sampled data systems, Z and S domain relationship, digital PID controller
6. Make students familiar with the basic ideas of open and closed loop control systems, their stability and controllability, and various methods of controlling a system.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **UNIT** | **COURSE CONTENTS** | **Hrs. 36** |
| **I** | **Introduction:** Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, brief idea of multivariable control systems. | **6** |
| **II** | **Mathematical Modelling of Physical Systems:** Representation of physical system (Electro Mechanical) by differential equations, Determination of transfer function by block diagram reduction techniques and signal flow method, Laplace transformation function, inverse Laplace transformation. | **6** |
| **III** | **Time Response Analysis of First Order and Second Order System:** Characteristic equations, response to step, ramp and parabolic inputs, transient response analysis, steady state errors and error constants, Transient and steady state analysis of LTI systems. | **8** |
| **IV** | **Stability of the System:** Absolute stability and relative stability, Routh’s stability criterion, root locus method of analysis, polar plots, Nyquist stability criterion. M and N Loci, Nichols chart. | **8** |
| **V** | **Elementary Ideas of Compensation, Networks:** Lag, lead and log lead networks, brief idea of proportional, derivative and integral controllers. | **8** |

**Reference:**

1) I J Nagrath and M Gopal: Control systems Engineering, 3rd Ed, New Age Publication.

2) K. Atsuhiko Ogata: Modern control engineering. PRENTICE HALL OF INDIA.

**Course outcomes:**

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

1. Identify basic open-loop and closed-loop control systems, and determine their transfer function by various techniques given.
2. Predict the stability of a given system by using techniques like Routh-Hurwitz criterion, Nyquist plots, etc.
3. Determine time response and frequency response analysis of basic first order and second order systems using standard inputs, and also do transient and steady-state analysis of any given LTI system.
4. Design different types of power factor compensations, and design various types of controllers like P, PI, PID, etc.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

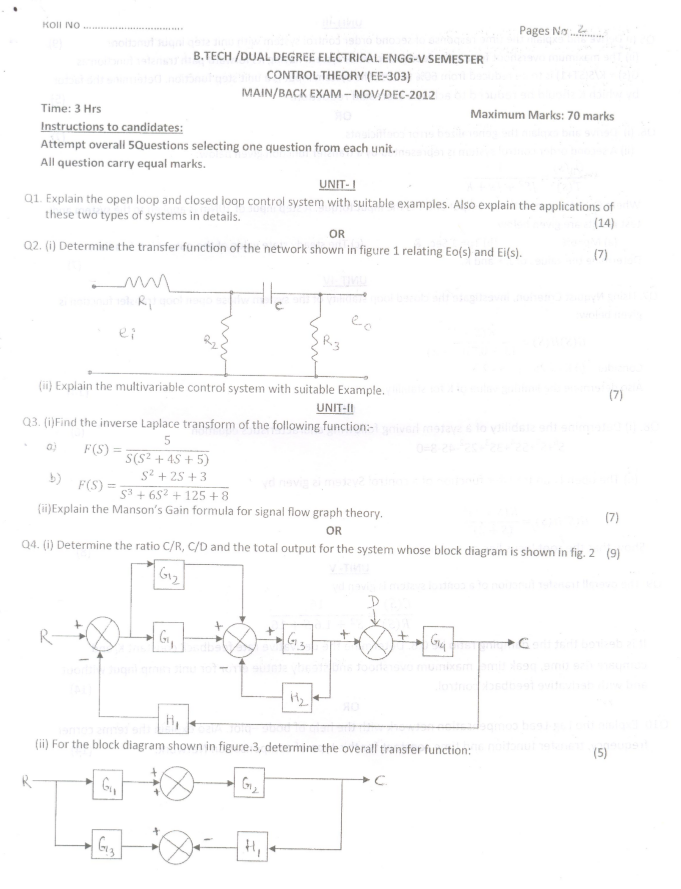
**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

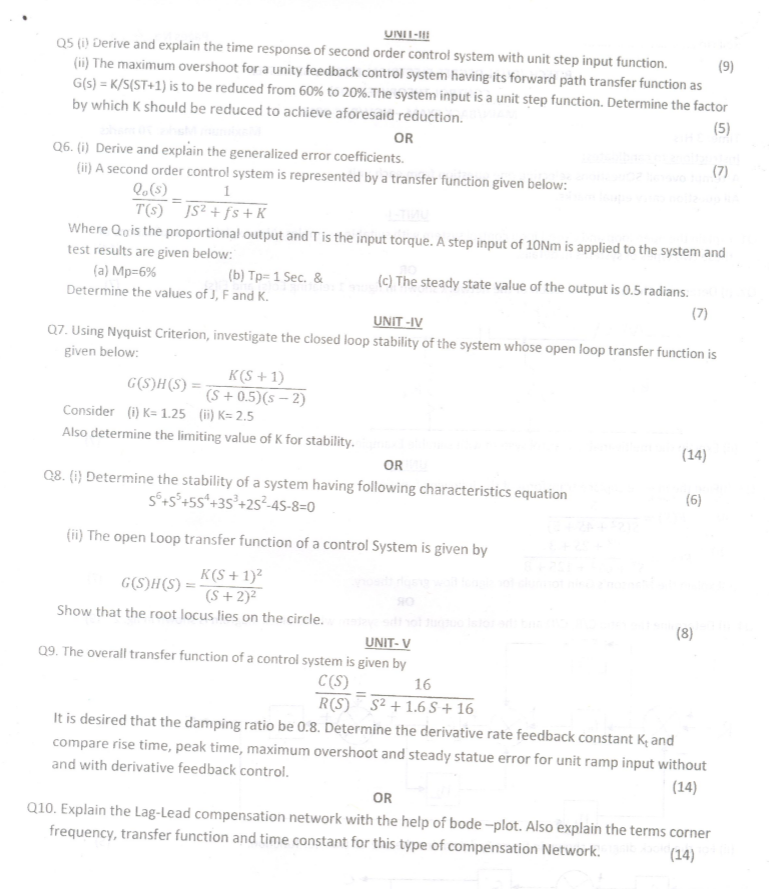
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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**





|  |  |
| --- | --- |
| Course Title: **TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER** | Course Code : **EE 305** |
| Semester : V | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Basics of electricity generation, transmission and distribution.

**Course Objectives:**

1. To understand the concept of supply systems and distribution systems.
2. Discuss mechanical features of overhead lines.
3. To understand parameters of transmission lines.
4. Discuss corona and ABCD line constants.
5. To understand behaviour insulators and underground cables.
6. Instruct students about the parameters of the transmission and the distribution systems, their characteristics and protection.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Supply systems Distribution Systems** | 6 | 12 |
| Basic network of power system. Transmission and distribution voltage, effect of system voltage on size of conductor and losses. Comparison of DC 2- wire, DC 3- wire, 1- phase AC and 3- phase AC (3- wire and 4- wire) systems.  Primary and secondary distribution systems, feeder, distributor and service mains. Radial and ring- main distribution systems. Kelvin’s law for conductor size. |  |  |
| UNIT-2: **Mechanical features of overhead lines** | 6 | 12 |
| Conductor material and types of conductor. Conductor arrangements and spacing. Calculation of sag and tension supports at different levels, effect of wind and ice loading, stringing chart and sag template. Conductor vibrations and vibration dampers. |  |  |
| UNIT-3: **Parameters of Transmission Lines** | 08 | 12 |
| Resistance inductance and capacitance of overhead lines, effect of earth, line transposition. Geometric mean radius and distance. Inductance and capacitance of line with symmetrical and unsymmetrical spacing Inductance and capacitance of double circuit lines. Skin and proximity effects. Equivalent circuits and performance of short and medium transmission lines**.** |  |  |
| UNIT-4: **1.**  **Generalized ABCD line constants**  **2. Corona** | 8 | 12 |
| Generalized ABCD line constants, equivalent circuit and performance of long transmission line. Ferranti effect. Interference with communication circuits. Power flow through a transmission line.  Electric stress between parallel conductors. Disruptive critical voltage and visual critical voltage, Factors affecting corona. Corona power loss. Effects of corona and calculation of losses. |  |  |
| UNIT **V 1. Insulators**   1. **Underground Cables** | 8 | 12 |
| Pin, shackle, suspension, post and strain insulators. Voltage distribution across an insulator string, grading and methods of improving string efficiency  Conductor, insulator, sheathing and armouring materials. Types of cables. Insulator resistance and capacitance calculation. Electrostatic stresses and reduction of maximum stresses. Causes of breakdown. Thermal rating of cable. Introduction to oil filled and gas filled cables. |  |  |
| **TOTAL** | **36** | **60** |

**Reference:**

1) B.R. Gupta - Power system analysis and design.

2) Soni Gupta and Bhatnagar – A Course in Electrical Power.

3) C.L. Wadhwa - Electrical Power system.

4) Nagrath Kothari - Modern Power system Analysis.

**Course outcomes:**

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

1. Understand the concept of supply systems and distribution systems.
2. Discuss mechanical features of overhead lines.
3. To understand parameters of transmission lines.
4. Discuss corona and ABCD line constants.
5. To understand behaviour insulators and underground cables.
6. Use different transmission line parameters to improve their performance and reduce the unwanted effects occurring in them and reduce faults.

**Mapping Course Outcomes with Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

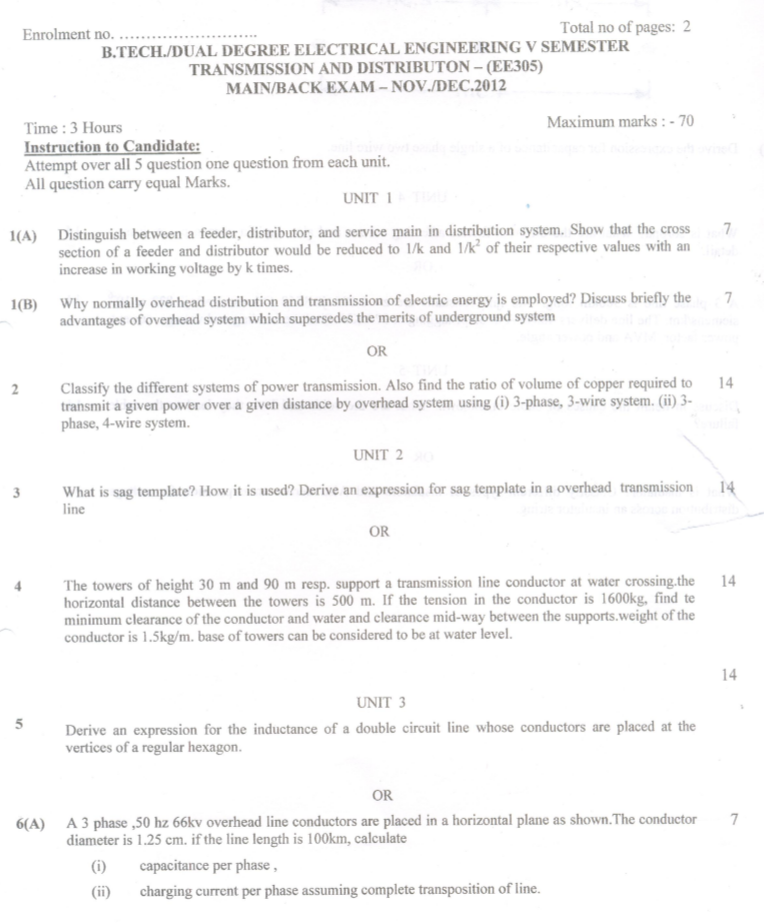
**Model Question Paper:**

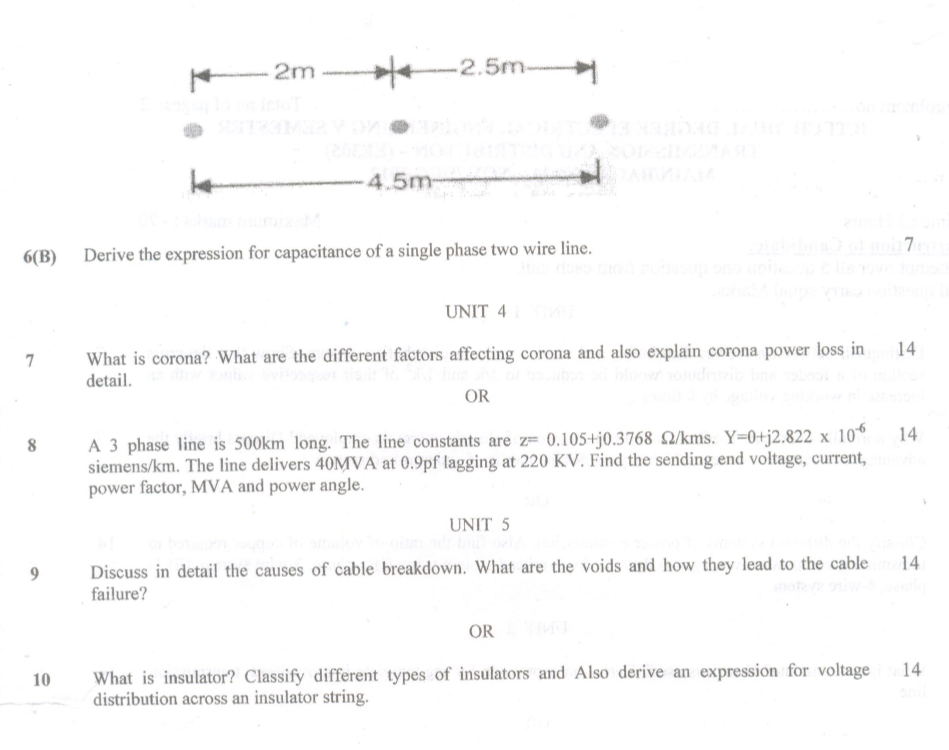
**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to

* The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
* Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
* Student shall be given Internal choice in every Unit.

Questions should not be set from the recapitulation topics.





|  |  |
| --- | --- |
| Course Title: **POWER SYSTEM INSTRUMENTATION** | Course Code : **EE 311** |
| Semester : V | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Circuit analysis and basic electrical.

**Course Objectives:**

1. Help the learner to understand systematic and random errors, limits of error.
2. Understand the construction and operation of transducers, learn Measurement of temperature, pressure, displacement, acceleration, noise level, etc.
3. Understand the construction and operation of various amplifiers for **Signal Conditioning**.
4. Learn measurement methods of power system quantities like voltage, current, phase angle, frequency, active power and reactive power.
5. Learn capacitive voltage transformers and their transient behaviour, Current Transformers for measurement and protection.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Theory of Errors** | 7 | 20 |
| Accuracy and precision, systematic and random errors, limits of error, probable error and standard deviation. Gaussian error curves, combination of errors. |  |  |
| UNIT-2: **Transducers** | 7 | 20 |
| Construction and Operating Characteristics of active and digital transducers, Measurement of temperature, pressure, displacement, acceleration, noise level, Instrumentation for strain, displacement, velocity, acceleration, force, torque and temperature. |  |  |
| UNIT-3: **Signal Conditioning** | 7 | 20 |
| **I**nstrumentation amplifiers, isolation amplifiers, analog multipliers, analog dividers, function generators, timers, sample and hold, optical and magnetic isolators, frequency to voltage converters, temperature to current converters. Shielding and grounding. |  |  |
| UNIT-4: **Power System Instrumentation - I** | 7 | 20 |
| Measurement of voltage, current, phase angle, frequency, active power and reactive power in power plants. Energy meters and multipart tariff meters. |  |  |
| UNIT-5: **Power System Instrumentation - II** | 8 | 20 |
| Capacitive voltage transformers and their transient behaviour, Current Transformers for measurement and protection, composite errors and transient response. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Electrical and Electronics measurements and measuring instruments. A.K. Sawhney – Dhanpat Rai and Sons.
2. R. H. Cerni and L. E. Foster: Instrumentation for Engineering Measurements, John Wiley and Sons.
3. A course in Electronics and Electrical measurements and instrumentation by J.B.GUPTA-Kataria Publications.
4. Electrical measurements and measuring instruments by Rajendra Prasad-Khanna Publishers.
5. A.S. Moris: Principles of Measurement & Instrumentation, Prentice Hall.

**Course outcomes:**

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

1. Measure the AC and DC electrical quantities (voltage, current and energy).
2. Measure single and three phase ac power.
3. Calibrate the voltmeter, ammeter by the help of potentiometer.
4. Measure earth resistance.
5. Measure the value of capacitance and inductance by the help of different measuring transformers.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
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| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

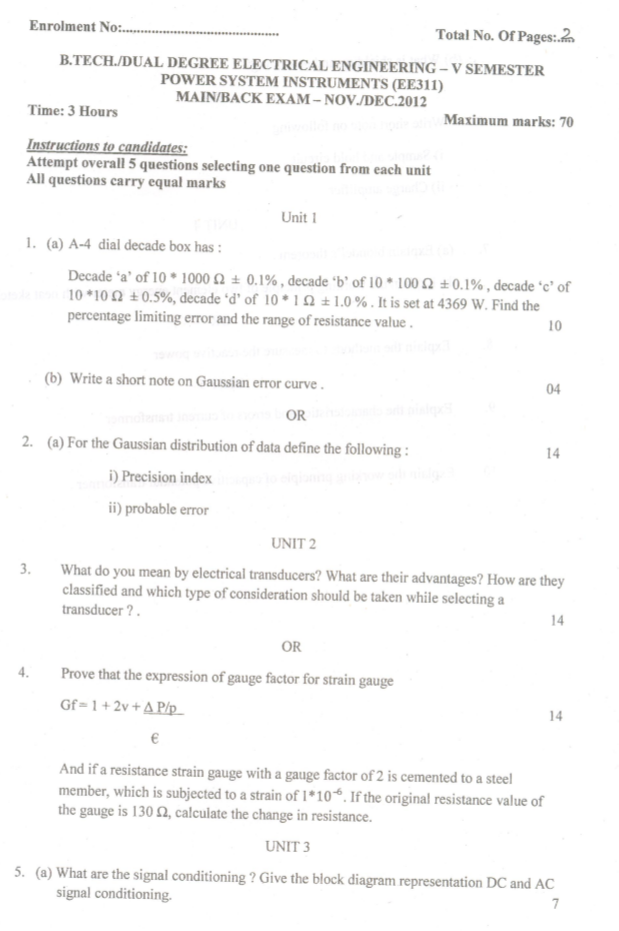
**Model Question Paper:**

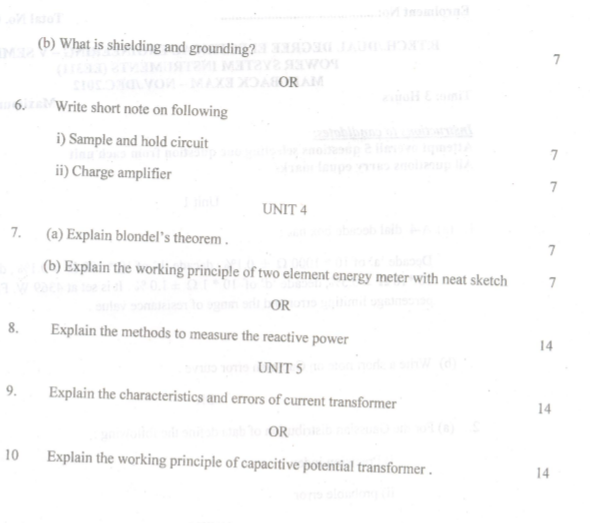
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2. The question paper pattern provided should be adhered to

* The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
* Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
* Student shall be given Internal choice in every Unit.

Questions should not be set from the recapitulation topics.





|  |  |
| --- | --- |
| Course Title: **MATLAB FOR ENGINEERS** | Course Code : EE 353 |
| Semester : V | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree EE + PS** | |

**Pre-requisites:**

Basic Computer

**Course Objectives:**

1. Understand various built-in functions for technical computation, graphics, and animation of MATLAB
2. Understand tools for linear algebra computations, data analysis, signal processing, optimization
3. Understand solution of ordinary differential equations (ODEs), quadrature, and many other types of scientific computations.
4. Make students familiar with basic scripts, tools and applications of MATLAB, and their use in solving simple mathematical problems used in engineering.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Introduction to MATLAB | | 2 | 10 |
|  | Basic operation in MATLAB using Matrix and array input type | | 2 | 10 |
|  | To study plotting simple graphs | 2 | | 10 |
|  | To study Programming in MATLAB :script and function files | | 2 | 10 |
|  | To study Loop, branches and control flow statements. | | 2 | 10 |
|  | To study curve fitting and interpolation | | 2 | 10 |
|  | To study Application of Simulink in MATLAB | | 2 | 10 |
|  | Application of MATLAB to Ordinary Differential Equations | | 2 | 10 |
|  | Application of MATLAB to Nonlinear numerical methods | | 2 | 10 |
|  | Application of MATLAB to Polynomials and data interpolation | | 2 | 10 |
|  | **TOTAL** | | **20** | **100** |

**Reference:** Lab Manual

**Course outcomes:**

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

1. Use arithmetic operators, assign values to variables, suppress screen output, controlling the appearance of floating point numbers on the screen.
2. Create arrays and vectors, and how to perform arithmetic and trigonometric operations on them.
3. Make a simple 2-D plot in MATLAB and print it out.
4. Create, write, execute, and save a script and function file.
5. Do basic programming in MATLAB.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **OPERATION RESEARCH** | Course Code :  **MA 305** |
| Semester : V | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : 4**0 Marks** | SEE : 60 **Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree** | |

**Pre-requisites:**

Basics of electrical engineering components and basic theorems of power.

**Course Objectives:**

1. To understand the concept of Optimization Problem.
2. To understand linear and non linear programming.
3. Discuss single and multivibrational optimization.
4. To understand Transportation and Assignment problems.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **UNIT** | **COURSE CONTENTS** | **Hrs. 36** |
| **I** | **INTRODUCTION** : Introduction, Engineering application of optimization, statement of an optimization problem, classification of optimization problems. Single variable and multivariable optimization with and without constraints. | **6** |
| **II** | **PERT and CPM**: Introduction to various components, advantages and disadvantages of PERT AND CPM. Probabilistic estimate of job using PERT. | **6** |
| **III** | **LINEAR PROGRAMMING** : Single and multivariable optimization. Graphical interpretation pivotal reduction of general systems of equations. Simplex method. Transportation and Assignment problems. | **8** |
| **IV** | **NON LINEAR PROGRAMMING** : Unconstrained Optimization techniques: Direct search method, random search method, univariate method and pattern search method. Basic idea of Hooks and Heaves, Simplex, Powell and Newton methods. | **8** |
| **V** | **Dynamic Programming :** Introduction, solving linear programming problem and non linear programming problem using dynamic programming. | **8** |

**Reference:**

1. S.S Rao:Optimization theory and application, wiley eastern limited.
2. Goel and Mittal: Operation Research

**Course outcomes:**

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

1. Understand the concept of Engineering application of optimization.
2. Discuss Graphical interpretation pivotal reduction of general systems of equations.
3. To understand parameters of linear programming problem and non linear programming.
4. Discuss Single variable and multivariable optimization.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | S | M | S | S | M |  |  | M |  |  | M |
| 2 | S | S | S | M |  |  |  | S | M |  | M |
| 3 | M | S | S | S |  |  |  |  |  |  | M |
| 4 | M | S | S | S |  | M |  | S |  |  | M |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

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| --- | --- |
| **EC 309** | **MICROPROCESSOR C(L,T,P) =3(3,0,0)** |
| **Version** | 1.0 |
| **Prerequisite** | Nil |
| **Objective:** | The objective of the course are: |
|  | 1. To learn the architecture of 8085 microprocessor |
|  | 2. To learn the assembly language programming of 8085 microprocessor |
|  | 3. To study the interrupt, InputOutput of 8085 microprocessor. |
| **Expected Outcome:** | The student will be able to |
|  | 1. Students will become familiar with 8085 microprocessor architecture and programming. |
|  | 2. Students get to know the interrupt I/O process of microprocessor. |
|  | 3. Students will be able to do interfacing with peripherals. |
| **Unit -1 (7 Hours)** | **INTRODUCTION**: CPU, address bus, data bus and control bus. Input/ Output devices, buffers,encoders, latches and memories. |
|  |  |
| **Unit -2 (7 Hours)** | **8085 MICROPROCESSOR ARCHITECTURE**: Internal data operations and registers, pins and signals, peripheral devices and memory organization, interrupts. CISC and RISC architecture overview. |
|  |  |
| **Unit -3 (7 Hours)** | **8085 MICROPROCESSOR INSTRUCTIONS**: Classification, format and timing. Instruction set.Programming and debugging, 8 bit and 16 bit instructions. |
|  |  |
| **Unit -4 (7 Hours)** | **8085 MICROPROCESSOR INTERFACING**: 8259, 8257, 8255, 8253, 8155 chips and their applications. A/D conversion, memory, keyboard and display interface (8279). |
|  |  |
| **Unit -5 (8 Hours)** | **8086/8088 MICROPROCESSOR:** Hardware specifications, architecture, address spaces, clock generator, bus controller and arbiter, Minimum and maximum mode. System Bus Timing. Assembly language programming, addressing mode and instructions of 8086/8088, linking and execution of programs. MACRO programming, assembler directives and operators. |
| **Total (36 Hours)** |  |
| **List of Expt.** | 10 |
| **Text Book** | Microprocessors Architecture, Programming &Application, Ramesh S. Gaonkar, (2000) |
| **Reference book** | 1. Introduction to Microprocessors, A.P. Mathur, Mc Graw Hill 2002 |
|  |  |
| **Mode of Evaluation** | Assignment/Quiz/Viva-voce/Lab examination/student seminar/written examination |
| **Recomm. by BOS on** |  |
| **Approved by AC on** |  |

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| --- | --- |
| Course Title: **EMBEDDED SYSTEMS** | Course Code :  **EC 325** |
| Semester : V | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : 4**0 Marks** | SEE : 60 **Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree** | |

**Pre-requisites:**

Basics of Computer.

**Course Objectives:**

1. To understand the Introduction to embedded systems, their characteristics.
2. To understand translation of various features.
3. Discuss functional partitioning for systems.
4. Study of a system design methodology and study of generic synthesis system.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **UNIT** | **COURSE CONTENTS** | **Hrs. 36** |
| **I** | **Introduction**: Introduction to embedded systems, their characteristics, modeling of systems, system specifications, specification languages, study of specification example. | **6** |
| **II** | **Translation**: Specification translation, translation of various features such as state transition, message passing communication, concurrency, exception handling etc. | **6** |
| **III** | **System partitioning**: Introduction, partitioning issues, partitioning algoritms, functional portioning, hardware/software partitioning algorithms, functional partitioning for systems. | **8** |
| **IV** | **Design quality estimation**: Quality metrics, hardware estimation, software estimation. | **8** |
| **V** | **Specification refinement**: Refining variable grouping, channel refinement, resolving accesss conflict, refining incompatible interfaces, refining hardware/software interfaces. Study of a system design methodology and study of generic synthesis system. | **8** |

**Reference:**

1. Specification and design of embedded systems, David D Gajski, Frandkvahid, S. Narayan, J Garg.
2. Embedded system design, Heath Steve and Newns 1997.
3. Art of programming Embedded Systems, J. Gassle.

**Course outcomes:**

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

1. Understand the concept of embedded systems, their characteristics.
2. Discuss hardware/software partitioning algorithms.
3. To understand parameters of system design methodology and study of generic synthesis system.
4. Discuss functional partitioning for systems.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | S | M | S | S | M |  |  | M |  |  | M |
| 2 | S | S | S | M |  |  |  | S | M |  | M |
| 3 | M | S | S | S |  |  |  |  |  |  | M |
| 4 | M | S | S | S |  | M |  | S |  |  | M |
| 5 | S | S | M | S | S |  | S |  |  | S | M |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

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| --- | --- |
| **EC 355** | **MICROPROCESSOR LAB C(L,T,P)=1(0,0,2)** |
| **Version** | 1.0 |
| **Prerequisite** | Nil |
| **Objective:** | The objective of the course are: |
|  | 1. To learn assembly language programming related to Arithmetic, logical operation and jump instruction. |
|  | 2. To learn assembly language programming related to Communication with memory and calling subroutine and conversion. |
|  | 3. To learn assembly language programming related to Display of data on address and data fields. |
| **Expected Outcome:** | The student will be able to |
|  | 1. Students will be able to do programming on 8085 microprocessor. |
|  | 2. Students will be able to do microprocessor based projects |
| **Experiments 1** | Study of 8085 microprocessor kit |
| **Experiments 2** | Addition of two 8 bit numbers with and without carry |
| **Experiments 3** | Subtraction of two 8 bit numbers with and without borrow |
| **Experiments 4** | Multiplication of two 8 bit number using successive addition and resistor shifting method |
| **Experiments 5** | Program to find ones compliment of 1 byte number |
| **Experiments 6** | Program to find ones compliment of 2 byte number |
| **Experiments 7** | Program to find MASK OFF for LSB and MSB compliment of 1 byte number |
| **Experiments 8** | Program to find out square of a number. |
| **Experiments 9** | Programs to find sum of first ten natural number involving data arrays |
| **Experiments 10** | Programs to Generating odd numbers. |
| **Experiments 11** | Programs to Data transfer schemes |
| **Experiments 12** | Programs to Sorting of odd/even numbers. |
| **Experiments 13** | Programs to Finding largest and smallest numbers. |
| **Experiments 14** | Programs to Arrange data array in ascending / descending order |
| **Experiments 15** | Programs using stack |
| **Experiments 16** | Programs using subroutine. |
| **Experiments 17** | Debugging of programs using single stepping on kit |
| **List of Expt.** | 17 |
| **Total Hours** | 20 |
| **Text Book** |  |
| **Reference book** |  |
|  |  |
| **Mode of Evaluation** | Assignment/Quiz/Viva-voce/Lab examination/student seminar/written examination |
| **Recomm. by BOS on** |  |
| **Approved by AC on** |  |

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| --- | --- |
| Course Title:  **Consumer Affairs** | Course Code : |
| Semester : **III** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : | Credits : 2 **Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : |
| Continuous Internal Evaluation : | ESE : |
| Programmes: **B.Tech. Electrical Engineering** | |

#### Duration: 3 hrs. Max Marks: 100 Total Lectures: 24

**Objective:** This paper seeks to familiarize the students with their rights and responsibilities as a consumer, the social framework of consumer rights and legal framework of protecting consumer rights. It also provides an understanding of the procedure of redress of consumer complaints, and the role of different agencies in establishing product and service standards. The student should be able to comprehend the business firms’ interface with consumers and the consumer related regulatory and business environment.

|  |  |  |
| --- | --- | --- |
| Unit-1 | Conceptual Framework 5 Lectures Consumer and Markets: Concept of Consumer, Nature of markets: Liberalization and Globalization of markets with special reference to Indian Consumer Markets, E-Commerce with reference to Indian Market, Concept of Price in Retail and Wholesale, Maximum Retail Price (MRP), Fair Price, GST, labeling and packaging along with relevant laws, Legal Metrology.  Experiencing and Voicing Dissatisfaction: Consumer buying process, Consumer Satisfaction/dissatisfaction-Grievances-complaint, Consumer Complaining Behaviour: Alternatives available to Dissatisfied Consumers; Complaint Handling Process: ISO 10000 suite | **5 Hours** |
| Unit-2 | **The Consumer Protection Law in India** 5 Lectures  Objectives and Basic Concepts: Consumer rights and UN Guidelines on consumer protection, Consumer goods, defect in goods, spurious goods and services, service, deficiency in service, unfair trade practice, restrictive trade practice.  Organizational set-up under the Consumer Protection Act: Advisory Bodies: Consumer Protection Councils at the Central, State and District Levels; Adjudicatory Bodies: District Forums, State Commissions, National Commission: Their Composition, Powers, and Jurisdiction (Pecuniary and Territorial), Role of Supreme Court under the CPA with important case law. | **5 Hours** |
| Unit-3 | **Grievance Redressal Mechanism under the Indian Consumer Protection Law:**  Who can file a complaint? Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases, Relief/Remedy available; Temporary Injunction, Enforcement of order, Appeal, frivolous and vexatious complaints; Offences and penalties.  Leading Cases decided under Consumer Protection law by Supreme Court/National Commission: Medical Negligence; Banking; Insurance; Housing & Real Estate; Electricity and Telecom Services; Education; Defective Products; Unfair Trade Practices. | **5 Hours** |
| Unit-4 | Role of Industry Regulators in Consumer Protection 5 lectures  1. Banking: RBI and Banking Ombudsman 2. Insurance: IRDA and Insurance Ombudsman 3. Telecommunication: TRAI 4. Food Products: FSSAI 5. Electricity Supply: Electricity Regulatory Commission   Real Estate Regulatory Authority | **5 Hours** |
| Unit-5 | Contemporary Issues in Consumer Affairs 4 Lectures Consumer Movement in India: Evolution of Consumer Movement in India, Formation of  consumer organizations and their role in consumer protection, Misleading Advertisements and sustainable consumption, National Consumer Helpline, Comparative Product testing,  Sustainable consumption and energy ratings.  Quality and Standardization: Voluntary and Mandatory standards; Role of BIS, Indian  Standards Mark (ISI), Ag-mark, Hallmarking, Licensing and Surveillance; Role of International  Standards: ISO an Overview | **4 Hours** |

**Suggested Readings:**

1. Khanna, Sri Ram, Savita Hanspal, Sheetal Kapoor, and H.K. Awasthi. (2007) Consumer Affairs, Universities Press.

2. Choudhary, Ram Naresh Prasad (2005). Consumer Protection Law Provisions and Procedure, Deep and Deep Publications Pvt Ltd.

3. G. Ganesan and M. Sumathy. (2012). Globalisation and Consumerism: Issues and Challenges, Regal Publications

4. Suresh Misra and Sapna Chadah (2012). Consumer Protection in India: Issues and Concerns, IIPA, New Delhi

5. Rajyalaxmi Rao (2012), Consumer is King, Universal Law Publishing Company

6. Girimaji, Pushpa (2002). Consumer Right for Everyone Penguin Books.

7. E-books :- www.consumereducation.in

8. Empowering Consumers e-book,

9. ebook, www.consumeraffairs.nic.in

10. The Consumer Protection Act, 1986 and its later versions. [www.bis.org](http://www.bis.org)

**Articles**

1. Misra Suresh, (Aug 2017) “Is the Indian Consumer Protected? One India One People.

2. Raman Mittal, Sonkar Sumit and Parineet Kaur (2016) Regulating Unfair Trade Practices: An Analysis of the Past and Present Indian Legislative Models, Journal of Consumer Policy.

3. Chakravarthy, S. (2014). MRTP Act metamorphoses into Competition Act. CUTS Institute for Regulation and Competition position paper. Available online at www.cuts-international.org/doc01.doc.

4. Kapoor Sheetal (2013) “Banking and the Consumer” Akademos (ISSN 2231-0584)

5. Bhatt K. N., Misra Suresh and Chadah Sapna (2010). Consumer, Consumerism and Consumer Protection, Abhijeet Publications.

6. Kapoor Sheetal (2010) “Advertising-An Essential Part of Consumer’s Life-Its Legal and Ethical Aspects”, Consumer Protection and Trade Practices Journal, October 2010.

7. Verma, D.P.S. (2002). Regulating Misleading Advertisements, Legal Provisions and Institutional Framework. Vikalpa. Vol. 26. No. 2. pp. 51-57.

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| --- | --- |
| Course Title: **ADVANCED CONTROL SYSTEMS** | Course Code : EE 310 |
| Semester : VI | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Engineering Physics & Circuit Theory.

**Course Objectives:**

1. Impart knowledge about the concept of Linear vector space and Linear Independence.
2. Learn about differences between Modern and conventional control theory, concept of state, state variable, state vector.
3. Understand state space representation using canonical variables, diagonal matrix. Jordan canonical form, derivation of transfer function from state-space model.
4. Learn Pole placement technique by state feedback, Ackerman’s formula.
5. Learn about z-transform, Z-Transfer Function, block diagram analysis of sampled data systems, z and s domain relationship, digital PID controller.
6. Make students familiar with the state-space approach of Control System analysis and various methods to solve the state equations.
7. Introduce the basics of Digital Control Systems to the students.

**Course Content:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic and Contents** | | **Hours** | **Marks** |
|  | | | |
| **Unit 1 Introduction** | | 7 | 20 |
| Concept of Linear vector space Linear Independence, Bases and Representation, domain and range. Concept of Linearity, relaxedness, time invariance, causality. | |  |  |
|  | | | |
| **Unit 2 State Space Approach of Control System Analysis** | 7 | | 20 |
| Modern Vs conventional control theory, concept of state, state variable state vector, state space, state space equations, Writing state space equations of mechanical, Electrical systems, Analogous systems. | |  |  |
|  | | | |
| **Unit 3 State Space Representation using physical and phase variables** | | 08 | 20 |
| Comparison form of system representation. Block diagram representation of state model. Signal flow graph representation. State space representation using canonical variables. Diagonal matrix. Jordan canonical form, Derivation of transfer function from state-model. | |  |  |
|  | | | |
| **Unit 4 Solution of State Equations** | | 7 | 20 |
| Digitalization, Eigenvalues and eigenvectors, Matrix exponential, State transition matrix, Properties of state transition matrix. Computation of State transition matrix concepts of controllability and observability. Pole placement by state feedback, Ackerman’s formula. | |  |  |
|  | | | |
| **Unit 5 Digital Control Systems** | | 7 | 20 |
| Introduction, sampled data control systems, signal reconstruction, difference equations. The z-transform, Z-Transfer Function. Block diagram analysis of sampled data systems, z and s domain relationship, digital PID controller. | |  |  |
| **TOTAL** | | **36** | **100** |

**Reference:**

1. I J Nagrath and M Gopal: Control systems Engineering, 3rd Ed, New Age Publication.
2. Katsuhiko Ogata: Modern control engineering. PRENTICE HALL OF INDIA.

**Course outcomes:**

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

1. Represent the dynamics of any simple mechanical, electrical or analogous system as a state-space equation.
2. Derive the transfer function of any simple state-space model using signal flow graph representation or block diagram representation.
3. Solve any state space equations using State Transition Matrix technique.
4. Determine controllability and observability of any system, and make a system controllable using pole placement technique.
5. Represent any discrete system into difference equations, and solve them using z-transform technique.

**Mapping Course Outcomes with Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

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| --- | --- |
| Course Title:  **CONTROL LAB** | Course Code : EE 358 |
| Semester : VI | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Practical knowledge of Control System Components and their uses.

**Course Objectives:**

1. Understand the practical application of MATLAB Computing Control Software.
2. Help the learner to understand basic Defining Systems in TF, ZPK form.
3. Understand the application of 2nd order system plot step response and obtain time response specification.
4. Understand the use and application of AC servomotor.
5. Learn how to determine the time-response and frequency-response characteristics of different kind of 2nd order electrical systems using different standard inputs, or by using Bode Plot, and determine its stability.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** |
| **I** | Introduction to MATLAB Computing Control Software. Plot bode plot for a 2nd order system and find GM and PM. | 2 |
| **II** | Defining Systems in TF, ZPK form. | 2 |
| **III** | (a) Plot step response of a given TF and system in state-space. Take different values of damping ratio and natural undamped frequency.  (b) Plot ramp response. | 2 |
| **IV** | For a given 2nd order system plot step response and obtain time response specification | 2 |
| **V** | To design 1st order R-C circuits and observes its response with the following inputs and trace the curve. (a) Step (b) Ramp (c) Impulse. | 2 |
| **VI** | To design 2nd order electrical network and study its transient response for step input and following cases. (a) Under damped system (b) Over damped System. (c) Critically damped system. | 2 |
| **VII** | To Study the frequency response of following compensating Networks, plot the graph and final out corner frequencies. (a) Lag Network (b) Lead Network (c) Lag-lead Network. | 2 |
| **VIII** | To draw characteristics of AC servomotor. | 2 |
| **IX** | To perform experiment on Potentiometer error detector. | 2 |
| **X** | Check for the stability of a given closed loop system. | 2 |
| **XI** | Plot bode plot for a 2nd order system and find GM and PM. | 2 |
|  | **Total** | 20 (Any 10) |

**Reference:**

Lab Manual.

**Course outcomes:**

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

1. Analyse and understand the practical application of MATLAB Computing Control Software.
2. Apply applications of Defining Systems in TF, ZPK form
3. Check for the stability of a given closed loop system.
4. Plot bode plot for a 2nd order system and find GM and PM.
5. Determine time response and frequency response characteristics of a 2nd order system using various techniques described in theory course.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **SWITCHGEAR & PROTECTION** | Course Code : EE 312 |
| Semester : VI | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Basics of electricity and magnetism in Secondary Education, basics of circuit analysis, basics of transformers, basics of measurement, basics of transmission line parameters (R, L, C, G).

**Course Objectives:**

1. To understand the basics of electrical discharges.
2. To understand the basics of high voltage generation for testing purposes.
3. To understand the basics of measurement of capacitance and dielectric loss of insulations.
4. To understand the basics of partial discharges.
5. To understand the basics of over voltages, travelling waves and protection from over voltages.
6. Make the students familiar with different types of relay protection schemes and different types of circuit breakers used in the industry today.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Basics of Protection and Protection devices** | 7 | 20 |
| **Introduction:** Introduction to protection, trip circuit of a circuit breaker. Functional characteristics of a relay, zone of protection, primary and backup protection.  **Electromagnetic Relays:** Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays.  **CTs & PTs:** Transient errors in CT and CVT (Capacitive Voltage Transformer). |  |  |
| UNITS-2: **Classification & Applications of Protective Relays** | 9 | 20 |
| Relays Classification: Instantaneous, DMT and IDMT types. Application of relays: Over current/ Under voltage relays, Direction relays, Differential Relays, Percentage Differential Relays, Relays based on timing, Distance Relays, Thermal Relays, Earth fault Relays & Other types of Relays. Universal torque equation, Distance relays: Impedance, Reactance and Mho and Off-Set Mho relays |  |  |
| **Unit 3 Introduction to Static Relays** | 8 | 20 |
| Introduction to static relays, merits and demerits.  **Comparators**: amplitude and phase comparators, duality between amplitude and phase comparators. Introduction to (a) amplitude comparators-circulating current type, phase splitting type and sampling type, (b) phase comparators-vector product type and coincidence type.  **Static Overcurrent Relays**: Introduction to instantaneous, definite time, inverse time and directional overcurrent relays. | 6  2 |  |
| **Unit 4 Circuit Breakers - I** | 6 | 20 |
| HRC Fuse & its characteristics, Differences between HRC fuse & Circuit Breaker, Electric arc and its characteristics, arc interruption-high resistance interruption and current zero interruption. Arc interruption theories– recovery rate theory and energy balance theory.  Re-striking voltage and recovery voltage, develop expressions for re-striking voltage and RRRV. Resistance switching, current chopping and interruption of capacitive current. Oil circuit breakers-bulk oil and minimum oil circuit breakers. Air circuit breakers. Miniature Circuit breaker (MCB). | 3  3 |  |
| **Unit 5 Circuit Breakers - II** | 6 | 20 |
| Air blast, SF6 and vacuum circuit breakers. Selection of circuit breakers, rating of circuit breakers.  **Digital Protection:** Introduction to digital protection. Brief description of block diagram of digital relay. Introduction to digital overcurrent, transformer differential and transmission line distance protection. | 3  3 |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1) C.L. Wadhwa: High voltage Engineering, New Age International Publishers.

2) Kamraj and Naidu: High voltage Engineering, TATA MCGRAW HILL.

**Course outcomes:**

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

1. Understand the discharge phenomenon in solid, liquid and gaseous insulating mediums.
2. Understand the basics of high voltage generation and measurement for testing purposes.
3. Understand the basics of measurement of capacitance and tan delta of insulating mediums.
4. Understand the phenomenon of partial discharges.
5. Understand the phenomenon of travelling waves.
6. Understand the phenomenon of over voltages in power system, protection from these over voltages and the insulation coordination.
7. To be able to visualize above related field problems.
8. Use different types of switchgear and protection in the industry today.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |
| 7 | S | S | S | S | S | M | M | M | M | M | S |
| 8 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 6 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 7 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 6 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 6 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 3, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 6,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **Solar Lab** | Course Code : EE 360 |
| Semester : VI | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Practical knowledge of Renewable energy sources

**Course Objectives:**

1. Understand the practical application of Renewable energy sources.
2. Help the learner to understand basic principle and working of solar system.
3. Understand the application of solar energy.
4. Understand the use and application of Solar / PV Cell.
5. Help students have a hands-on experience of working on Solar devices, so that they can do it in industry easily afterwards.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** |
| **I** | To estimate the efficiency of solar photovoltaic panels and demonstrate the I-V and P-V characteristics of PV module with varying radiation and temperature level. | 2 |
| **II** | To demonstrate the effect of variation in tilt angle on PV module power. | 2 |
| **III** | To demonstrate the effect of shading on module output power. | 2 |
| **IV** | To demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules. | 2 |
| **V** | Study of Solar Radiation by using pyranometer. | 2 |
| **VI** | To calculate overall efficiency and energy balance of solar air heater. | 2 |
| **VII** | To demonstrate the COP of Hybrid Solar Air – Conditioning system. | 2 |
| **VIII** | To calibrate two thermocouples, and to examine some of the properties and behavior of thermocouples. | 2 |
| **IX** | To find out overall efficiency and energy balance of solar still. | 2 |
| **X** | To study the constructional details of a box type solar cooker. | 2 |
|  | **Total** | **20** |

**Reference:**

Lab Manual.

**Course outcomes:**

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

1. Student will be able to analyse and understand the basic and characteristics of Solar/ PV Cell.
2. Apply applications of Renewable energy sources
3. Apply network theorems practically on Solar system.
4. Evaluation of intensity of sun rays and its usability.
5. Work on most of the devices encountered in a Solar Plant, and also will be able to design some of them.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **MODERN POWER ELECTRONICS** | Course Code :EE 304 |
| Semester : **VI** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **Electrical engineering** | |

**Pre-requisites:**

Basics of power electronics and circuit analysis.

**Course Objectives:**

|  |
| --- |
| 1. Help the learner to understand basic principle of controller |
| 1. Understand the principle of inverter and its harmonic reduction techniques |
| 1. Understand the basic principles of cyclo-converter and its applications |
| 1. Learn about different type of DC power supply 2. Learn about AC power supply 3. Make students familiar with different types of modern Power electronic devices, such as AC Voltage Controller, Cyclo-converter, Inverter, SMPS, etc. |
|  |

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: AC VOLTAGE CONTROLLER | 8 | 20 |
| Principle of On-Off Control, Principle of Phase control, Single Phase Bi-directional Controllers with Resistive Loads, Single Phase Controllers with Inductive Loads, Three Phase full wave AC controllers, AC Voltage Controller with PWM Control. |  |  |
| UNITS-2: INVERTERS | 7 | 20 |
| |  | | --- | | Principle of Operation, Single-phase bridge inverters, Three phase bridge Inverters:  180 and 120 degree modes of conduction. Voltage control of Single Phase and Three Phase  Inverters, Current Source Inverters, Harmonics and its reduction techniques. | |  | |  |  |
| UNITS-3: CYCLOCONVERTERS | 7 | 20 |
| Basic principle of operation, single phase to single phase, three-phase to three-phase and three phase to single phase cyclo-converters. Output equation, Control circuit. |  |  |
| UNIT-4: DC POWER SUPPLY | 7 | 20 |
| Switched Mode DC Power Supplies, fly back converter, forward converter, half and full bridge converter, resonant DC power supplies, bi-directional power supplies. |  |  |
| UNIT 5: AC POWER SUPPLY | 7 | 20 |
| Switched mode power supplies, Resonant AC power supplies, bidirectional AC power supplies. Multistage Conversions, Control Circuits: Voltage Mode Control, Current Mode Control. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. M.H Rashid: Power Electronics, circuit devices and applications, PRENTICE HALL OF INDIA., 1988.
2. V. Subrahmanyam: Power electronics, New Age Inc. Publishers, New Delhi, 1996.
3. P.C. Sen: Power electronics Tata McGraw-Hill 1987
4. CW Lander: Power electronics, 2nd edition, McGraw Hill, 1987
5. P.S Bimbhra: Power electronics, 2nd Ed. Khanna Publishers, 1987
6. M.D. Singh and K.B. Khanchandani: Power electronics, TATA MCGRAW HILL, 1998



**Course outcomes:**

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

|  |
| --- |
| 1. Student will be able to understand the application of AC voltage controller |
| 1. Understand the different type of inverters, their applications and their harmonic reduction |
| 1. Understand how to change frequency with the help of cyclo-converter |
| 1. Understand different type of DC power supply 2. Understand different type of AC power supply 3. Understand and work on different types of modern Power electronic devices, and use them in industry. |
|  |

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 TO 4 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 TO 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 TO 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

Enrolment No..................................

B.Tech/M.Tech Dual Degree

(Elect. Engg)

Semester VIsemester )

MODERN POWER ELECTRONICS (EE 304)

MAIN/BACK EXAMS-APRIL/MAY-2014

Time:3 Hours Max.marks:-70 Instructions to candidate:

Attempt overall 5 questions selecting one question from each unit.

All questions carry equal marks

UNIT 1

Q1.A single phase a.c voltage regulator, with two thyristor arranged in anti parallel, is connected to RL load. discuss its working when firing angle is more than the load power factor angle. Illustrate your answer with waveform of source voltage, Gate signals, load and source currents, output voltage and voltage across the SCRs. (14)

OR

Q2. (a) Explain why the single phase A.C voltage regulator using two SCRs must have its trigger sources isolated from each other with proper diagram?

(b) For the single phase voltage controller the source is 120 volt rms at 60 Hz, and the load is a series RL combination with R= 20 ohm and L = 50mH.the delay angle α is 90 degree Determine (a) the rms load current (b) the rms SCR current (c) the average SCR current (d) the power deliver to load and (e) the power factor. ( 4+10)

UNIT 2

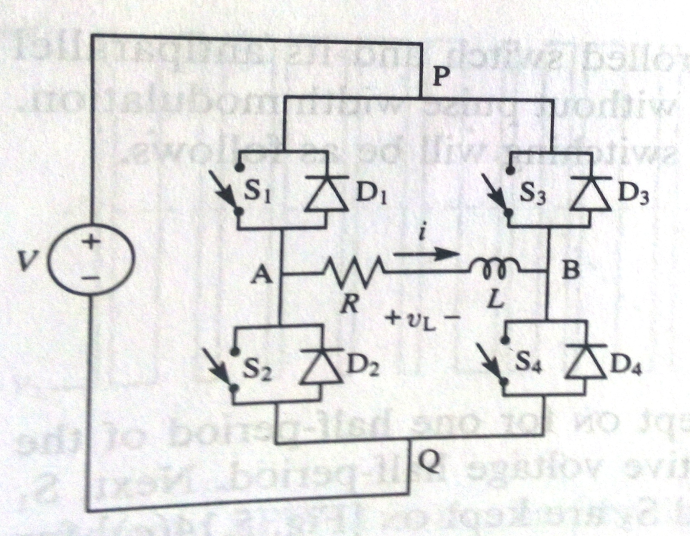
Q3. With an appropriate power diagram, discuss the principle of working of a three phase bridge inverter. Draw phase and line voltage waveforms on the assumption that each thyristor conduct for 120 degree and the resistive load is star connected. Also, prepare a table which shows the sequence of firing of various SCRs.

(3+4+4+3)

OR

Q4. The following data relate to the full bridge inverter. it is operate without PWM: R=20 ohm,L= 0.2 H,V=400V and frequency f= 100Hz.assume repetitive conditions.

1. Obtain a numerical expression for the current in one half cycle of the AC output
2. Sketch the waveform of the output current and voltage. Determine the instants at which the zero crossing occur, commencing from the positive going zero- crossing of the voltage.
3. State the conduction sequence of all eight power semiconductors switching elements and the conduction angle of each element. (14)



UNIT 3

Q5. (a)Discuss why three phase to single phase cyclo-converter requires positive and negative group phase controlled converters. Under what conditions, the group work as inverter or rectifiers? How should the firing angles of the two converters be controlled?

(b) Draw the control circuit block diagram of cyclo-converter. ( 3+3+4+4)

OR

Q6.(a) show that the fundamental RMS value of per phase output voltage of low frequency for an m –pulse cyclo -converter is given by

Eor = Eph( m/π) sin (m/π) also express Eor  in terms of voltage reduction factor r.

(b) A three phase cyclo converter feeds a single phase load of 190 V, 45 A at a power factor of 0.7 lagging. Determine (a) the required supply voltage (b) thyristor rating (9+5)

UNIT 4

Q7. Explain the forward converter as SMPS (with proper diagram and waveform)( 14)

OR

Q8.What is resonant DC power supplies and bidirectional power supplies.(7+7)

UNIT 5

Q9.briefly describe the switched-mode, resonant and bi-directional AC power supplies.

OR

Q10. Explain the concept of AC power supplies or UPS. What are the types of AC power supplies available?

|  |  |
| --- | --- |
| Course Title:  **MODERN POWER ELECTRONICS LAB** | Course Code : EE 354 |
| Semester : VI | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Power Electronics components and their uses.

**Course Objectives:**

1. Understand the practical application of AC voltage regulators.
2. Help the learner to understand and test buck, boost and buck- boost regulators.
3. Understand the application of Control speed of a single-phase induction motor using single phase AC voltage regulator.
4. Understand the use and application of AC servomotor.
5. Give the students hands-on experience of various basic Power electronic devices like converters, AC voltage controllers, cyclo-converters, inverters and DC choppers.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** |
| **I** | Study and test AC voltage regulators using TRIAC, ant parallel thrusters and TRIAC and DIAC. | 2 |
| **II** | 2 Study and test single phase PWM inverter | 2 |
| **III** | Study and test buck, boost and buck- boost regulators | 2 |
| **IV** | Study and test MOSFET chopper | 2 |
| **V** | Study and test Zero voltage switching. | 2 |
| **VI** | Study and test SCR DC circuit breaker | 2 |
| **VII** | Control speed of a dc motor using a chopper and plot armature voltage versus speed characteristic. | 2 |
| **VIII** | Control speed of a single-phase induction motor using single phase AC voltage regulator | 2 |
| **IX** | Study single-phase dual converter. (ii) Study speed control of dc motor using single-phase dual converter | 2 |
| **X** | Study one, two and four quadrant choppers (DC-DC converters) | 2 |
| **XI** | Study speed control of dc motor using one, two and four quadrant choppers. | 2 |
| **XII** | Study single-phase cyclo-converter. | 2 |
|  | **Total** | 20 (Any 10) |

**Reference:**

Lab Manual.

**Course outcomes:**

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

1. Student will be able to analyse and understand the practical application of AC voltage regulators.
2. Apply applications of SCR DC circuit breaker.
3. Control speed of a dc motor using a chopper and plot armature voltage versus speed characteristic.
4. Study speed control of dc motor using one, two and four quadrant choppers.
5. Use various Power electronic devices for speed control of different electrical machines like DC motors and single-phase induction motors.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: DATA STRUCTURES IN C | Course Code : CP 320 |
| Semester : VI | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : 3 **Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Computer basic and c Language

**Course Objectives:**

1. To introduce about the data structure and algorithm, linear data structure and non linear data structure
2. To introduce about array representation and application of Stack and Queue and Sparse matrix and practice on them
3. To introduce the link list architecture of data structure and the application of it and practice on that
4. To introduce the tree architecture of data structure and the application of it and practice on that
5. To introduce the graph architecture of data structure and the application of it and practice on that

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Performance Measurement:** | 06 | 20 |
| 1. **Performance Measurement:** Space complexity and Time complexity, big oh, omega and theta notations and their significance. 2. Linear Lists **- Array** and linked representation, singly and doubly linked lists. Concept of circular linked lists. | 03  04 |  |
|  | | |
| UNITS-2: **Array and Matrices** | 06 | 20 |
| 1. Row and Column Major mapping and representation, irregular 2D array, 2. Matrix operations, Special matrices: diagonal, tri-diagonal, triangular and symmetric. Sparse matrices representation and its transpose. | 03  03 |  |
| UNITS-3: **Stacks** | 08 | 20 |
| 1. Representation in array and linked lists, basic operation, 2. Applications of stacks in parenthesis matching, towers of Hanoi etc. 3. Queues **-** Representation in array and linked lists, applications, circular queues. | 03  02  02 |  |
|  | | |
| **UNIT 4: Trees** | 08 | 20 |
| 1. Binary Tree, representation in array and linked lists, basic operation on binary trees, binary tree traversal (preorder, post order, in order). 2. Search Trees **-** Binary search tree, indexed-binary search tree, basic operation, AVL tree, B-tree and Heap Tree. | 04  04 |  |
| **UNIT 5: Graphs** | 08 | 20 |
| 1. Representation of unweighted graphs, BFS, DFS, and Minimum cost spanning trees, Single source shortest path. 2. Sorting **-** Bubble sort, insertion sort, merge sort, selection sort, quick sort, heap sort. | 04  04 |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Tannenbaum:Data structures in C (PRENTICE HALL OF INDIA)
2. Data Structures in C by Lipsutcz in Schaum Series.
3. Havowitz and Sawhni:Data structures in C and C++ (BPB Publication).

**Course outcomes:**

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

1. Get knowledge about the data structure, how to design an algorithm and importance of data structure
2. How we represent an array in memory and all application of array
3. How we implement the link list and its application
4. How we implement the tree data structure and its application
5. How we implement the graph data structure and its application

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S |  |  | S |  |  |  |  |  |  |  |  |
| 3 | S |  | S |  |  |  |  |  |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  |  |  | M |  |
| 5 | S |  |  |  |  |  |  |  |  | M |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 20 |
| 2 | Applying the knowledge acquired from the course | 40 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: DATA STRUCTURES LAB | Course Code : CP 358 |
| Semester : VI | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 0**:0:3** | Credits : 1 **Credit** |
| Type of course : **Practical** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: B. Tech. Electrical Engineering | |

**Pre-requisites:**

C language

**Course Objectives:**

1. Demonstrate familiarity with major algorithms and data structures.
2. Analyze performance of algorithms.
3. Choose the appropriate data structure and algorithm design method for a specified application
4. Determine which algorithm and data structure to use in different scenarios.
5. Be familiar with writing recursive methods

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **List of Experiments** |  | **Marks** |
|  | Simple array and sorting algorithm implementations. | 2 |
|  | Addition, multiplication and transpose of sparse matrices represented in array form. | 2 |
|  | Polynomial addition, multiplication (8th degree polynomials), using array and linked lists. | 2 |
|  | Implementation of stack and queue using array and linked lists | 2 |
|  | Implementation of circular queue using array. | 2 |
|  | Infix to postfix/prefix conversion. | 2 |
|  | Binary search tree creation and traversing | 2 |
|  | Generation of spanning trees for a given graph using BFS and DFS algorithms. | 2 |
|  | AVL tree implementation (creation, insertion, deletion). | 2 |
|  | Symbol table organization (Hash Table). | 2 |
|  | Simple array and sorting algorithm implementations. | 2 |
|  | Basic operation over linked list (add node, delete node). | 2 |
|  | **Total** | 20 (Any 10) |

**Reference:**

Lab manual

**Course outcomes:**

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

1. Represent an array in memory and all application of array
2. Analyze performance of algorithms
3. implement the link list and its application
4. implement the tree data structure and its application
5. implement link list.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S |  |  |  |  |  |  |  |  |  |  |
| 2 |  | S |  |  |  |  |  |  | M |  |  |  |
| 3 | S | S |  |  |  |  |  |  |  |  |  |  |
| 4 | S |  |  |  |  |  |  | M |  |  |  |  |
| 5 | S |  |  |  |  |  |  |  |  |  | M |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Attendance | Student | Every lab | 10 | Attendance Register |  |
| Performance+ Record+ viva | Every lab | 30 | Lab Record |  |
| Project | Every lab | 20 | Project Report |  |
| **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 25 |
| 2 | Applying the knowledge acquired from the course | 30 |
| 3 | Analysis and Evaluation | 45 |

|  |  |
| --- | --- |
| Course Title:  **FUNDAMENTALS OF DIGITAL COMMUNICATION** | Course Code : EC 316 |
| Semester : VI | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : 3 **Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Basics of Communication, Waveforms.

**Course Objectives:**

1. To introduce about the different Modulation Techniques.
2. To introduce Digital Modulation Technique.
3. To introduce the Error Probability in Digital Modulation.
4. To introduce Error Probability in Digital Modulation.
5. To introduce the Coding of Information.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **UNIT** | **COURSE CONTENTS** | **Hrs. 36** |
| **I** | **PCM and DELTA Modulation Systems:** PCM and delta modulation, quantization noise in PCM and delta modulation. Signal-to-noise ratio in PCM and delta modulation, T1 Carrier System, Comparison of PCM and DM. Adaptive delta Modulation. Bit, word and frame synchronization, Matched filter detection. | **6** |
| **II** | **Digital Modulation Techniques:** Various techniques of phase shift, amplitude shift and frequency shift keying. Minimum shift keying. Modulation and Demodulation. | **6** |
| **III** | **Error Probability in Digital Modulation:** Calculation of error probabilities for PSK, ASK, FSK and MSK techniques. | **8** |
| **IV** | **Information Theory:** Amount of Information, Average Information, Entropy, Information rate, Increase in Average information per bit by coding, Shannon's Theorem and Shannon's bound, Capacity of a Gaussian Channel, BW-S/N trade off, Orthogonal signal transmission. | **8** |
| **V** | **Coding:** Coding of Information, Hamming code, Single Parity-Bit Code, Linear Block code, cyclic code and convolution code. | **8** |

**Reference:**

1)Digital Communication by Simon Hykin by John Wiley and Sons.  
2) Digital Communication by P.Chakraborty.Dhanpat Rai and Sons.

3) Principle of Communication systems by Taub SCHILLING, TATA MCGRAW HILL

**Course outcomes:**

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

1. Get knowledge about the PCM and DELTA Modulation Systems
2. How we represent word and frame synchronization.
3. How we implement the Calculation of error probabilities.
4. How we implement the cyclic code and convolution code.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S |  |  | S |  |  |  |  |  |  |  |  |
| 3 | S |  | S |  |  |  |  |  |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  |  |  | M |  |
| 5 | S |  |  |  |  |  |  |  |  | M |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 20 |
| 2 | Applying the knowledge acquired from the course | 40 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **MICROPROCESSOR AND COMPUTER ARCHITECTURE II** | Course Code : EC 314 |
| Semester : VI | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : 3 **Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Basics of Computer.

**Course Objectives:**

1. To introduce about the Hardware specifications, architecture.
2. To introduce Software and Instruction Set.
3. To introduce the Programmable peripheral interfacing.
4. To introduce Data and Memory Interfacing.
5. To introduce the 8086 based Multiprocessor systems.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **UNIT** | **COURSE CONTENTS** | **Hrs. 36** |
| **I** | **8086 Microprocessor:** Hardware specifications, architecture, address spaces, clock generator, bus controller and arbiter, Minimum and maximum mode, System Bus Timing. | **6** |
| **II** | **Software and Instruction Set:** Assembly language programming: addressing mode and instructions of 8086, linking and execution of programs, MACRO programming, assembler directives and operators. | **6** |
| **III** | **I / O Interfaces:** Programmable peripheral interfacing **(**8255, 8155), Programmable Timer interfacing (8253, 8254), Programmable interrupt controller (8259) Serial Communication interfaces. | **8** |
| **IV** | **Data and Memory Interfacing:** A/D, D/A converter interfacing, Memory interfacing and Decoding, DMA controller. | **8** |
| **V** | **Multiprocessor Configurations:** 8086 based Multiprocessor systems. 8087 Numeric data processor. | **8** |

**Reference:**

1) Gaonkar:Microprocessors.

2) Douglas Hall:Digital Electronics and Microprocessors.

3) B.Ram.Microprocessors.

4) Morris Mono:digital electronics.

**Course outcomes:**

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

1. Get knowledge about the 8086 Microprocessor.
2. How we represent Assembly language programming.
3. How we implement the Programmable interrupt controller.
4. How we implement the Memory interfacing and Decoding.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S |  |  | S |  |  |  |  |  |  |  |  |
| 3 | S |  | S |  |  |  |  |  |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  |  |  | M |  |
| 5 | S |  |  |  |  |  |  |  |  | M |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 20 |
| 2 | Applying the knowledge acquired from the course | 40 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **Renewable Energy Sources** | Course Code : EE 314 |
| Semester : **VI** | Core / Elective :  **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree3,5** | |

**Pre-requisites:**

Names of common Renewable energy sources.

**Course Objectives:**

1. Understand the practical application of Renewable energy sources
2. Help the learner to understand basic principle and working of solar system.
3. Understand the application of wind power.
4. Understand the use and application of Solar /PV Cell.
5. Make students familiar with the various types of Renewable energy sources being used in the world today, and different technologies related to them.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Introduction and Tidal Energy** | 7 | 20 |
| 1. **Introduction**: World energy situation, conventional and non-conventional energy sources, Indian energy scene. 2. **Tidal Energy**: Introduction to tidal power. Components of tidal power plants, double basin arrangement. Power generation. Advantages and limitations of tidal power generation. Prospects of tidal energy in India. | 4  3 |  |
|  | | |
| UNITS-2: **Solar Energy** | 7 | 20 |
| 1. **Solar Energy**: Solar radiation, solar radiation geometry, solar radiation on tilted surface. Solar energy collector. Flat- plate collector, concentrating collector – parabolic and heliostat. 2. **Solar power plant**: Solar pond. Solar cell, solar cell array, basic photo-voltaic power generating system. | 4  3 |  |
| UNITS-3: **Wind Energy and Geothermal Energy** | 8 | 20 |
| 1. **Wind Energy**: Basic principle of wind energy conversion, efficiency of conversion, site selection. Electric power generation-basic components, horizontal axis and vertical axis wind turbines, towers, generators, control and monitoring components. Basic electric generation schemes- constant speed constant frequency, variable speed constant frequency and variable speed variable frequency schemes. Applications of wind energy. 2. **Geothermal Energy**: Geothermal fields, estimates of geothermal power. Basic geothermal steam power plant, binary fluid geothermal power plant and geothermal preheat hybrid power plant. Advantages and disadvantages of geothermal energy. Applications of geothermal energy. Geothermal energy in India. | 4  4 |  |
|  | | |
| **UNIT 4: Nuclear Energy** | 7 | 20 |
| 1. **Nuclear Fusion Energy**: Introduction, nuclear fission and nuclear fusion. Requirements for nuclear fusion. Plasma confinement – magnetic confinement and inertial confinement. 2. Basic Tokamak reactor, laser fusion reactor. Advantages of nuclear fusion. Fusion hybrid and cold fusion. | 4  4 |  |
| **UNIT 5: Biomass Energy** | 7 | 20 |
| 1. **Biomass Energy**: Introduction, biomass categories, bio-fuels. Introduction to biomass conversion technologies. 2. Biogas generation, basic biogas plants-fixed dome type, floating gasholder type, Deen Bandhu biogas plant, Pragati design biogas plant. Utilization of bio gas. Energy plantation. Pyrolysis scheme. Alternative liquid fuels –ethanol and methanol. Ethanol production. | 3  4 |  |
| **TOTAL** | **36** | **100** |

**Reference:**

Lab Manual

**Course outcomes:**

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

1. Analyse and understand the basic and characteristics of Solar/ PV Cell.
2. Apply applications of Renewable energy sources.
3. Apply network theorems practically on Wind Energy.
4. Evaluation of intensity of sun rays and its usability.
5. Work with all types of Renewable energy sources, like Tidal energy, Solar energy, Wind energy, Geothermal energy, Nuclear energy and Biomass energy, in the industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **Smart Grid Lab** | Course Code : EE 362 |
| Semester : VI | Core / Elective :  **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Practical knowledge is important with the subject GPE.

**Course Objectives:**

1. Understand the basics of a Smart Grid and its benefits.
2. Learn about the challenges faced while installing or using Smart Grid.
3. Learn to calculate and measure certain parameters of Power Quality, and use them to increase efficiency of the Smart Grid.
4. Understand the use and application of some online computing tools like Web Service, CLOUD Computing and Cyber Security to make Smart Grids smarter and secure.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** |
| **I** | Study of smart grid-I: Concept, definition, need for smart grid, functions. | 2 |
| **II** | Study of smart grid-II: Opportunities, challenges & benefits. Difference between conventional & smart grid. | 2 |
| **III** | Present development & international policies in smart grid. | 2 |
| **IV** | To visit thermal/nuclear power plant. | 2 |
| **V** | Study different terminology used in power quality assessment. | 2 |
| **VI** | Power Quality issues of Grid connected Renewable Energy Sources. | 2 |
| **VII** | Study and measure certain parameters of power quality in laboratory with and without power quality improvement devices. | 2 |
| **VIII** | Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. | 2 |
| **IX** | Basics of Web Service and CLOUD Computing to make Smart Grids smarter. | 2 |
| **X** | Study of Cyber Security for Smart Grid. | 2 |
|  | **Total** | 20 |

**Reference:**

Lab Manual

**Course outcomes:**

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

1. Understand the basic components of Smart Grid and their working.
2. Understand the various terminology used in Power Quality Assessment.
3. Detect and resolve Power Quality issues related to Grid-connected Renewable energy sources.
4. Implement different online methods taught in Lab to make Smart Grid smarter and secure.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **SMART GRID TECHNOLOGY** | Course Code : EE 316 |
| Semester : VI | Core / Elective : Elective |
| Teaching Scheme in Hrs (L:T:P) : **3:0:1** | Credits : **3 Credits** |
| Type of course :  **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering** | |

**Objectives:**

1. To provide students with a understanding of basics of smart grids;

2. To acquire the knowledge of differences of conventional grid & smart grid;

3. To acquire knowledge of the development & international policies

4. To acquire knowledge on the components in smart grids and their functions

**Outcomes:**

Upon completion of the subject, students will be able to:

a. Acquire in-depth understanding on recent development of smart grid;

b. Apply advanced analysis tools in planning and operation of smart grids; and

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **UNIT I** | 8 | 20 |
| Introduction to Smart Grid: Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits | 5 |  |
| Difference between conventional & Smart Grid, Concept of Resilient &Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives. | 3 |
| **UNIT II** | 8 | 20 |
| Smart Grid Technologies: Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring. | 5 |  |
| Protection and Control, Distribution Systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV). | 3 |
| **UNIT III** | 8 | 20 |
| Smart Meters and Advanced Metering Infrastructure: Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives. | 4 |  |
| AMI needs in the smart grid, Phasor Measurement, Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection. | 4 |
| **UNIT IV** | 8 | 20 |
| Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources. | 5 |  |
| Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. | 3 |
| **UNIT V** | 8 | 20 |
| High Performance Computing for Smart Grid Applications: Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broad bandover Power line (BPL). | 5 |  |
| IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid | 3 |
| **TOTAL** | **48** | **100** |

**Reference Books:**

1. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke: Smart Grid Technologies- Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang: Smart Grid – The New and Improved Power Grid- A Survey, IEEE Transaction on Smart Grids, 2011.
3. Stuart Borlase: Smart Grid-Infrastructure, Technology and Solutions, CRC Press, 2012

Peter Fox-Penner, “Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities,” Island Press, 2010.

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL VEHICLE TECHNOLOGY** | Course Code : EE 336 |
| Semester : VI | Core / Elective : ELECTIVE |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes:  **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

**Engineering Mechanics, Electric Machines Power Electronic converters,**

**Course Objectives:**

1. Help the learner to understand basic problems of modern transportation.
2. Understand the construction and operation of vehicle.
3. Understand the construction and operation of electric vehicle and hybrid electric vehicle.
4. Learn about different type of vehicle propulsion systems
5. Learn about different types new vehicle propulsion systems

**Course Contents:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **Unit 1: Introduction** | 8 | 20 |
| Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. |  |  |
| **Unit 2: Hybrid Electric Vehicle** | 6 | 20 |
| Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.  Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. |  |  |
| **Unit 3: Electric Propulsion unit** | 6 | 20 |
| Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency. |  |  |
| **Unit 4: Energy Storage** | 8 | 20 |
| Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems |  |  |
| **Unit 5: Energy Management Strategies** | 8 | 20 |
| Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles:by [Mehrdad Ehsani](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Mehrdad+Ehsani&search-alias=stripbooks) ,‎ [Yimin Gao](https://www.amazon.in/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=Yimin+Gao&search-alias=stripbooks) ,‎ [Ali Emadi](https://www.amazon.in/s/ref=dp_byline_sr_book_3?ie=UTF8&field-author=Ali+Emadi&search-alias=stripbooks) ,CRC Press
2. Electric Vehicle Technology Explained by [James Larminie](https://www.amazon.in/James-Larminie/e/B001IR1E72/ref=dp_byline_cont_book_1)  ,‎ [John Lowry](https://www.amazon.in/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=John+Lowry&search-alias=stripbooks) ,Wiley Publishers
3. Introduction to Hybrid Vehicle System Modeling and Control by Wei Lu, Wiley Student edition
4. Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011.
5. Hybrid Electric Vehicles: Energy Management Strategies, S. Onori, L. Serrao and G. Rizzoni Springer, 2015.
6. Electric and Hybrid Vehicles, T. Denton, Routledge, 2016.

**Course outcomes:**

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

1. Student will be able to understand environmental impact of modern transportation
2. Understand fundamental working of vehicle
3. Understand fundamental of electric vehicle, hybrid electric vehicle
4. Design DC and induction motor propulsion system
5. Understand PMBLDC and SRM propulsion system.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | s | M | s | M | M | S |
| 3 | S | S | S | S | S | M | s | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | s | s | s | M | M | S |

S: Strong relationship M: Moderate relationship

|  |  |
| --- | --- |
| Course Title:  **DISASTER MANAGEMENT** | Course Code :  **IGI 305** |
| Semester : **III** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : | Credits : 2 **Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : |
| Continuous Internal Evaluation : | ESE : |
| Programmes: **B.Tech. Electrical Engineering** | |

|  |  |  |
| --- | --- | --- |
| **Unit-1** | Introduction to Disasters: Concepts and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks) |  |
| **Unit-2** | Disasters: Classification Causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc.), Differential impacts- in terms of caste, class, gender, age, location, disability, Global trends in disasters! Urban disasters, pandemics, complex emergencies, Climate change |  |
| **Unit-3** | Approaches to Disaster Risk reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural non-structural ensures roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders. |  |
| **Unit-4** | Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc. Climate Change Adaptation. Relevance of indigenous knowledge, appropriate technology and local resources. |  |
| **Unit-5** | Disaster Risk Management in India Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programs and legislation) |  |
| **Unit-6** | Project Work: (Field Work, Case Studies)  The project /fieldwork is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located. |  |

**Suggested Reading list**

1. Alexander David, Introduction in 'Confronting Catastrophe', Oxford University Press, 2000
2. Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social Sciences Working Paper no. 8, 2008
3. Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters, Routledge.
4. Coppola P Damon, 2007. Introduction to International Disaster Management,
5. Carter, Nick 1991. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila Philippines.
6. Cuny, F. 1983. Development and Disasters, Oxford University Press.
7. Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.
8. Government of India, 2009. National Disaster Management Policy,
9. Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi , Indian Journal of Social Work 2002.Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April.
10. Kapur, Anu & others, 2005: Disasters in India Studies of grim reality, Rawat Publishers, Jaipur

|  |  |
| --- | --- |
| Course Title **INFORMATION TECHNOLOGY LAB** | Course Code : IT 457 |
| Semester : VII | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : 0**:0:3** | Credits : 1 **Credits** |
| Type of course : **Lecture** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Computer basic and c Language

**Course Objectives:**

1. To introduce about Creating a web page of learning usage of tables
2. To introduce about Create a web page of your own description using all the information learned above
3. To introduce the Create a web page of learning usage of frames.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** |
| **I** | Create a web page of meaningful story or description using various tags i.e. <u>, <i>, <b>, <big>, <small>, <large>, <tt>, <s>, <p>, <marquee> etc. | 2 |
| **II** | Create a web page of learning various lists e.g. ordered lists, unordered lists, definition lists and hence inscribe meaning list of various fields for e.g. academics, sports, politics etc. | 3 |
| **III** | Create a web page of learning usage of tables | 3 |
| **IV** | Create a web page of learning usage of frames. | 3 |
| **V** | Create a web page of learning usage of target and hyperlinks (same page and different page linking). | 3 |
| **VI** | Create a web page of learning usage of forms, using various buttons and fields | 3 |
| **VII** | Create a web page of your own description using all the information learned above | 3 |
|  | **Total** | 20 |

**Reference:**

Lab Manual

**Course outcomes:**

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

1. Get knowledge about the data structure, how to design an algorithm and importance of data structure
2. How we represent an array in memory and all application of array
3. How to create a webpage by using different techniques.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S |  |  | S |  |  |  |  |  |  |  |  |
| 3 | S |  | S |  |  |  |  |  |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  |  |  | M |  |
| 5 | S |  |  |  |  |  |  |  |  | M |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 20 |
| 2 | Applying the knowledge acquired from the course | 40 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **POWER SYSTEM ANALYSIS** | Course Code : EE 401 |
| Semester : **VII** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

* EE 311 - Power System Instrumentation
* EE 312 – Switch Gear And Protection

**Course Objectives:**

1. Make students familiar with per unit system, and how the power system is modelled using it.
2. Help the learner understand the basic applications, principles and concepts of Fault Analysis.
3. Learn about the different types of Faults.
4. Obtain a detailed understanding of Symmetrical Components, their applications and their design.
5. Understand the Load Flow Analysis and the calculations involved in it.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Per unit system based modelling of power system** | 10 | 20 |
| 1. **Per unit System:** Percent and per unit quantities. Single line diagram for a balanced 3-phase system. 2. **Admittance Model:** Branch and node admittances Equivalent admittance network and calculation of Y bus. Modification of an existing Y bus. 3. **Impendence Model:** Bus admittance and impedance matrices of real power system. Thevenin’s theorem and Z b direct determination of Z bus. Modification of an existing bus. | 4  3  3 |  |
|  | | |
| UNITS-2: **Symmetrical fault analysis** | 10 | 20 |
| Transient on a Transmission line, short circuit of a synchronous machine on no load, short circuit of a loaded synchronous machine. Equivalent circuits of synchronous machine under sub transient, transient and steady state conditions. Selection of circuit breakers, Algorithm for short circuit studies. Analysis of three phase faults. |  |  |
| UNITS-3: **Symmetrical Components** | 8 | 20 |
| Fortescure theorem, symmetrical component transformation. Phase shift in star-delta transformers. Sequence Impedances of transmission lines, Synchronous Machine and Transformers, zero sequence network of transformers and transmission lines. Construction of sequence networks of power system. |  |  |
|  | | |
| **UNIT 4: Unsymmetrical Fault Analysis** | 10 | 20 |
| Analysis of single line to ground faults using symmetrical components, connection of sequence networks under the fault condition. Analysis of line-to-line and double line to ground faults for real power system using symmetrical components, connection of sequence networks under fault conditions. Analysis of unsymmetrical shunt faults using bus impedance matrix method. |  |  |
|  |  |  |
| **UNIT 5: Load Flow Analysis** | 10 | 20 |
| Load flow problem, development of load flow equations for real power system, bus classification. Gauss Seidel method, Newton Raphson method, decoupled and fast decoupled methods for load flow analysis. Comparison of load flow methods. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. Power System Analysis by Nagrath Kothari, TMH.
2. Electrical Power System by C.L. Wadhwa, New Age Publisher.
3. Power System Analysis by B.R Gupta, Wheeler Publication.
4. Power System Analysis by J.B Gupta, Katria & Sons Publication.
5. Power System Analysis by Bakshi & Bakshi, Technical Publication.

**Course outcomes:**

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

1. Understand and implement basic equations governing the operation of power.
2. Develop a control scheme for the overall control of the Faults.
3. Able to evaluate the performance of Impedance and Admittance Model and its applications.
4. Calculate the evaluating parameters for Symmetrical Components.
5. The student will have a better understanding of the applications and trends of Load Flow Solutions in the current industry.
6. Analyse any type of symmetrical or unsymmetrical fault and calculate fault parameters of the power system.

**Mapping Course Outcomes with Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

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| --- | --- |
| Course Title: **HIGH VOLTAGE ENGINEERING** | Course Code : EE 415 |
| Semester : VII | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

Basics of electricity and magnetism in Secondary Education, basics of circuit analysis, basics of transformers, basics of measurement, basics of transmission line parameters (R, L, C, G).

**Course Objectives:**

1. To understand the basics of electrical discharges.
2. To understand the basics of high voltage generation for testing purposes.
3. To understand the basics of measurement of capacitance and dielectric loss of insulations.
4. To understand the basics of partial discharges.
5. To understand the basics of over voltages, travelling waves and protection from over voltages.
6. Learn about High Voltage generation, transmission and protection.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Electrical Breakdown** | 06 | 20 |
| 1. **Breakdown in Gases:** Introduction to mechanism of breakdown in gases, Townsend’s breakdown mechanism. Breakdown in electromagnetic gases. Application of gases in power system. 2. **Breakdown in Liquids:** Introduction to mechanism of breakdown in liquids, suspended solid particle mechanism and cavity breakdown. Application of oil in power apparatus. 3. **Breakdown in Solids:** Introduction to mechanism of breakdown in solids, electromechanical breakdown, treeing and tracking breakdown and thermal breakdown. |  |  |
| UNITS-2: **High Voltage Generation and Measurement** | 06 | 20 |
| 1. **High DC Voltage Generation:** Generation of high dc voltage, basic voltage multiplier circuit. 2. **High AC Voltage Generation:** Cascaded Transformers. 3. **Impulse Voltage generation:** Impulse voltage, basic impulse circuit, Marx’s multistage impulse generator. 4. **Measurement of High Voltage:** Potential dividers - resistive, capacitive and mixed potential dividers. Sphere gap - Construction and operation. Klydonorgraph. |  |  |
| UNITS-3: **Measurements at High Voltage** | 08 | 20 |
| 1. **Non-destructive Insulation Tests:** Measurement of resistively, dielectric constant & loss factor. High Voltage Schering Bridge- measurement of capacitance & dielectric loss. 2. **Partial Discharges:** Introduction to partial discharge, partial discharge equivalent circuit. Basic wide-band and narrow band PD detection circuits. |  |  |
| UNIT-4: **Over voltages and Travelling Waves** | 8 | 20 |
| 1. **Over voltages:** Causes of over voltages, introduction to lightning phenomena, over voltages due to lighting. 2. **Travelling Waves:** Travelling waves on transmission lines-open end line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at a T-junction and line terminated through a capacitance. Attenuation of travelling waves. |  |  |
| UNIT 5: **Overvoltage Protection and Insulation Coordination** | 08 | 20 |
| 1. **Over Voltage Protection:** Basic construction and operation of ground wires- protection angle and protective zone, ground rods, counterpoise, surge absorber, rod gap and arcing horn, lighting arresters - expulsion type, non -linear gap type and metal oxide gapless type. 2. **Insulation Coordination:** Volt - time curves, basic impulse insulation levels, coordination of insulation levels. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1) C.L.Wadhwa: High voltage Engineering, New Age International Publishers

2) Kamraj and Naidu: High voltage Engineering, TATA MCGRAW HILL

**Course outcomes:**

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

1. Understand the discharge phenomenon in solid, liquid and gaseous insulating mediums.
2. Understand the basics of high voltage generation and measurement for testing purposes.
3. Understand the basics of measurement of capacitance and tan delta of insulating mediums.
4. Understand the phenomenon of partial discharges..
5. Understand the phenomenon of travelling waves.
6. Understand the phenomenon of over voltages in power system, protection from these over voltages and the insulation coordination.
7. To be able to visualize above related field problems.
8. Use High Voltage generation, transmission and protection devices and techniques in the industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |
| 7 | S | S | S | S | S | M | M | M | M | M | S |
| 8 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 6 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 7 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 6 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 6 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 3, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 6,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL DRIVES** | Course Code : EE 407 |
| Semester : **VII** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

* EE 204 - Electro-Mechanics
* EE 301 - Power Electronics
* EE 304 - Modern Power Electronics

**Course Objectives:**

1. Help the learner understand the basic applications, principles and concepts governing Electric Drives and their operation.
2. Learn about the different types of Drives.
3. Obtain a detailed understanding of AC Drives and DC Drives, their applications and their design.
   1. DC Drives – DC Motor s with various converters
   2. AC Drives – Induction Motors/ Synchronous Motors with various converters
4. Understand the Control Methodology for implementing these drives.

**Course Content:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic and Contents** | | **Hours** | **Marks** |
|  | | | |
| Unit 1 **Dynamics of Electric Drives** | | 10 | 20 |
| Fundamental torque equations, speed-torque conventions and multi-quadrant operation, equivalent values of drive parameters, nature and classification of load torques, steady state stability, load equalization, close loop configurations of drives. | |  |  |
|  | | | |
| Unit 2 **DC Drives** | 10 | | 20 |
| Speed torque curves, torque and power limitation in armature voltage and field control, **Starting**. **Braking-**Regenerative Braking, dynamic braking and plugging. **Speed Control-**Controlled Rectifier fed DC drives, Chopper Controlled DC drives. | |  |  |
|  | | | |
| Unit 3 **Induction Motor Drives – I** | | 10 | 20 |
| **Starting. Braking-**Regenerative braking, plugging and dynamic braking. **Speed Control-**Stator voltage control, variable frequency control from voltage source, Voltage Source Inverter (VSI) Control | |  |  |
|  | | | |
| Unit 4 **Induction Motor Drives – II** | | 8 | 20 |
| Variable frequency control from current source, Current Source Inverter (CSI) Control, Cyclo-converter Control, Static rotor resistance control, Slip Power Recovery- Static Scherbius drive, Static Kramer drive. | |  |  |
|  | | | |
| Unit 5 **Synchronous Motor Drive** | | 10 | 20 |
| Control of Synchronous Motor-Separately Controlled and VSI fed Self-Controlled Synchronous Motor Drives. Dynamic and Regenerative Braking of Synchronous Motor with VSI. Control of Synchronous Motor Using Current Source Inverter (CSI). | |  |  |
| **TOTAL** | | **48** | **100** |

**Reference:**

1. Fundamentals of Electric Dives, G.K. Dubey, Narosa Publishing House, New Delhi 1995
2. V Subrahmanyam: Thyristor control of electric Drives, Tata McGraw Hill, New Delhi, 1988.
3. V Subrahmanyam: Electric Drives-Concepts and Applications, Tata McGraw Hill, New Delhi.
4. S K Pillai: A first course on electrical Drives, Wiley Eastern limited, India.
5. B K Bose: Power electronics and A. C. Drives, Prentice Hall.

**Course outcomes:**

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

1. Understand and implement basic equations governing the operation of drives.
2. Design converters based on the Electric Motor being used in the Drive.
3. Develop a control scheme for the overall control of the Drive.
4. Able to evaluate the performance of a designed drive and its applications.
5. Calculate the evaluating parameters for Electric Drives.
6. The student will have a better understanding of the applications and trends of Electric Drives in the current industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **POWER SYSTEM ENGINEERING** | Course Code : EE 413 |
| Semester : **VII** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **Electrical engineering** | |

**Pre-requisites:**

Basics of machine, circuit analysis and generation of electrical power

**Course Objectives:**

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| --- |
| 1. Help the learner to understand basic principle and economic operation of power system. |
| 1. Understand the different type of stability, causes of instability in power system. |
| 1. Understand the transient stability in power system. |
| 1. Learn about different type of excitation system. |
| 1. Learn about voltage control and phase angle control. 2. Make students familiar with the concepts of Steady-state stability, Dynamic stability and Transient stability in a power system, and methods to ensure them. |

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Economic Operation of Power Systems** | 7 | 20 |
| Introduction, system constraints, optimal operation of power systems. Input output, heat rate and incremental rate curves of thermal generating units. Economic distribution of load between generating units within a plant. Economic distribution of load between power stations, transmission loss equation. Introduction to unit commitment and dynamic programming. |  |  |
| UNIT-2: **Power System Stability - I** | 8 | 20 |
| Power angle equations and power angle curves under steady state, and transient conditions. Rotor Dynamics and swing equation (solution of swing equation not included), synchronizing power coefficient. Introduction to steady state and dynamic stabilities, steady state stability limit. |  |  |
| UNIT-3: **Power System Stability - II** | 7 | 20 |
| .  Introduction to transient stability. Equal area criterion and its application to transient stability studies under basic disturbances, critical clearing angle and critical clearing time. Factors affect stability and methods to improve stability. |  |  |
|  | | |
| UNIT-4: **Excitation System** | 7 | 20 |
| (i) **Excitation Systems**: Introduction of excitation systems of synchronous machines, types of excitation systems, Elements of various excitation systems and their control (functional block diagrams and their brief description) -DC excitation systems, AC excitation systems, brushless excitation system.  (ii) **Interconnected Power Systems**: Introduction to isolated and interconnected powers systems. Reserve capacity of power stations, spinning and maintenance reserve. Advantages and problems of interconnected power systems. Power systems inter connections in India. |  |  |
| UNIT 5: **Voltage Control** | 7 | 20 |
| (i) Tap Changing transformer, phase angle control and phase shifting transformer. Series compensation of transmission lines, location and protection of series capacitors, advantages and problems.  (ii) Introduction to power system security.  (iii) Introduction to voltage control. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

|  |  |
| --- | --- |
| |  | | --- | | 1. Electrical Power System by C.L. Wadhwa, New Age Publisher 2. Power System Engineering by Nagrath Kothari, TMH 3. Power System Engineering by C.M Arora 4. Power System Engineering by B.R Gupta, Wheeler Publication | |

**Course outcomes:**

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

|  |
| --- |
| 1. Identify the most economic generation unit. |
| 1. Understand the different type of stability in power system and stability limit in power system. |
| 1. Determine the transient stability, its limit and its improvement method. |
| 1. Understand how to excite synchronous generator and control terminal voltage by different excitation system. |
| 1. Learn how to control active and reactive power. 2. Improve the Steady-state stability limit, Dynamic stability limit and Transient stability limit for a given Power System. |

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL DRIVES & CONTROL LAB** | Course Code : EE 459 |
| Semester : VII | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Torque equation and impedances of inductor and capacitor

**Course Objectives:**

1. Implement various Electrical Drives and analyse their performance
2. Implement various power converters and understand the effect of various control signals on the system
3. Observe the performance of various motors with control through different power converters.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Study and test the firing circuit of three phase half controlled bridge converter. | | 2 | 10 |
|  | Study and obtain waveforms of 3 phase half controlled bridge converter with R and RL loads. | | 2 | 10 |
|  | Study and test the firing circuit of 3-phase full controlled bridge converter. | 2 | | 10 |
|  | Study and obtain waveforms of 3-phase full controlled bridge converter with R and RL loads. | | 2 | 10 |
|  | Study and test 3-phase AC voltage regulator | | 2 | 10 |
|  | Control speed of dc motor using 3-phase half controlled bridge converter. Plot armature voltage versus speed characteristic | | 2 | 10 |
|  | Control speed of dc motor using 3-phase full controlled bridge converter. Plot armature voltage versus speed characteristic | | 2 | 10 |
|  | Control speed of a 3-phase induction motor in variable stator voltage mode using 3-phase AC voltage regulator | | 2 | 10 |
|  | Control speed of universal motor using AC voltage regulator. | | 2 | 10 |
|  | Study 3-phase dual converter. | | 2 | 10 |
|  |  | | **20** | **100** |

**Reference:**

1. Fundamentals of Electric Dives, G.K. Dubey, Narosa Publishing House, New Delhi 1995
2. Lab Manuals

**Course outcomes:**

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

1. Understand the practical response of various converters and motors.
2. Understand the practical response of various Electric Drive Systems when working together.
3. Through project development, students will be able to design, develop and implement an Electric Drive System.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

1. The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **POWER SYSTEM RELIABILITY** | Course Code : EE 411 |
| Semester : **VII** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

* EE 311 - Power System Instrumentation
* EE 312 – Switch Gear And Protection

**Course Objectives:**

1. Help the learner understand the basic applications, principles and concepts of System Reliability.
2. Learn about the different types of Interconnected Systems.
3. Obtain a detailed understanding of Necessity short-term forecasting by preliminary analysis control.
4. Understand the Outage Definition.
5. Learn to make strategies for Generation, Transmission and Distribution networks using Reliability Analysis.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Power System Reliability** | 6 | 20 |
| Introduction, definition of reliability, failure, probability, concepts, power quality variation, reliability measurements, power supply quality survey, Reliability aids, and recent development. |  |  |
| UNIT-2: **Reliability Theory Concepts** | 6 | 20 |
| Measure of reliability rules for combining probabilities, Mathematical expectation. Distributions, reliability theory series and parallel systems, Markov processes. Static generating capacity reliability. |  |  |
| UNIT-3: **Power System Design and Planning based on Reliability Theory** | 8 | 20 |
| Loss of load probability methods, loss of energy probability method. Load forecast, System Design and planning, Strategies for generation, Transmission and Distribution networks. Transmission system reliability evaluation-Average interruption rate method. The frequency and duration method. |  |  |
| UNIT-4: **Reliability of Interconnected systems** | 8 | 20 |
| Generating capacity reliability evaluation introduction. The loss of load approach, reliability evaluation in two and more than two interconnected systems, Interconnection benefits. |  |  |
| UNIT 5: **Load Forecasting** | 8 | 20 |
| Necessity short-term forecasting by preliminary analysis control, medium term forecasting by field survey method, and long-time forecasting by statistical method. Regression analysis. Analysis of time series. Factors in power system loading |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Roy Billinton and Ronald N. Allan-Reliability Evaluation of power system volume-I
2. Roy Billinton and Ronald N. Allan-Reliability evaluation of power System volume-II
3. J Endreny - Reliability modelling in electric power system.
4. A.S. Pabla - Electric power distribution.

**Course outcomes:**

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

1. Help the learner understand the basic applications, principles and concepts of System Reliabilty.
2. Learn about the different types of Interconnected Systems.
3. Obtain a detailed understanding of Necessity short-term forecasting by preliminary analysis control.
4. Understand the Outage Definition.
5. Use Reliability Analysis to make strategies for Generation, Transmission and Distribution networks using Reliability Analysis.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title**: DISTRIBUTION OF ELECTRICAL POWER** | Course Code : EE 409 |
| Semester : **VII** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree 3,5** | |

**Pre-requisites:**

* EE 311 - Power System Instrumentation
* EE 312 – Switch Gear And Protection

**Course Objectives:**

1. Help the learner understand the basic applications, principles and concepts of System Reliability.
2. Learn about the different types of Interconnected Systems and Grounding.
3. Obtain a detailed understanding of Concept of communication-power line carrier, radio communication.
4. Understand the Load Variation.
5. Make students familiar with basic concepts, devices and control of Distribution Power Systems.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Distribution Systems and Load Forecasting** | 7 | 20 |
| 1. **Distribution Systems:** Distribution of power, future distribution systems, power loads. 2. **Load Forecasting:** Introduction, load survey, load forecasting-regression analysis, correlation theory, analysis of time series, load growth factors, sources of error. |  |  |
| UNIT-2: **Voltage Control in Distribution Power Systems** | 8 | 20 |
| 1. **Operation:** Operation criterion and standards: Voltage control – voltage regulation, kVA – km conductor loading, correction of system voltage. Harmonics – introduction, effects of harmonics on networks, limits of harmonics, filters. 2. **Load variations**- causes of voltage fluctuations, measures to reduce flickering. Ferro resonance. System losses - introduction, losses in components, measurement of losses, reduction of losses. Energy management. |  |  |
| UNIT-3: **Distribution Power Capacitors** | 7 | 20 |
| Reactive power flow, monitoring and compensation in distribution system, maintaining system voltage. Series and shunt capacitors, comparison. Shunt capacitors in distribution system - LT and HT shunt capacitors, capacitor rating for power factor improvement, constructional features. System harmonics. |  |  |
| UNIT-4: **Grounding** | 7 | 20 |
| Grounding system, earth and safety, earth electrode- earth resistance calculation, effect of rod size and soil resistivity, earth conductor sizes. Introduction to earth electrode design. Brief description of system grounding – system neutral grounding, grounding of substations, lines and consumer premises. Earth fault protection of feeders. |  |  |
| UNIT 5: **Distribution Automation** | 7 | 20 |
| Introduction to distribution automation. Concept of communication-power line carrier, radio communication, fibre optics, satellite communication and sensors. Introduction to supervisory control and data acquisition (SCADA).Brief descriptor of an automation system. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1) B.R. Gupta - Power system analysis and design  
2) Soni, Gupta and Bhatnagar – A Course in Electrical Power  
3) C.L. Wadhwa - Electrical Power system.

4) Nagrath Kothari - Modern Power system Analysis  
5) J.J. Graingner and W.D. Stevenson - Power system Analysis

**Course outcomes:**

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

1. Help the learner understand the basic applications, principles and concepts of System Reliabilty.
2. Learn about the different types of Interconnected Systems and Grounding.
3. Obtain a detailed understanding of Introduction to supervisory control and data acquisition (SCADA).
4. Understand the Load variations.
5. Work in Distribution Power System industry, knowing about the various devices and schemes used to control them.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **Electrical Machine Design** | Course Code : EE 403 |
| Semester : VII | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course :**Lecture+Tutorial+ Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: **Common to B.Tech Electrical Engineering/ DD(EE+PS)/ DDEE+Energy Engineering) Programmes** | |

**Pre-requisites:**

Basic knowledge of Electrical Machines.

**Course Objectives:**

1. To understand the design of various parts of the rotating machines.
2. To understand the design of the armature winding.
3. To understand the heating, cooling and ventilation in electrical rotating machine and to design the cooling arrangement.
4. To understand basic concepts of design of transformers.
5. To understand the basic concepts of design of induction and synchronous machines.
6. Make students familiar with the basic design parameters and techniques for basic electrical machines and their components.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  |  |  |
| **UNIT-1: Introduction to Electrical Machine Design** | 6 | 20 |
| Basic principles of electrical machine design. Factors and limitations in design, Main dimensions, output equations and output co-efficient, classification of magnetic materials and allowable flux densities. Calculation of magnetic circuits, magnetizing current, coils for given ampere-turns. Real and apparent flux densities. Tapered teeth. Carter's coefficient, leakage fluxes reactance. Classification of insulation materials and their temperature ranges. |  |  |
| **UNITS-2: Armature Winding** | 6 | 20 |
| General features of armature windings, single layer and double layer and commutator windings, integral and fractional slot windings, winding factors. |  |  |
| **UNITS-3: Heating, Cooling and Ventilation** | 8 | 20 |
| Heat dissipation, heat flow, heating cooling curves. Heating cooling media. Quantity of cooling media. Types of enclosures. Ratings, heat dissipation. Methods of ventilation. |  |  |
| **UNIT-4: Design of Transformers** | 8 | 20 |
| Application Of Above Design Principles To The Design of power Transformers And Distribution Transformer. |  |  |
| **UNIT 5: Design of Synchronous and Induction machines** | 8 | 20 |
| Application Of Above Design Principles To The Design of induction Machines And Synchronous Machines. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1) A.K. Sawahney: Electrical machine design.Dhanpat Rai & Sons.

2) V.N. Mittle: Electrical Machine Design.

3) R.K. Agrawal-Electrical machine Design, Kataria Publications.

**Course outcomes:**

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

1. Understand the design of various parts of the rotating machines.
2. Understand the design of armature winding.
3. Understand the design of the cooling system of rotating electrical machines.
4. Understand the basic concepts of design of transformers
5. Understand the basic concepts of design of induction and synchronous machines.
6. Design and test basic Electrical machines and their components within the given constraints and specifications.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

**B.TECH (EE) / DUAL DEGREE (EE + PS) – VII Semester**

**Switchgear and Protection (EE-406)**

**Time: 3 Hours Maximum Marks: 60**

***Instructions to candidates:*** Attempt over all 5 questions selecting one question from each unit. All questions carry equal marks.



UNIT-I

Que.1 Starting from the first principles, derive the output equation of a single phase a.c. machine it in terms of its specific loadings etc. Indicate the significance of the terms used. Define the output coefficient In this equation?

OR

Que.2. Why the insulation is provided in electrical machines. What are the desired properties of an insulating material used in electrical machine?

UNIT-II

Que.3. For a 4 pole, simplex wave wound armature having 25 slots , 25 coils.and 25 commutator segments, draw the winding table

OR

Que.4. Write short notes on

1. Integral slot and fractional slot winding.
2. Lap and wave winding.

UNIT-III

Que.5. A 15 kW induction motor running on full load has temperature rise of 250 C after 20 minutes of start and 400 C after 40 minutes of start from the ambient temperature of 350 C. Estimate the heating time constant and final steady temperature of the motor. OR

Que.6. What are the causes of heating of an electrical machine during its operation. When the temperature becomes constant during its operation. What are the various methods of cooling? Derive an expression for temperature rise – time curve.

UNIT-IV

Que.7. Determine the main dimensions of the core and the yoke for a 200 kV, 2000/400 V, 50 Hz, 1-phase, core type, oil immersed, self-cooled, power transformer with induced emf per turn = 12 V, Maximum flux density in the core = 1.20 Wb/m2, current density = 2.75 A/mm2, window space factor = 0.3, ratio of window height to window width = 3. Assume a 3 stepped core section with net iron area = 0.6d2, and the width of the largest stamping = 0.9d, where d is the diameter of circumscribing circle.

OR

Que.8. Calculate approximate overall dimensions for a 100 kVA, 6600/400 V, 50 Hz, 3 phase core type transformer. Assume emf per turn = 10V, maximum flux density = 1.2 Wb/m2, Current density = 2.2 A/mm2, window space factor = 0.3, overall height = overall width, stacking factor = 0.9. Use 3 stepped core with largest stamping width = 0.9d and net iron area = 0.6d2, where d is the diameter of circumscribing circle.

UNIT-V

Que.9. Calculate diameter, length, no. Of turns per phase, full load current, cross section of conductors and total copper loss of three phase, 120 kW, 2200 V, 50 Hz, 750 rpm (synchronous speed), star connected slip ring induction motor, if average flux density is 0.40 wb/square meter, specific electric loading is 24000 amp. Cond. Per metre, efficiency is 90%, power factor is 0.88, L = 1.25 pole pitch, Kw = 0.955, current density = 5 A / mm2, mean length of stator conductor = 75 cm, specific resistance is 0.021 ohm per metre and mm2 section. OR

Que.10. Estimate the kVA rating of a 3-phase, 50 Hz, 4-pole turbo machine having core length 160 cm, peripheral speed 140 m / sec, ac = 525 per cm and Bav = 0.52 Wb / m2 . Assume uniformly distributed winding.

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to
3. The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
4. Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
5. Student shall be given internal choice in every Unit.
6. Questions should not be set from the recapitulation topics.

|  |  |
| --- | --- |
| **EC 407** | **ELECTROMAGNETIC FIELD THEORY C(L,T,P) =4(3,1,0)** |
| **Version** | 1.0 |
| **Prerequisite** | Nil |
| **Objective:** | The objective of the course are: |
|  | 1.To get the knowledge of vectors and different coordinate systems, Understand the meaning of divergence and curl; be able to calculate line  integrals, surface and volume integrals |
|  | 2. To understand the properties of static electric field, Use Gauss Law, Coulombs law and Poisson’s Equation to find fields and potentials for a  variety of situations including charge distributions and capacitors. Electric fields in the presence of dielectrics. |
|  | 3. Understand the properties of static magnetic field, use of Ampere’s law for calculate magnetic field in different situations. |
|  | 4. To find the Maxwell’s Equations in integral and differential form for static field and their modifications in dynamic conditions. To  Understand Maxwell’s Equations for timeharmonic  fields and the boundary conditions across media boundaries. To Analyze electromagnetic  wave propagation and attenuation in various medium and propagation through boundaries between media |
|  |  |
| **Expected Outcome:** | The student will be able to |
|  | 1. Understand the meaning of divergence and curl; be able to calculate line integrals, surface and volume integrals in all coordinate systems. |
|  | 2. Understands the Use of Gauss Law, Coulombs law and Poissons’s Equation to find fields and potentials for a variety of situations including  different charge distributions. Use boundary conditions to find electric field in different mediums |
|  | 3. Understands the Use of Ampere’s Law, to find magnetic fields and magnetic vector potentials for a variety of situations including different  current distributions. Use boundary conditions to find magnetic field in different mediums. |
|  | 4. Understand the different Maxwell’s equations (both in integral and differential form) in static field. Modifications of these equations in dynamic  cases. |
|  |  |
| **Unit -1 (7 Hours)** | **VECTOR ANALYSIS** |
|  | Fundamental Concepts, Scalar and vector fields; Physical interpretation of gradient, divergence and curl; Vector Relation in rectangular, cylindrical, spherical and general curvilinear coordinates system, Green’s and Stoke’s theorems. |
| **Unit -2 (7 Hours)** | **ELECTROSTATICS** |
|  | Electric field intensity and flux density. Electric field due to various charge configurations. The potential functions and displacement vector. Gauss’s law. Poisson’s and Laplace’s equation and their solution. Uniqueness theorem. Continuity equation. Capacitance and electrostatics energy. Field determination by method of images. Boundary conditions, Field mapping and concept of field cells |
| **Unit -3 (7 Hours)** | **MAGNETOSTATICS** |
|  | Magnetic field intensity, flux density and magnetization, Faraday’s Law, Bio-Savart’s law, Ampere’s law, Magnetic scalar and vector potential, self and mutual inductance, Energy stored in magnetic field, Boundary conditions, Analogy between electric and magnetic field, Field maping and concept of field cells. |
| **Unit -4 (7 Hours)** | **TIME VARYING FIELDS** |
|  | Displacement currents and equation of continuity. Maxwell’s equations, Uniform plane wave in free space, dielectrics and conductors, skin effect sinusoidal time variations, reflection and refraction of Uniform Plane Wave, standing wave ratio. Pointing vector and power considerations. |
| **Unit -5 (7 Hours)** | **RADIATION, EMI and EMC** |
|  | Retarded Potentials and concepts of radiation, Radiation from a small current element. Radiation resistance**:** Introduction to Electromagnetic Interference and Electromagnetic compatibility, EMI coupling modes, Methods of eliminating interference, shielding, grounding, conducted EMI, EMI testing: emission testing, susceptibility testing. |
| **List of Expt.** | Nil |
| **Text Book** | 1. Sadiku, Electromagnetic Field Theory, Oxford .(2000)  2. Mahapatra, Principles of Electromagnetics, TMH.(2011) |
| **Reference book** | 1 Kshetrimeyum – Electromagnetic field theory, Cengage learning 2012 |
|  | 2 Hayt, Engineering Electromagnetics, TMH 2007 |
| **Mode of Evaluation** | Assignment/Quiz/Viva-voce/Lab examination/student seminar/written examination |
| **Recomm. by BOS on** |  |
| **Approved by AC on** |  |

|  |  |
| --- | --- |
| Course Title:  **ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS** | Course Code : CP 425 |
| Semester : VII | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : 3 **Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

Computer Basic

**Course Objectives:**

1. Explain the basic knowledge representation, problem solving, and learning methods of artificial intelligence
2. Asses the applicability, strength, and weakness of the basic knowledge representation ,problem solving and learning methods on solving particular engineering problems
3. Develop intelligent system by assembling solutions of concrete computational problems
4. Understand the role of knowledge presentation, problem solving, and learning in intelligent – system engineering
5. Develop an interest in the field sufficient to take more advanced subjects

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| **UNIT-1: Artificial Intelligence** | 06 | 20 |
| 1. Introduction to AI and knowledge based Expert systems 2. Expert System: Introduction, Importance and Definition of AI, ES, ES building tools and shells. | 03  03 |  |
|  | | |
| **UNITS-2: Knowledge Representation:** | 06 | 20 |
| 1. Concept of knowledge, Representation of knowledge using logics rules, frames. Procedural versus. Declarative knowledge, forward versus backward chaining. 2. **Control Strategies: -**Concept of heuristic search, search techniques depth first search, Breath first search, Generate and test hill climbing, best first search. | 03  03 |  |
| **UNITS-3: Artificial Neural Network** | 08 | 20 |
| 1. Biological Neurons and synapses, characteristics Artificial Neural Networks, types of activation functions. 2. **Perceptions:** Perception representation, limitations of perceptrons. Single layer and multiplayer perceptrons. Perceptron learning algorithms. | 04  04 |  |
|  | | |
| **UNIT 4: Basic Concepts in Learning ANN** | 08 | 20 |
| 1. Supervised learning, Back propagation algorithm, unsupervised learning, 2. Kohonen’s top field network and Algorithm. | 04  04 |  |
| **UNIT 5: Fuzzy Logic** | 08 | 20 |
| 1. Fuzzy logic concepts, Fuzzy relation and membership functions, Defuzzufication, Fuzzy controllers   (b) Genetic algorithm: concepts, coding, reproduction, crossover, mutation, scaling and fitness. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Elaine Rich and Kevin Knight, Artificial Intelligence, TATA MCGRAW HILL Publishers
2. James A Anderson, An introduction to Neural Networks.
3. Dan. W Patterson, Artificial Intelligence and Expert Systems.

**Course outcomes:**

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

1. Student will be able to explain AI
2. Get knowledge about Knowledge based expert system
3. How search techniques can be used.
4. Get knowledge about fuzzy logic
5. Use genetic algorithm.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S | S |  |  |  |  |  |  |  |  |  |  |
| 3 | S |  |  |  |  |  |  | M |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  | M |  |  |  |
| 5 | S |  | S |  |  |  |  |  |  |  |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 40 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 35 |

**Model Question Paper:**

Enrollment no…………… Total No. of pages……

B. TECH ELECTRICAL ENGG – SEMESTER VII

ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS (CP425)

MAIN/ BACK EXAM, DECEMBER 2015

Time: 3 Hours Maximum Marks: 70

**Instructions to candidate:**

Attempt over all 5 questions selecting one question from each unit.

All questions carry equal marks.

**UNIT I**

Q1. Define Artificial intelligence. Discuss the area in which applications of AI are used. [14]

**OR**

Q2. What is Expert System? What is difference between an Expert System and knowledge base system. [14]

**UNIT II**

Q3. Define knowledge representation in your own words. Also give properties of knowledge representation System. [14]

**OR**

Q4. Describe the Declarative and Procedural knowledge. [14]

**UNIT III**

Q5. Explain briefly the terms cell body, axon, synapse, dendrite and neuron with reference to a biological neural network. [14]

**OR**

Q6. What is Neural Network? Discuss various application of Neural Network. [14]

**UNIT IV**

Q7. What do you mean by unsupervised learning, explain in detail. [14]

**OR**

Q8. Give Kohonen’s top field network algorithm. [14]

**UNIT V**

Q9. What do you mean by Defuzzification? Explain various types of techniques for Defuzzification. [14]

**OR**

Q10. Write a note on: Scaling and Fitness. [14]

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to
3. The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
4. Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
5. Student shall be given Internal choice in every Unit.

Questions should not be set from the recapitulation topics.

|  |  |
| --- | --- |
| Course Title**: DATABASE MANAGEMENT SYSTEMS** | Course Code : CP 423 |
| Semester : VII | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 3**:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

General Computer Application.

**Course Objectives:**

1. Explain the basic knowledge representation, problem solving, and learning methods of DBMS.
2. Asses the applicability, strength, and weakness of the basic knowledge representation ,problem solving and learning methods on DBMS.
3. Develop intelligent system by assembling solutions of DBMS.
4. Develop an interest in the Advantage of DBMS Describing and Storing Data in a DBMS.

**Course Content:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | |  |  |  |  |
|  |  |  | |  |  |
| **Unit** |  | **Contents of the Course** | | **Total Contact** |  |
|  |  |  |  | **Hrs.** |  |
|  |  | INTRODUCTION TO DATABASE SYSTEMS: Overview and History of DBMS. File System vs DBMS | |  |  |
| **I** |  | .Advantage of DBMS Describing and Storing Data in a DBMS. | | 7 |  |
|  |  | Queries in DBMS. Transaction management and Structure of a DBMS | |  |  |
|  |  | ENTITY RELATIONSHIP MODEL: Overview of Data Design Entities, Attributes and Entity Sets, Relationship | |  |  |
| **II** |  | and Relationship Sets. Features of the ER Model-Key Constraints, Participation Constraints, Weak Entities, Class | | 7 |  |
|  | Hierarchies, Aggregation Conceptual Data Base, Design with ER Model-Entity vs Attribute, Entity vs Relationship | |  |
|  |  |  |  |
|  |  | Binary vs Ternary Relationship and Aggregation vs ternary Relationship Conceptual Design for a Large Enterprise | |  |  |
| **III** |  | RELATIONSHIP ALGEBRA AND CALCULUS**:** Relationship Algebra Selection and Projection, Set Operations, | | 7 |  |
|  | Renaming, Joints, Division Relation Calculus, Expressive Power of Algebra and Calculus | |  |
|  |  |  |  |
|  |  | SQL QUERIES PROGRAMMING AND TRIGGERS: The Forms of a Basic SQL Query, Union, Intersection and | |  |  |
| **IV** |  | Except, Nested Queries ,Correlated Nested Queries, | Set-Comparison Operations, Aggregate Operators, Null Values | 7 |  |
|  |  | Embedded SQL, Dynamic SQL, ODBC and JDBC, Triggers and Active Databases. | |  |  |
|  |  | SCHEMA REFINEMENT AND NORMAL FORMS: Introductions to Schema Refinement, Functional | |  |  |
| **V** |  | Dependencies, Boyce-Codd Normal Forms, Third Normal Form | | 8 |  |
|  |  | Normalization-Decomposition into BCOMPUTER NETWORK F Decomposition into 3-NF manufacturing sector. | |  |  |
|  |  |  | **Total** | 36 |  |

**Reference:**

1. Korth, Pearson

**Course outcomes:**

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

1. Explain the basic knowledge representation, problem solving, and learning methods of DBMS.
2. Asses the applicability, strength, and weakness of the basic knowledge representation ,problem solving and learning methods on DBMS.
3. Develop intelligent system by assembling solutions of DBMS.
4. Develop an interest in the Advantage of DBMS Describing and Storing Data in a DBMS.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S |  | S |  |  |  |  |  |  |  |  |  |
| 2 | S | S |  |  |  |  |  |  |  |  |  |  |
| 3 | S |  |  |  |  |  |  | M |  |  |  |  |
| 4 | S |  |  |  |  |  |  |  | M |  |  |  |
| 5 | S |  | S |  |  |  |  |  |  |  |  |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 40 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 35 |

|  |  |
| --- | --- |
| Course Title:  **DATABASE MANAGEMENT SYSTEM LAB** | Course Code : CP 457 |
| Semester : VII | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : 0**:0:3** | Credits : 1 **Credits** |
| Type of course : **Practical** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: B. Tech. Electrical Engineering | |

**Pre-requisites:**

C language, Basic of Computer.

**Course Objectives:**

1. Demonstrate familiarity with major algorithms and data structures.
2. Analyse performance of algorithms.
3. Choose the appropriate data structure and algorithm design method for a specified application
4. Determine which algorithm and data structure to use in different scenarios.
5. Be familiar with writing recursive methods

**Course Content:**

Student can use MySql (preferred open source DBMS) or any other Commercial DBMS tool (MS-Access / ORACLE) at backend and C++ (preferred) VB/JAVA at front end.

1. (a) Write a C++ program to store students records (roll no, name, father name) of a class using file handling. (Using C++ and File handling).

(b) Re-write program 1, using any DBMS and any compatible language. (C++/MySQL) (VB and MS-Access)

1. Database creation/ deletion, table creation/ deletion.
2. Write a program to take a string as input from user. Create a database of same name. Now ask user to input two more string, create two tables of these names in above database.
3. Write a program, which ask user to enter database name and table name to delete. If database exist and table exist then delete that table.
4. Write a program, which ask user to enter a valid SQL query and display the result of that query.
5. Write a program in C++ to parse the user entered query and check the validity of query. (Only SELECT query with WHERE clause)
6. - 6. Create a database db1, having two tables t1 (id, name, age) and t2 (id, subject, marks).

(a) Write a query to display name and age of given id (id should be asked as input).

(b) Write a query to display average age of all students.

(c) Write a query to display mark-sheet of any student (whose id is given as input).

(d) Display list of all students sorted by the total marks in all subjects.

1. - 8. Design a Loan Approval and Repayment System to handle Customer's Application for Loan and handle loan repayments by deposi ting installments and reducing balances.

9 -10. Design a Video Library Management System for managing issue and return of Video tapes/CD and manage customer's queries

**Reference:**

Lab manual

**Course outcomes:**

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

1. Represent an array in memory and all application of array
2. Analyze performance of algorithms
3. implement the link list and its application
4. implement the tree data structure and its application

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Programme Outcomes** | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | S | S |  |  |  |  |  |  |  |  |  |  |
| 2 |  | S |  |  |  |  |  |  | M |  |  |  |
| 3 | S | S |  |  |  |  |  |  |  |  |  |  |
| 4 | S |  |  |  |  |  |  | M |  |  |  |  |
| 5 | S |  |  |  |  |  |  |  |  |  | M |  |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Attendance | Student | Every lab | 10 | Attendance Register |  |
| Performance+ Record+ viva | Every lab | 30 | Lab Record |  |
| Project | Every lab | 20 | Project Report |  |
| **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms |  |
| End of Course survey | | End of course | Questionnaire |  |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 25 |
| 2 | Applying the knowledge acquired from the course | 30 |
| 3 | Analysis and Evaluation | 45 |

|  |  |
| --- | --- |
| Course Title**: Industrial Electrical Systems** | Course Code :  **EE 417** |
| Semester : **III** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : | Credits : 2 **Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : |
| Continuous Internal Evaluation : | ESE : |
| Programmes: **B.Tech. Electrical Engineering** | |

**Course Outcomes:** At the end of this course, students will demonstrate the ability to

• Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.

• Understand various components of industrial electrical systems.

• Analyze and select the proper size of various electrical system components.

|  |  |  |
| --- | --- | --- |
| **Unit-1** | **Electrical System Components :**LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices. | **(8 Hours)** |
| **Unit-2** | **Residential and Commercial Electrical Systems :**Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components. | **(8 Hours)** |
| **Unit-3** | **Illumination Systems :**Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting. | **(6 Hours)** |
| **Unit-4** | **Industrial Electrical Systems I :**HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components. | **(8 Hours)** |
| **Unit-5** | **Industrial Electrical Systems II :**DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. | **(6 Hours)** |
| **Unit-5** | **Industrial Electrical System Automation :**Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation. | **(6 Hours)** |

**Text/Reference Books**

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.

2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.

3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.

4. Web site for IS Standards.

5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008

|  |  |
| --- | --- |
| Course Title:  **Power System Planning** | Course Code : EE 418 |
| Semester : VIII | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

General Electrical Theorems, Power System Analysis.

**Course Objectives:**

1. Explain the basic knowledge representation, problem solving, and learning methods of power planning.
2. Asses the applicability, strength, and weakness of the basic knowledge representation, problem solving and learning methods on power sector finance.
3. Develop intelligent system by assembling solutions of power system reliability.
4. Develop an interest in the field sufficient to take more advanced subjects.
5. Make students familiar with various aspects of Power System Planning, like – Generation Planning, Transmission & Distribution Planning, Load Planning, Environmental & Technological Planning, Power System Expansion Planning, etc.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  |  |  |
| **UNIT-1: Introduction to Power System Planning** | 6 | 20 |
| 1. Introduction of power planning, National and Regional Planning, structure of Power System., planning tools. 2. Electricity Regulation, Electrical Forecasting, forecasting techniques modelling. | 3  3 |  |
| **UNIT-2: Areas of Power System Planning** | 8 | 20 |
| 1. Generation planning, integrated power generation cogeneration/captive power, Power pooling and power trading. Transmission and distribution planning. 2. Power system Economics. Power sector finance, financial planning, private participation Rural Electrification investment, concept of rational tariffs. | 4  4 |  |
| **UNIT-3: Power System Reliability and Load Planning** | 8 | 20 |
| 1. Power supply Reliability, Reliability planning. System operation planning, load management, load prediction, reactive power balance. 2. Online power flow studies, state estimation, computerized management, power system simulator. | 4  4 |  |
| **UNIT-4: Environmental and Technological Planning** | 6 | 20 |
| 1. Computer aided planning, wheeling. Environmental effects, the greenhouse effect. 2. Technological impacts. Insulation coordination. Reactive compensation. | 3  3 |  |
| **UNIT 5: Optimal power system expansion planning** | 8 | 20 |
| 1. Formulation of least cost optimization problem incorporating the capital. 2. Operating and maintenance cost of candidate plants of different types (Thermal, Hydro, Nuclear, Renewable etc.) and minimum assured reliability constraint – optimization techniques for solution by programming. | 4  4 |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Elaine Rich and Kevin Knight, Artificial Intelligence, TATA MCGRAW HILL Publishers
2. James A Anderson, An introduction to Neural Networks.
3. Dan. W Patterson, Artificial Intelligence and Expert Systems.

**Course outcomes:**

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

1. Student will be able to explain power system planning.
2. Get knowledge about Knowledge based expert system.
3. How search techniques can be used.
4. Get knowledge about power economics.
5. Plan for various aspects of Power System, and will be able to implement them in industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 40 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 35 |

|  |  |
| --- | --- |
| Course Title:  **Computer Aided Electrical Machine Design Lab** | Course Code : EE 461 |
| Semester : VII | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **2 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **30** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Basic Electrical Machines.

**Course Objectives:**

1. Implement various Electrical Machines and analyse their performance
2. Implement various machines and understand the effect of various control signals on the system
3. Observe the performance of various motors with control through different power converters.
4. Make students familiar with the design parameters & specifications of different types of Electrical machines.

**Course Content:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Topic and Contents** | **Hours** | **Marks** |
|  | Design of transformers: output of transformer, output equation- volt per turn, core area and weight of iron & copper, optimum design (i) minimum cost and (ii) minimum losses. | 3 | 10 |
|  | Design of core and windings. Design a 3-phase transformer. | 3 | 10 |
|  | Design of rotating machines: General concepts. specific loading, output equations –dc machines and ac machines, factor affecting size of rotating machines, choice of specific magnetic and electric loadings. | 3 | 10 |
|  | Design of 3-phase induction motors: output equation, choice of air gap flux density and ampere conductors, parameter, main dimensions. | 3 | 10 |
|  | Design of a 3-phase squirrel cage induction motor. | 3 | 10 |
|  | Design of single phase induction motors: output equation, main dimensions, relative size of single phase and 3-phase induction motors. | 3 | 10 |
|  | Design of a single phase capacitor start induction motor. | 3 | 10 |
|  | Design of synchronous machines: output equation, choice of specific magnetic and electric loadings, main dimensions, short circuit ratio. | 3 | 10 |
|  | Design a 3-phase, 2-pole turbo alternator. | 3 | 10 |
|  | Study of BLDC Motors & its design parameters. | 3 | 10 |
|  |  | **30** | **100** |

**Reference:**

Lab Manuals

**Course outcomes:**

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

1. Understand the practical response of various converters and motors.
2. Understand the practical response of various Electric Drive Systems when working together.
3. Through project development, students will be able to design, develop and implement an Electric Drive System.
4. Design and work on different kinds of Electrical machines in the industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

1. The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **EHV AC/DC TRANSMISSION** | Course Code : EE 404 |
| Semester : **VIII** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech | |

**Pre-requisites:**

Transmission & Distribution, Power System Analysis

**Course Objectives:**

1. Analyse the problems of EHV AC transmission
2. Apply and analyse the need of HVDC transmission in solving the problem of long distance transmission.
3. Evaluate the load frequency control mechanism.
4. Apply and evaluate voltage control concept.
5. Create the basic concept of FACTS.
6. Make students familiar with the basic concepts of EHV AC/DC transmission and its parameter control, like Load Frequency control and Voltage Control.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **EHV AC Transmission** | 10 | 20 |
| Need of EHV transmission lines, power handling capacity and surge impedance loading & calculation. Problems of EHV transmission, bundled conductors: geometric mean radius of bundle, properties of bundle conductors. Electrostatic fields of EHV lines and their effects, corona effects: Corona loss, audio and radio noise. |  |  |
| UNIT-2: **Load Frequency Control** | 10 | 20 |
| Introduction to control of active and reactive power flow, turbine speed governing system. Speed governing characteristic of generating unit and load sharing between parallel operating generators. **Method of Load Frequency Control:** Flat frequency, flat tie line and tie line load bias control. Automatic generation control (description of block diagram only). |  |  |
| UNIT-3: **Voltage Control** | 10 | 20 |
| No load receiving end voltage and reactive power generation. Methods of voltage control. Synchronous phase modifier, shunt capacitors and reactors, saturable reactors, **Thyristorised static VAR compensators-** TCR, FC-TCR and TSC-TCR. |  |  |
| UNIT-4: **FACTS** | 10 | 20 |
| Introduction to FACTS controllers, types of FACTS controllers, Brief description of STATCOM, SVC, Thyristor-controlled series capacitors and unified power flow controller, Need of FACTS in wind farm. |  |  |
| UNIT 5: **HVDC Transmission** | 8 | 20 |
| Types of D.C. links, advantages and disadvantages of HVDC transmission. Basic scheme and equipment of converter station. Ground return. Basic principles of DC link control and basic converter control characteristics. Application of HVDC transmission. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. R.D. Begamudre - EHV AC Transmission Engineering.
2. K.R. Padiyar - HVDC Power Transmission System
3. J.J. Grainger and W.D. Stevenson - Power system analysis.
4. B.R. Gupta - Generation of Electrical Engineering.

**Course outcomes:**

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

1. Solve the problems EHV AC transmission
2. Understand and solve the problems on voltage control.
3. Evaluate the need of HVDC transmission.
4. Prepare for further study in power system.
5. Solve practical problems of power system.
6. Control Load Frequency, Voltage and Power Flow in the EHV AC/DC Transmission systems.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 3 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **25** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 30 |
| 2 | Applying the knowledge acquired from the course | 30 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **PROTECTION OF POWER SYSTEM** | Course Code : EE 414 |
| Semester : VIII | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: **Common to B.Tech Electrical Engineering/ DD(EE+PS)/ DD (EE+Energy Engineering) Programmes** | |

**Pre-requisites:**

Basic knowledge of protective schemes, switchgear, electro-magnetic relays.

**Course Objectives:**

1. Learn about the basic design and working of Power System Protection devices like CTs, PTs, Relays and Circuit Breakers.
2. Understand the causes of Over-currents in Power System, and protection used against over-currents.
3. Make students familiar with various types of Protection schemes used for different components of Power System, like Synchronous Generator, Induction Motor, Bus bars, Transformers and Transmission Line.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **Unit 1 Differential Relay and Distance Relays** | 8 | 20 |
| **Static Differential Relays**: Brief description of static differential relay schemes single phase and three phase schemes. Introduction to static differential protection of generator and transformer.  **Static Distance Relays**: Introduction to static impedance, reactance and mho relays. | 5  3 |  |
| **Unit 2 Carrier Current protection and Distance Protection** | 10 | 20 |
| **Carrier Current Protection**: Basic apparatus and scheme of power line carrier system. Principle of operation of directional comparison and phase comparison carrier protection and carrier assisted distance protection.  **Distance Protection**: Effect of power swings on the performance of distance protection. Out of step tripping and blocking relays, mho relay with blinders. Introduction to quadrilateral and elliptical relays. | 5  5 |  |
| UNITS-3: **Synchronous Generator Protection** | 10 | 20 |
| **Stator Protection:** Stator protection–differential and percentage differential protection, protection against stator inter-turn faults, stator overheating protection.  **Rotor protection:** Protection against excitation and prime mover failure, field earth fault and unbalanced stator currents (negative sequence current protection). |  |  |
| UNIT-4: **Transformer & Bus Bar Protection** | 10 | 20 |
| **Transformer Protection:** Percentage differential protection, magnetizing inrush current, percentage differential relay with harmonic restraint. Buchholz relay. Differential protection of generator transfer unit.  **Bus bar Protection:** Differential protection of bus bars. High impedance relay scheme, frame leakage protection. |  |  |
| UNIT 5: **Transmission Line and Induction Motor Protection** | 10 | 20 |
| **Transmission Line Protection:** Introduction to distance protection. Construction, operating principle and characteristics of an electromagnetic impedance relay. Effect of arc resistance. Induction cup type reactance and mho relays. Comparison between impedance, reactance and mho relays. Three stepped distance protection of transmission line.  **Induction Motor Protection:** Introduction to various faults and abnormal operating conditions, unbalance supply voltage and single phasing. Introduction to protection of induction motors- HRC fuse and overcurrent, percentage differential, earth fault and negative sequence voltage relays. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. Switch Gear Protection by J.B. Gupta, Katria & Sons Publishers

2. Switch Gear Protection by B. Ram, TMH.

3. Switch Gear Protection by S.S Rao, TMH

**Course outcomes:**

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

1. Design and work on basic Power System Protection devices, like CTs, PTs, Relays and Circuit Breakers.
2. Understand the causes of Over-current in Power System and implement measures to protect system from them.
3. Implement various Protection techniques for different Power System components used in the industry, like - Synchronous Generator, Induction Motor, Bus bars, Transformers and Transmission Line.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

**B.TECH (EE) / DUAL DEGREE (EE + PS) – VII Semester Switchgear and Protection (EE-406)**

**Time: 3 Hours Maximum Marks: 60**

***Instructions to candidates:*** Attempt over all 5 questions selecting one question from each unit. All questions carry equal marks.



UNIT-I

Que.1 Describe various types of phase comparators used in static relays.

OR

Que.2. With the help of neat diagram explain the principle of static over current relay.

UNIT-II

Que.3. Realize impedance relay using static components.

OR

Que.4. Draw a block diagram for static differential protection and explain the working of each block.

UNIT-III

Que.5. Explain in detail carrier current protection scheme, Describe carrier phase comparison relay with neat sketches.

OR

Que.6. What do you understand by the power swings. How they affect the working of distance protection schemes. How the operation of the protection scheme during power swing can be avoided.

UNIT-IV

Que.7. Why are circuit breakers provided with arcing contacts in addition to main contacts? Explain.

OR

Que.8. Explain the working of an air blast circuit breaker with the help of suitable diagram. What is current chopping phenomenon associated with ABCB?

UNIT-V

Que.9. Describe the working principle of a vacuum circuit breaker. How contact movement and electrical connections with the contacts are made in vacuum circuit breaker? What are the shortcomings of a vacuum circuit breaker?

OR

Que.10. Explain the advantages of digital relays.

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to
3. The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
4. Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
5. Student shall be given Internal choice in every Unit.
6. Questions should not be set from the recapitulation topics.

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL ENGINEERING MATERIALS** | Course Code : EE 410 |
| Semester : VIII | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: **Common to B.Tech Electrical Engineering/ DD(EE+PS)/ DD (EE+Energy Engineering) Programmes** | |

**Pre-requisites:**

Basic Physics and Chemistry.

**Course Objectives:**

1. To obtain an overall understanding of the different materials which are used in Electrical Engineering.
2. Understand the properties of conducting materials, dielectric materials, magnetic materials, and semiconductor materials.
3. Obtain a detailed understanding of how these materials are affected by Electric and Magnetic Fields.
4. Understand the application of these materials in Electrical Engineering.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Dielectric Materials** | 6 | 20 |
| Static dielectric constant, Polarization, atomic interpretation of the dielectric constant of mono-atomic and poly atomic gases, internal fields in the solids and liquids, static dielectric constants of solids, ferroelectric materials and spontaneous polarization, piezo- electricity. Frequency dependence of electronics, ionic and orientation polarization, complex dielectric constant and dielectric losses. |  |  |
| UNITS-2: **Conductivity of Metals** | 6 | 20 |
| Ohm's Law and relaxation time of electrons, collision time and mean free path. Electron scattering, and resistivity of metals. Heat developed in current carrying conductor, thermal conductivity of metals, and superconductivity. |  |  |
| UNITS-3: **Magnetic Materials** | 8 | 20 |
| Magnetisation from microscopic view point, orbital magnetic dipole movement and angular momentum materials. Diamagnetism, origin of permanent magnetic dipoles in material, and paramagnetic spin systems. |  |  |
| UNIT-4: **Properties of Ferromagnetic Materials** | 8 | 20 |
| Spontaneous magnetization and the Curie-Weils Law. Ferromagnetic Domains and coercive force, anti-ferromagnetic and ferromagnetic materials. Magnetic materials for electrical devices, and introduction to permanent magnets. |  |  |
| UNIT 5: **Mechanism of Conduction in Semiconductor Materials** | 8 | 20 |
| Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Electrical Engineering materials by J.B. Gupta**.**
2. Electrical Engineering materials by A.J. Dekker.
3. Electrical Engineering Materials by G.P. Chhalotra.
4. Electrical Engineering materials by S.P. Seth and P.V. Gupta.

**Course outcomes:**

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

1. Understand the characteristic performance of different materials.
2. Apply a procedure for the selection of the material based on the Electrical Engineering Application.
3. Recognize the reason(s) for selection of a material for the construction of electrical wires, transformers and switches.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **MATLAB SIMULATION FOR POWER SYSTEM** | Course Code : EE 460 |
| Semester : VIII | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.TECH Electrical Engineering + Dual Degree EE + PS** | |

**Pre-requisites:**

Torque equation and impedances of inductor and capacitor

**Course Objectives:**

1. To simulate the power system components in MATLAB environment
2. To model the power system components.
3. To model the wind energy generation system.
4. Learn simulation of different components of Power Systems through MATLAB Simulink, like Synchronous Machine, Induction Machine, FACTS devices, DFIG-type Wind Generator, WEGS-integrated Power System, etc.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Simulate Swing Equation in Simulink (MATLAB) | | 2 | 10 |
|  | Modelling of Synchronous Machine | | 2 | 10 |
|  | Modelling of Induction Machine | 2 | | 10 |
|  | Simulate simple circuits using Circuit Maker | | 2 | 10 |
|  | Modelling of Synchronous Machine with PSS (b) Simulation of Synchronous Machine with PSS. | | 2 | 10 |
|  | Modelling of Synchronous Machine with FACTS device (b) Simulation of Synchronous Machine with FACTS devices. | | 2 | 10 |
|  | FACTS Controller designs with FACTS devices for SMIB system | | 2 | 10 |
|  | Modelling of DFIG type wind generator | | 2 | 10 |
|  | Simulation of WEGS integrated power system | | 2 | 10 |
|  | Simulation of WEGS integrated power system with FACTS devices | | 2 | 10 |
|  |  | | **20** | **100** |

**Reference:**

1. Lab Manuals
2. MATLAB User’s Manual

**Course outcomes:**

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

1. Perform modelling of machines
2. Perform modelling of transmission lines, transformer breaker etc
3. Perform simulation of machines transmission lines, transformer breaker
4. Perform modelling of FACTS devices, WEGS
5. Perform simulation of FACTS devices, WEGS.
6. Simulate various Power System components used in industry, and also use MATLAB to solve complex equations used in Power Systems, like Swing Equation.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **HIGH VOLTAGE ENGINEERING LAB** | Course Code : EE 458 |
| Semester : VIII | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

EE 404: EHV AC/DC Transmission.

**Course Objectives:**

1. Implement various Electrical Machines and analyse their performance.
2. Implement various Machines and understand the effect of EHV Transmission Line.
3. Observe the performance of capacitance and dielectric loss of an insulating material using Schering Bridge.
4. Make students familiar with characteristics and testing of various devices and materials used in High Voltage engineering, like Transformer Oil, insulating materials, circuit breakers, line insulator, cable, bushing, power capacitor, power transformer, etc.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **S. No** | **LIST OF EXPERIMENTS** | **Hrs.** |
| **I** | Study filtration and Treatment of transformer oil. | 2 |
| **II** | Determine dielectric strength of transformer oil | 2 |
| **III** | Determine capacitance and dielectric loss of an insulating material using Schering bridge. | 2 |
| **IV** | Study solid dielectrics used in power apparatus. | 2 |
| **V** | Study applications of insulating materials. | 2 |
| **VI** | Study direct testing and indirect testing of circuit breakers. | 2 |
| **VII** | Study high voltage testing of electrical equipment: line insulator, cable, bushing, power capacitor, and power transformer | 3 |
| **VIII** | Design an EHV transmission line. | 3 |
|  | **Total** | 20 |

**Reference:**

Lab Manual

**Course outcomes:**

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

1. Understand the practical response of filtration and Treatment of transformer oil.
2. Understand the practical response of applications of insulating materials.
3. Through project development, students will be able to design, develop and implement an Electric Drive System.
4. Do High Voltage testing of various electrical equipment used in High Voltage Power System Transmission.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

1. The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title:  **FACTS Devices & Their Applications** | Course Code : EE 420 |
| Semester : VIII | Core / Elective :  **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: B.Tech. Electrical Engineering | |

**Pre-requisites:**

General Electrical Theorems, Power System Analysis.

**Course Objectives:**

1. Explain the basic knowledge representation, problem solving, and learning methods of power planning.
2. Asses the applicability, strength, and weakness of the basic knowledge representation, problem solving and learning methods on power sector.
3. Develop intelligent system by assembling solutions of power system reliability.
4. Develop an interest in the field sufficient to take more advanced subjects.
5. Make students familiar with various types of devices and techniques used in FACTS systems.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Introduction to FACTS Technology** | 6 | 20 |
| 1. **Introduction:** Problems of AC transmission systems, power flow in parallel paths and meshed system, factors limiting loading capability. 2. **FACTS Technology:** Stability consideration. Power flow control of an AC transmission line. Basic types of facts controllers. Advantages of FACTS technology. |  |  |
| UNIT-2: **Static Shunt Compensators** | 8 | 20 |
| 1. **Power Factor Control:** Voltage-Sourced Converters: Basic concept of voltage-sourced converters, single and three phase bridge converters. Introduction to power factor control. Transformer connections for 12-pulse, 24 pulse and 48 pulse operations. 2. **Static Shunt Compensators:** Mid-point and end point voltage regulation of transmission line, and stability improvement. Basic operating principle of Static Synchronous Compensators (STATCOM). Comparison between STATCOM and SVC. |  |  |
| UNIT-3: **Other Compensators used in FACTS Technology** | 8 | 20 |
| 1. **Static Series Compensators:** Concept of series capacitive compensation, voltage and transient stabilities, power oscillation and sub synchronous oscillation damping. 2. Introduction to thyristor switched series capacitor (**TSSC**), thyristor controlled series capacitor (**TCSC**), and **static synchronous series compensator** - operation, characteristics and applications. |  |  |
| UNIT-4: **Voltage and Phase Angle Regulators** | 8 | 20 |
| 1. **Static Voltage and Phase Angle Regulators:** Voltage and phase angle regulation. Power flow control and improvement of stability by phase angle regulator. 2. Introduction to thyristor controlled voltage and phase angle regulators (**TCVR** and **TCPAR**) (ii) Introduction to **thyristor controlled braking resistor** and **thyristor controlled voltage limiter**. |  |  |
| UNIT 5: **Power Flow Controllers** | 6 | 20 |
| 1. **UPFC:** Unified Power Flow Controller (UPFC), basic operating principles, conventional transmission control capabilities. Comparison of UPFC to series compensators and phase angle regulator. Applications of UPFC. 2. **IPFC:** Interline Power Flow Controller (IPFC), basic operating principles and characteristics. Applications of IPFC. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Elaine Rich and Kevin Knight, Artificial Intelligence, TATA MCGRAW HILL Publishers
2. James A Anderson, An introduction to Neural Networks.
3. Dan. W Patterson, Artificial Intelligence and Expert Systems.

**Course outcomes:**

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

1. Work with various devices used for Power Factor control in FACTS systems, like Static Shunt Compensators, Static Series Compensators, TSSC, TCSC, etc.
2. Use various types of Voltage and Phase Angle Regulators, like TCVR, TCPAR, etc. in industry.
3. Understand the basic operating principles and characteristics of Power Flow Controllers like UPFC and IPFC.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books |  |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies |  |
| Graded  Assignments | Two Assignments | 10 | Log of record |  |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at SGVU |  |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 40 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 35 |

|  |  |
| --- | --- |
| Course Title**: UTILIZATION OF ELECTRIC POWER AND TRACTION** | Course Code : EE 412 |
| Semester : **VIII** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Electrical Engineering + Dual Degree3,5** | |

**Pre-requisites:**

* EE 311 - Power System Instrumentation
* EE 312 – Switch Gear And Protection

**Course Objectives:**

1. Help the learner understand the basic applications, principles and concepts of Different methods of electric heating.
2. Learn about the different types of Classification of Electric Welding.
3. Obtain a detailed understanding of Concept of Principles and applications of electrolysis.
4. Understand the Electric Traction and Means of Supplying Power.
5. Make students familiar with modern day applications of Electrical Power and Electrical Traction.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  | | |
| UNIT-1: **Heating uses of Electric Power** | 7 | 20 |
| 1. **Electric Heating:** Different methods of electric heating. Principle of high frequency induction and di-electric heating. Construction, operation, performance and applications of arc furnace and induction furnace. 2. **Electric Welding:** Welding process, welding transformer, Classification of Electric Welding: arc welding, resistance welding, welding of various metals. |  |  |
| UNIT-2: **Lighting uses of Electric Power** | 7 | 20 |
| 1. **Illuminations:** Definitions, laws of illuminations, polar curves, luminous efficiency, photometer, incandescent lamps: filament materials, halogen lamp. Electric discharge lamps: sodium vapour lamp mercury vapour lamp and fluorescent lamp. 2. **Light Calculations:** Commercial, industrial, street and flood lighting. |  |  |
| UNIT-3: **Electrolytic Process** | 7 | 20 |
| Principles and applications of electrolysis, electro-deposition, manufactures of chemicals, anodizing, electro polishing electro-cleaning, electroextraction, electro refining, electro-stripping (parting) power supplies for electrolytic process. |  |  |
| UNIT-4: **Electric Traction and Means of Supplying Power** | 7 | 20 |
| Systems of Electric Traction: DC and AC Systems, Power Supply for Electric Traction System: Comparison and application of different systems. Sub-station equipment and layout, conductor rail and pantograph. |  |  |
| UNIT 5: **Application and methods of Electric Traction Control** | 8 | 20 |
| 1. **Traction Methods:** Types of services, speed time and speed distance curves, estimation of power and energy requirements, Mechanics of train movement. Co-efficient of adhesion, Adhesive weight, effective weight. 2. **Traction Motor Controls:** DC and AC traction motors, Series parallel starting. Methods of electric braking of traction motors. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. H. Pratap - Art and Science of Utilization of Electric Power
2. H. Pratap - Modern Electric Traction.
3. C.L Wadhwa - Utilization of electric traction electric power.
4. G.K. Dubey - Electric Drives, Narosa Publishing House.
5. Vedam and Subrahmanyam - Concept and Application of Electric Drives.

**Course outcomes:**

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

1. Help the learner understand the basic applications, principles and concepts of Different methods of electric heating.
2. Learn about the different types of Classification of Electric Welding.
3. Obtain a detailed understanding of Concept of Principles and applications of electrolysis.
4. Understand the Electric Traction and Means of Supplying Power.
5. Utilize Electric Power and Traction in various applications in the industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title**: Energy Conservation & Auditing** | Course Code :  **EE 422** |
| Semester : **VIII** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : | Credits : 2 **Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : |
| Continuous Internal Evaluation : | ESE : |
| Programmes: **B.Tech. Electrical Engineering** | |

Course Outcomes: At the end of this course, students will demonstrate the ability to

• Understand the current energy scenario and importance of energy conservation.

• Understand the concepts of energy management.

• Understand the methods of improving energy efficiency in different electrical systems.

• Understand the concepts of different energy efficient devices.

|  |  |  |
| --- | --- | --- |
| **Unit-1** | **Energy Scenario:** Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features. | **(6 Hours)** |
| **Unit-2** | **Basics of Energy and its various forms :** Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion. | **(7 Hours)** |
| **Unit-3** | **Energy Management & Audit :** Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams. | **(6 Hours)** |
| **Unit-4** | **Energy Efficiency in Electrical Systems :**Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. | **(7 Hours)** |
| **Unit-5** | **Energy Efficiency in Industrial Systems :** Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers. | **(8 Hours)** |
| **Unit-6** | **Energy Efficient Technologies in Electrical Systems:** Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology. | **(8 Hours)** |

**Text/Reference Books:**

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)

2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

3. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.

4. Success stories of Energy Conservation by BEE, New Delhi ([www.bee-india.org](http://www.bee-india.org))

|  |  |
| --- | --- |
| Course Title: **Advanced Power System Analysis** | Course Code : EE 501 |
| Semester : I(M.Tech) | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: M.Tech **(PS)** | |

**Pre-requisites:**

Graduate level Electrical Engineering Course of Indian Universities.

**Course Objectives:**

1. To understand and analyse the abnormal working of the power systems in form of faults.
2. To understand the behaviour of induction machines under unbalanced conditions.
3. To understand the mathematical model of synchronous machines.
4. To understand the concepts of linear graph theory.
5. To study and analyse the load flow problems.
6. Make students familiar with Fault Analysis techniques used for 3-phase Induction Machines and Synchronous Machines.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  |  |  |
| UNIT-1: **Fault Analysis** | 6 | 20 |
| Positive, Negative and Zero Sequence equivalent circuits of lines, two and three winding transformers, induction machines and synchronous machines. Analysis of shunt and series faults, effect of neutral grounding. |  |  |
| UNIT-2: **Unbalanced Operation of 3-phase Induction Motors** | 6 | 20 |
| Characteristics with application of unbalanced voltage to a balanced motor and with application of balanced voltage to a motor having unbalanced impedances in the rotor circuit. |  |  |
| UNIT-3: **Synchronous Machines** | 8 | 20 |
| Short circuit currents and reactance of synchronous machine. Modelling of synchronous machine at no load and symmetrical load under steady state conditions, Sequence impedance of synchronous machines. |  |  |
| UNIT-4: **Linear Graph Theory** | 8 | 20 |
| Study of linear graph theory, Network topology, incidence, Cut-set and Tie-set matrices and their interpretation. Calculation of Z-bus, Y-bus, Z-branch and Y loop matrices by singular and non-singular transformations. Algorithm for the calculation of Y-bus and Z-bus. Fault calculations using Z-bus. |  |  |
| UNIT 5: **Load Flow Studies** | 8 | 20 |
| Formulation of load flow problem. Various types of buses. Gauss-Siedel, Newton-Raphson and Fast Decoupled Algorithms. Calculation of reactive power at voltage controlled buses in the Gauss-Seidel iterative method using Y-bus, Phases, Representation of transformers - Fixed tap setting transformer, Tap changing under load transformers shifting transformers, Tie line control, Comparison of methods for load flow. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1) J.J. Grainger, William, D. Stevenson Jr., Power system Analysis.

2) C.L. Wadhwa, Electrical power system, New Age international publishers.

3) B.R. Gupta: Power system Analysis and Design.

**Course outcomes:**

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

1. Understand and analyse the behaviour of the power systems under different fault conditions.
2. Understand and analyse the behaviour of induction machines under unbalanced operations
3. Understand the mathematical model for synchronous machines.
4. Understand the concept of linear graph theory and its use to solve electrical problems.
5. Solve and analyse the load flow problems.
6. Calculate fault parameters in any 3-phase Induction machine or Synchronous machine in a Power System.

**Mapping Course Outcomes with Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

**M.TECH (PS) – III Semester / DUAL DEGREE (EE + PS) – IX Semester Restructured Power System (EE-608)**

**Time: 3 Hours Maximum Marks: 60**

***Instructions to candidates:*** Attempt over all 5 questions selecting one question from each unit. All questions carry equal marks.



UNIT-I

Que.1. A double line to ground fault occurs on phase ‘A’ and ‘C’ of an unloaded generator in a power system. Represent this fault condition by sequence networks. Determine the fault current and the voltages across all the phases.

OR

Que.2. A 20 MVA, 11 kV generator is supplying a resistive load of 10 MW at 1.1 kV through a 22kV line. A single line to ground fault occurs at load side bus of the line (before step down transformer). Determine the fault current. The equipment parameters are as follows:

Generator – X1 = X2 = 0.1 pu; Xo = 0.15 pu;

Step up transformer – 30 MVA, 11/22 kV; X1 = X2 = X0 = 0.12 pu

Line - X1 = X2 = X0 = (1 + j5) Ω

Step down Transformer – 20 MVA, 22/1.1 kV; X1 = X2 = X0 = 0.05 pu

Fault resistance – 6.6 Ω

Unit II

Que.3. An induction motor is running at balanced three phase supply. If the phase sequence is reversed, what will be the performance of the motor? Describe in detail the impact on current and torque.

Que.4. An induction motor is fed from non sinusoidal voltage supply. Analyze its performance. How various harmonics affect the performance?

Unit III

Que.5. While analysing a power system, the effect of load current flowing just prior to fault occurrence, in short circuit studies, is neglected. In case it is not to be neglected, explain how it can be considered for such short circuit studies.

OR

Que.6. A three-phase salient pole synchronous generator has a terminal voltage of 1.0 pu. If the generator armature supplies a current of 0.8 pu at lagging power factor of 0.8, determine the excitation voltage and the load angle. Also calculate the real and reactive power generated. Neglect the armature resistance and assume Xd = 1.1 pu and Xq = 0.8 pu.

Unit IV

Que.7. Derive the equation Ybus = AtYA

Where Ybus = Bus admittance matrix,

A = Bus incidence matrix

At  = Transpose of A,

Y = Primitive admittance matrix.

OR

Que.8. What is an incidence matrix. Describe the properties of complete incidence matrix? Draw the oriented graph from the complete incidence matrix Aa given below:

Aa =

Unit V

Que.9. Draw flow chart of Newton Raphson method for load flow studies including PV buses. Explain each block of the chart.

OR

Que.10. A line with resistance 0.4 pu is supplying a load of 0.5 pu from bus 1 to bus 2. Assuming bus 1 as slack bus having a voltage of 1.0 pu, using the N-R iterative method , determine in pu (i) voltage at load bus 2, (ii) current in line 1-2, (iii) The slack bus power, and (iv) power loss in the line.

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| --- | --- |
| Course Title: **SMART GRID: DESIGN & ANALYSIS** | Course Code : EE 512 |
| Semester : **I** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course :  **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **M.Tech Power System** | |

**Objectives:**

1. To provide students with a comprehensive understanding on design and analysis of smart grids;

2. To ensure the students aware of the current state-of-the-art on design, operation and control of smart grid;

3. To acquire knowledge on the components in smart grids and their functions; and

4. To enable students to apply advanced analysis tools in planning and operation of smart grids

**Outcomes:**

Upon completion of the subject, students will be able to:

a. Acquire in-depth understanding on recent development of power grids, i.e. smart grid;

b. Apply advanced analysis tools in planning and operation of smart grids; and

c. Acquire skills in presentation and interpretation of results in written form.

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **UNIT I** | 10 | 20 |
| Introduction to smart grid (1.5 week): Overview of power system operation; Comparison between existing grid and smart grid; Objectives; Benefits; Challenges; Basic structure and functions of components. | 5 |  |
| Communications and measurement (1.5 weeks): Latest technologies; Wide Area Monitoring Systems (WAMS), Phasor Measurement Units (PMU), Smart Meters, Smart Appliances, and Advanced Metering Infrastructure (AMI); GIS and Google Mapping Tools; Multiagent Systems Technology. | 5 |
| **UNIT II** | 8 | 20 |
| . Micro-grid (2 weeks): Concept of micro-grid; design and analysis; distributed generation; distributed automation. | 8 |  |
| **UNIT III** | 8 | 20 |
| Renewable energy and storage (2 weeks): Renewable energy resources and options for smart grid including solar energy, wind energy, fuel cell, biomass etc.; Penetration and variability; Demand Response; Electric vehicles and plug-in hybrid; Battery energy storage systems. | 8 |  |
| **UNIT IV** | 12 | 20 |
| Interoperability, standards and cyber security (2 week): State-of-the-art, Benefits, Challenges, Risks. | 8 |  |
| Application examples and its trends (1 week): Demonstration projects; Testbeds and benchmark systems; Future trends; Research, education and training. | 4 |
| **UNIT V** | 10 | 20 |
| Analysis tools (3 weeks): Power/load flow studies; Static security assessment; State estimation and stability assessment; Reliability assessment; Decision support tools; Advanced optimization and control; Environmental impacts; Pathway for designing smart grid. | 10 |  |
| **TOTAL** | **48** | **100** |

**Reference Books:**

1. P. Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy,” Elsevier Inc., 2012.
2. J.A. Momoh, “Smart Grid: Fundamentals of Design and Analysis,” 2012 IEEE, John Wiley & Sons, Inc., 2012.

Peter Fox-Penner, “Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities,” Island Press, 2010.

|  |  |
| --- | --- |
| Course Title:  **ADVANCED POWER ELECTRONICS** | Course Code :EE 505 |
| Semester : **M. Tech 2nd SEM** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **M.TECH POWER SYSTEM + DUAL DEGREE POWER SYSTEMS** | |

**Pre-requisites:**

Basics of power electronics and modern power electronics

**Course Objectives:**

|  |
| --- |
| 1. Help the learner to understand basic principles of converters. |
| 1. Understand the principle and application of chopper. |
| 1. Understand the basic principles of inverters and PWM. |
| 1. Learn about different type of AC voltage controller and their application. |
| 1. Learn about cyclo-converters. 2. Make students familiar with various types of Power Electronic devices, like Converters, Choppers, Inverters, AC Voltage Controllers and Cyclo-converters. |

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **UNIT-1: Analysis of switched circuits** | 8 | 20 |
| Thyristor controlled half wave rectifier – R, L, RL, RC load circuits, classification and analysis of commutation. |  |  |
| **UNIT-2: AC to DC Converters** | 7 | 20 |
| Single-Phase and Three-Phase AC to DC converters- half controlled configurations- operating domains of three phase full converters and semi-converters – Reactive power considerations. |  |  |
| **UNIT-3: DC to DC Converters** | 6 | 20 |
| Analysis and design of DC to DC converters- Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converters, Cuk converter |  |  |
| **UNIT-4: Inverters** | 8 | 20 |
| Single phase and Three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters. |  |  |
| **UNIT 5: Power Conversion (Additional Techniques)** | 7 | 20 |
| AC to AC power conversion using voltage regulators, choppers and cycloconverters, consideration of harmonics. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. M.H. Rashid: Power Electronics, circuit devices and applications, PRENTICE HALL OF INDIA, 1988.
2. V Subrahmanyam: Power electronics, New Age Inc. Publishers, New Delhi,1996
3. P.C. Sen: Power electronics Tata McGraw-Hill 1987
4. CW Lander: Power electronics,2nd edition, McGraw Hill 1987
5. P.S. Bimbhra: Power electronics, 2nd Ed. Khanna Publishers,1987
6. M.D. Singh and K.B. Khanchandani: Power electronics, TATA MCGRAW HILL,1998
7. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design", John Wiley and sons.Inc, Newyork, 1995.

**Course outcomes:**

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

|  |
| --- |
| 1. Student will be able to understand the application of phase controlled converter |
| 1. Understand the different type of chopper and their application |
| 1. Understand the 1 phase and 3 phase inverters and their applications and harmonic reduction techniques |
| 1. Understand AC voltage controller |
| 1. How to change frequency with the help of cyclo-converter 2. Calculate the performance parameters of various Power electronic devices, and work on them in industry. |

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |
|  |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

Enrolment No..................................

M.Tech Dual Degree

(Elect. Engg)

Semester (II )M. TECH CORE

ADVANCED POWER ELECTRONICS (EE 503)

MAIN/BACK EXAMS-NOV/DEC-2015

Time:3 Hours Max.marks:-70

Instructions to candidate:

Attempt overall 5 questions selecting one question from each unit.

All questions carry equal marks

UNIT 1

Q1.Describe the working of a single phase full converter in the inverter mode with RLE load. Illustrate your answer with waveforms for source voltage, E, load voltage and current, source current and voltage across one SCR. Assume continuous conduction.

OR

Q2.For a 3 phase full converter , sketch the input voltage waveforms for Vab , Vac,Vbc and voltage variation across any one thyristor for one complete cycle for a firing angle delay of (a) 600(b) 1200

UNIT 2

Q3.For type a chopper circuit, source voltage Vs = 220 V,chopping period T = 2000 micro seconds, on period = 600 micro seconds, load circuit parameters: R=1 ohm, L= 5m H and E = 24 V

1. Find wheather load current is continuous or not
2. Calculate the value of average output current
3. Compare the maximum and minimum values of steady state output current
4. Find rms values of the first , second and third harmonics of the load current
5. Compute the average value of supply current
6. Compute input power, power absorbed by the load counter emf and the power loss in the resistor

OR

Q4. A series motor used for a rapid transit system is fed through a dc chopper. The series motor has total circuit resistance of 2 ohm and inductance of 2 m H. What external inductance should be inserted in series with the armature circuit to 10 % for a duty cycle ratio of 0.5. the chopping frequency is 1 k HZ

UNIT 3

Q5.Explain the different methods of voltage control in three phase inverter

OR

Q6. Explain PWM and harmonic reduction techniques in inverter

UNIT 4

Q7.A single phase voltage controller, with two thyristor s arranged in anti –parallel, is connected to RL. Discuss its working when firing angle is more than the load pf angle. Illustrate your answer with waveforms of source voltage , gate signals , load and source currents, output voltage and voltage across both thyristor

OR

Q8.The three phase full wave controller supplies a star connected resistive load of R = 10 ohm and the line to line input voltage is 208 V (rms) , 60 Hz. The delay angle is α = π/3 determine (a) the rms output phase voltage Vo (b) the input PF , (c) the expression for the instantaneous output voltage of phase a.

UNIT 5

Q9..Draw the control circuit block diagram of cyclo- converter

(b) Show that the fundamental RMS value of per phase output voltage of low frequency for an m –pulse cyclo-converter is given by Eor = Eph (m/π) sin (m/π) also express Eor  in terms of voltage reduction factor r.

OR

Q10. What is basic basic principle of cyclo –converter. Discuss why three phase to single phase cyclo -converter requires positive and negative group phase controlled converters. Under what conditions, the group work as inverter or rectifiers?

|  |  |
| --- | --- |
| Course Title: **ADVANCE** **POWER SYSTEM STABILITY** | Course Code : EE 502 |
| Semester : M.Tech. Sem-II/ Summer IX | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **2 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **30** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

|  |  |
| --- | --- |
| **Prerequisite** | Power System Analysis, AC machines |
| **Objective:** | The objective of the course are: |
|  | 1. Help the learner to model the synchronous machine and visualize flux linkage |
|  | 1. Understand the Steady state and transient stability |
|  | 1. Learn about SMIB and multi machine system. |
|  | 1. Learn about solution of various stability problems |
|  | 1. Learn various factors affecting stability |
| **Expected Outcome:** | The student will be able to |
|  | 1. Student will be able to model various synchronous machines. |
|  | 1. Solve swing equation and understand various stability |
|  | 1. Able to develop SMIB system & solve coherent non coherent system |
|  | 1. Give solution to various stability problems eg fault clearing time,critical clearing angle etc. |
|  | 1. Know the factors affecting stability and their remedy |
| **Unit -1 (7 Hours)** | **Modeling of synchronous machines** |
|  | Modeling of cylindrical rotor salient pole synchronous machines, flux linkage equations, voltage equations, Park's transformation, various inductances and time constraints of synchronous machines, vector diagrams for steady state and transient conditions, power angle curves. |
| **Unit -2 (7 Hours)** | **Stabilities** |
|  | Steady state and transient stabilities, their definitions and methods of determination. Development of Swing equation. |
| **Unit -3 (6Hours)** | **Machine Systems** |
|  | Steady state stability of single machine connected to an infinite bus by the method of small oscillations. Two machine systems. Coherent and non-coherent machines. |
| **Unit -4 (9 Hours)** | S**tudy of various stability methods** |
|  | Equal area criterion of determining transient stability, fault clearing time and critical clearing angle. Solution of Swing equation by step by step method. Euler's Method and Runga-Kutta Method, Application of Computers in the study of transient stability using these methods. Introduction to steady state and transient Stability using these methods. Introduction to steady state and transient stabilities of multi-machine system without controller. |
| **Unit -5(7 Hours)** | **Factors affecting Stabilities** |
|  | Factors affecting steady state and transient stabilities, methods of improving steady state and transient stabilities, high speed circuit breakers, auto-reclosing circuit breaker, single pole operation, excitation control, and bypass valving. |
| **List of Expt.** | Nil |
| **Text Book** | 1C L Wadhwa, Electrical power system.New Age international publishers. |
| **Reference book** | 1. B.R.Gupta: Power system Analysis and Design. |
| **Mode of Evaluation** | Continuous evaluation (Weekly test,Graded Assignments, Mid term test, End sem exam) |
| **Recomm. by BOS on** |  |
| **Approved by AC on** |  |

|  |  |
| --- | --- |
| Course Title: **POWER SYSTEM DESIGN USING PSCAD I** | Course Code : EE 553 |
| Semester : M.Tech. Sem-II/ Summer IX | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **2 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **30** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Basics of Power Systems (Generation, Transmission & Distribution)

**Course Objectives:**

1. To learn the design of power system applications in software other than MATLAB.
2. To learn and understand the working of PSCAD software.
3. Understand the application of the Software in the practical Power System World.
4. Learn modelling and simulation through PSCAD of various components and scenarios of Power System, like Rectifier circuits, fault analysis, DC-DC Converters, induction motors, transformers, etc.

**Course Content**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Introduction to PSCAD – Installation and use in Power System Modelling | | 3 | 10 |
|  | Introduction to PSCAD – Basics of PSCAD | | 3 | 10 |
|  | Design and implementation full wave rectifier circuit with R and RL Load | 3 | | 10 |
|  | L-L Fault Analysis of a simple AC System using PSCAD | | 3 | 10 |
|  | L-L-G Fault Analysis of a simple AC System using PSCAD | | 3 | 10 |
|  | Simulation of DC-DC Converter with a simple AC system as input | | 3 | 10 |
|  | Design of a VFD for a squirrel cage induction motor and an AC Voltage source. | | 3 | 10 |
|  | Simulation of a VFD for a squirrel cage induction motor and an AC Voltage source using PSCAD. | | 3 | 10 |
|  | Modelling of 3 phase transformer using PSCAD. | | 3 | 10 |
|  | Modelling and simulation of DC Series and Shunt Motors using PSCAD | | 3 | 10 |
|  |  | | **30** | **100** |

**Reference:**

**Course outcomes:**

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

1. Apply the theory covered in courses to obtain working simulations of advanced Electrical Engineering circuits.
2. Will be able to use PSCAD for designing of circuits/systems that have been covered in their theoretical topic thus far.
3. Through the project development, students will be able to showcase their skills in modelling an Electrical Engineering/Power System through PSCAD.
4. Understand the process of implementing design in the simulation.
5. Simulate any Power System component or scenario in the industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **HVDC TRANSMISSION** | Course Code : EE 504 |
| Semester : **M.Tech Sem-II, Summer DD (PS) IX-Sem** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **Common for M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

* B.Tech in Electrical Engineering
* Power Electronics
* Transmission & Distribution

**Course Objectives:**

1. Help the learner to understand basic principles and operation of HVDC Systems and the main switching devices, thyristor and IGBT Valves
2. Understand the application of Power Electronics Converters HVDC Systems
3. Understand and implement basic design concepts for HVDC Systems
4. Investigate the use of filters and how they may be used to remove the identified harmonics from the HVDC system.
5. Understand how MTDC systems function and their future applications.
6. Make students familiar with the various components of HVDC Power System and its advantages over HVAC systems.

**Course Content:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic and Contents** | | **Hours** | **Marks** |
|  | | | |
| **Unit 1 Thyristor & IGBT Valves** | | 7 | 20 |
| Thyristor device, Steady state and switching characteristics, Light activated power thyristor, LED, fibre optics, valve firing, parallel and series connections of thyristors. IGBT Device | |  |  |
|  | | | |
| **Unit 2 Converter Circuits** | 7 | | 20 |
| Rectification and inversion, effect of reactance, six pulse and twelve pulse converter circuits. | |  |  |
|  | | | |
| **Unit 3 DC Link Control** | | 8 | 20 |
| Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Extinction angle control, starting, stopping and power flow reversal of DC link, Power control, and Parallel operation of DC link with AC transmission line. Converter faults, commutation failure, valve blocking and bypassing. Protection against over currents, over voltages. DC circuit breakers. Reactive Power Control: Reactive power requirement in steady state, Sources of reactive power and reactive power control. | |  |  |
|  | | | |
| **Unit 4 Harmonics & Filters** | | 7 | 20 |
| Generation of harmonics, AC and DC side harmonics, Characteristics and non-characteristics harmonics. Types of AC filters – single tuned and double tuned filters, high pass filter, DC Smoothing reactor and filters. (ii) Scheme of a HVDC converter station and components of HVDC transmission system. | |  |  |
|  | | | |
| **Unit 5 Multi-Terminal DC Drives** | | 7 | 20 |
| Types of MTDC systems, Comparison of series and parallel MTDC systems, Control and protection of MTDC systems, Application of MTDC systems. | |  |  |
| **TOTAL** | | **36** | **100** |

**Reference:**

1. K.R. Padiyar - HVDC Power Transmission System
2. Power System Engineering by C.M. Arora
3. Power Electronics, M.H. Rashid
4. Electrical power system. C.L. Wadhwa, New Age international publishers.

**Course outcomes:**

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

1. Measure and calculate the switching behaviour of thyristor and IGBT valves
2. Design power electronic converters (AC- DC, DC - DC)
3. Understand control schemes for HVDC systems and their control
4. Measure and remove harmonics.
5. Understand the application of MTDC systems.
6. Work on and design the widespread HVDC Power Systems in the industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

1. The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

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| --- | --- |
| Course Title: **Power System Transients and Protection** | Course Code : EE 506 |
| Semester : M.Tech II-Sem, Summer(DD) VIII-Sem | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: **M.TECH POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Pre-requisites:**

Graduate level Electrical Engineering Course of Indian Universities.

**Course Objectives:**

1. To understand the wave phenomenon in power systems.
2. To understand the grounding and its impact on the behaviour of power systems and on insulation coordination
3. To understand the working of static relays, their advantages and the disadvantages and their reliability.
4. To understand the working of various types of comparators, being used in static relays.
5. To understand the role of switchgear in power systems.
6. Make students familiar with the various causes of Power System Transients and various protective Relays and Circuit Breakers used to prevent them.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Travelling waves & Over-voltages** | 6 | 20 |
| Wave terminology, development of wave equations, terminal problems, lattice diagrams. Origin and nature of power system surges, wave shapes, attenuation, effect of shielding by ground wires and masts, tower footing-resistance. Traveling waves, multi-velocity waves, methods of measuring tower footing resistance, voltages across insulator strings. Dynamic over voltages during surges and system faults, system recovery voltage characteristics. |  |  |
| UNIT-2: **Neutral Grounding & Insulation** | 6 | 20 |
| Methods of neutral grounding and their effect on system behaviour. Insulation coordination, requirement in surge protection of lines and equipment. |  |  |
| UNIT-3: **Static Relays** | 8 | 20 |
| Introduction, advantages of static relays over electromagnetic relays. Limitation of static relays, Reliability and Security of static relays, Recent Developments of static relays. |  |  |
| UNIT-4: **Comparators & Digital Relays** | 8 | 20 |
| Comparators and Level Detectors: Static Relay Functional circuits, Amplitude and Phase comparators, level detectors. Digital Relays, Microprocessor based protective relays. |  |  |
| UNIT 5: **Circuit Breakers** | 8 | 20 |
| **Switchgear:** Types of circuit breakers and their constructional features, operating mechanism Application of Circuit breakers, speed of circuit breakers, Auto reclosing, selection of circuit breakers, Rating of circuit breakers, Testing of circuit breakers, SF6 Insulated Metal clad Switchgear (CIS), Advantages, Demerits, Design aspects, Bus bar modules, SF6, Insulated EHV Transmission Cables (GIC). |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1) M. Chander: Switchgear protection.  
2) S.S. Rao: Switchgear and protection.   
3) T.M.S. Rao: Static Relays.  
4) C.L. Wadhwa - Electrical Power system.  
5) J.B. Gupta: Switchgear protection. Kataria Publications, New Delhi.

**Course outcomes:**

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

1. Understand the transient wave phenomenon in power systems
2. Understand the impact of grounding on the behaviour of power systems
3. Understand the working of static relays in power systems
4. Understand the working of comparators in static relays and to use them in various protective schemes.
5. Understand the operation of switchgear in power systems.
6. To be able to understand the above related field problems.
7. Calculate the values of Power System Transients in any basic scenario, and suggest the appropriate protective relay or circuit breaker for that case.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |
| 7 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 6 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE? | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 3, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 6,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and ESE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

**M.TECH (PS) / DUAL DEGREE (EE + PS) Power System Transients and Protection (EE-506)**

**Time: 3 Hours Maximum Marks: 60**

***Instructions to candidates:*** Attempt over all 5 questions selecting one question from each unit. All questions carry equal marks.



UNIT-I

Que.1. What are the surges in a power system. How these are generated. Discuss the effect of the ground wires and tower footing resistance on various types of surges. (4+4+4)

OR

Que.2. An overhead line with surge impedance 600 ohm bifurcates into two lines of surge impedance 600 ohm and 50 ohm, respectively. If a surge of 45 kV is incident on the overhead line, determine the magnitudes of voltage and current which enter the bifurcated lines. (12)

Unit II

Que.3. What is the role of neutral grounding? How various methods of neutral grounding do affect the impact of surges in a power system? (6+6)

Que.4. What do you understand by the insulation coordination. How volt - time curve for various components in a power system, to be protected are related with that of protecting equipment. Discuss critically. (5+7)

Unit III

Que.5. In static relays, which device is used to combine more than one signal. Describe the device, with its working and its use in static relays. (4+8)

OR

Que.6. Discuss the use of logic gates in protective relaying. With the help of logic gates, explain clearly the relay logic. (6+6)

Unit IV

Que.7. Name different types of static amplitude comparators. Discuss their working with relative advantages and disadvantages. (5+7)

OR

Que.8. Show that the amplitude and phase comparators are dual to each other. In static relays how these functions are achieved. (8+4)

Unit V

Que.9. What do you understand by symmetrical breaking current, asymmetrical breaking current, and making current as applied to circuit breakers. Can these be determined from oscillograms taken short circuit tests on a three phase circuit breaker? Explain. What is meant by the rated MVA breaking capacity of such a breaker? (2+2+2+3+3)

OR

Que.10. What is the principle of breaking dc currents? In what respect does it differ from ac current breaking? What are the practical limitations of breaking high voltage direct current and how can these be overcome? (3+3+3+3)

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to
3. The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
4. Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
5. Student shall be given internal choice in every Unit.
6. Questions should not be set from the recapitulation topics.

|  |  |
| --- | --- |
| Course Title: **POWER SYSTEM MODELLING AND SIMULATION LAB** | Course Code : EE 552 |
| Semester : II | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **2 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **30** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Torque equation and impedances of inductor and capacitor

**Course Objectives:**

1. To learn MATLAB software and its various applications.
2. Learn to implement advanced power system and electrical engineering problems to obtain a solution through MATLAB/ETAP analysis.
3. Obtain a better understanding of advanced theoretical concepts covered in M.Tech courses through mathematical modelling.
4. Make students familiar with the use of MATLAB in modelling and simulation of various components and equations of Power System, like Swing Equation, DC machines, Induction machines, Synchronous machines, FACTS devices, etc.

**Course Content**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | Simulate Swing Equation in Simulink (MATLAB) | | 3 | 10 |
|  | Modelling of DC Series Motor and DC Shunt Motor. | | 3 | 10 |
|  | Simulate DC Series Motor and DC Shunt Motor (Simulink). | 3 | | 10 |
|  | Modelling of Induction Machine. | | 3 | 10 |
|  | Simulation of Induction Machine. (Simulink) | | 3 | 10 |
|  | Modelling of Synchronous Machine with PSS | | 3 | 10 |
|  | Simulation of Synchronous Machine with PSS (Simulink) | | 3 | 10 |
|  | Modelling of Synchronous Machine with FACTS device | | 3 | 10 |
|  | Simulation of Synchronous Machine with FACTS devices (Simulink) | | 3 | 10 |
|  | FACTS Controller designs with FACT devices for SMIB system. | | 3 | 10 |
|  |  | | **30** | **100** |

**Reference:**

1. Fundamentals of Electric Dives, G.K. Dubey, Narosa Publishing House, New Delhi 1995
2. Lab Manuals

**Course outcomes:**

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

1. Apply the theory covered in courses to obtain working simulations of advanced Electrical Engineering circuits.
2. Will be able to use MATLAB/ETAP for designing of circuits/systems that have been covered in their theoretical topic thus far.
3. Through the project development, students will be able to showcase their skills in modelling an Electrical Engineering/Power System through MATLAB.
4. Simulate various components and equations using MATLAB to be used in the Power System industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

1. **CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **POWER SYSTEM LAB II** | Course Code : EE 554 |
| Semester : II | Core / Elective : CORE |
| Teaching Scheme in Hrs (L:T:P) : **0:0:3** | Credits : **2 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **30** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **M.Tech Power System + Dual Degree EE + PS** | |

**Pre-requisites:**

Torque equation and impedances of inductor and capacitor

**Course Objectives:**

1. To learn MATLAB software and its various applications.
2. Learn to implement advanced power system and electrical engineering problems to obtain a solution through MATLAB/ETAP analysis.
3. Obtain a better understanding of advanced theoretical concepts covered in M.Tech courses through mathematical modelling.
4. Make students familiar with modern Simulation software like MATLAB, PSCAD, etc. for simulating various Power System scenarios, like overcurrent, Ferranti effect, Load Flow Analysis, symmetrical and unsymmetrical fault analysis, etc.

**Course Content**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Topic and Contents** | | **Hours** | **Marks** |
|  | To determine negative and zero sequence reactance of an alternator. | | 3 | 10 |
|  | Determine direct axis reactance (Xd) and quadrature axis reactance (Xq) of a salient pole alternator. | | 3 | 10 |
|  | To study the IDMT over current relay and determine the time current characteristics. |  | | 10 |
|  | To study Ferranti effect and voltage distribution in H.V. long transmission line using transmission line model. (May use MATLAB/PSCAD/other simulation software) | | 3 | 10 |
|  | To determine location of fault in a cable using cable fault locator. | | 3 | 10 |
|  | To study operation of oil testing set. | | 3 | 10 |
|  | To study percentage differential relay and develop instrumentation for obtaining automated performance characteristics of the relay | | 3 | 10 |
|  | To obtain formation of Y-bus and perform load flow analysis using MATLAB/PSCAD (Other simulation software). | | 3 | 10 |
|  | To perform symmetrical fault analysis in a power system using MATLAB/PSCAD (Other simulation software) | | 3 | 10 |
|  | To perform unsymmetrical fault analysis in a power system using MATLAB/PSCAD (Other simulation software). | | 3 | 10 |
|  |  | | **30** | **100** |

**Reference:**

1. Fundamentals of Electric Dives, G.K. Dubey, Narosa Publishing House, New Delhi 1995
2. Lab Manuals

**Course outcomes:**

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

1. Apply the theory covered in courses to obtain working simulations of advanced Electrical Engineering circuits.
2. Will be able to use MATLAB/PSCAD for designing of circuits/systems that have been covered in their theoretical topic thus far.
3. Through the project development, students will be able to showcase their skills in modelling an Electrical Engineering/Power System through hardware and software.
4. Do various simulations and calculation of the Power System components in MATLAB, PSCAD, etc. to be used in industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1 to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

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| --- | --- |
| Course Title: **ADVANCED POWER SYSTEM** | Course Code : EE 508 |
| Semester : M.Tech. II-Sem | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: M.Tech **POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Pre-requisites:**

Graduate level Electrical Engineering Course of Indian Universities.

**Course Objectives:**

1. Help the learner to understand voltage stability
2. Understand the distribution automation system
3. Learn about various FACTS devices
4. Learn about basics of energy audit.
5. Learn superconductivity and applications
6. Imparting knowledge to students about recent advancements in Power Systems, like SCADA, FACTS, etc.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
|  |  |  |
| UNIT-1: **Voltage Stability** | 6 | 20 |
| Power system voltage stability concept, comparison of angle and voltage stabilities, Power system loads, generator P-Q and Q-V characteristics. Voltage collapse. Voltage stability analysis. Methods of improving voltage stability. |  |  |
| UNIT-2: **Distribution Automation** | 6 | 20 |
| Introduction to distribution automation. Concepts of communication - power line carrier, radio communication, fibre optics, satellite communication and sensors. Introduction to supervisory control and data acquisition (SCADA). Brief description of an automation system. |  |  |
| UNIT-3: **FACTS** | 8 | 20 |
| Problem of AC transmission systems, basic principle of power flow control of an AC transmission line. Basic types of FACTS controllers. Brief description of FACTS controllers- STATCOM, Static Voltage and phase angle regulators, thyristor switched and thyristor controlled series capacitors, Unified Power Flow Controller. |  |  |
| UNIT-4: **Energy Conservation** | 8 | 20 |
| Introduction, conservation of natural resources, principles of energy conservation and energy audit. Brief description of energy conservation in power plants, electric utilities, electric drives, industries and electric lighting. |  |  |
| UNIT 5: **Superconductivity** | 8 | 20 |
| Basic characteristics of superconductors. Brief description of applications of superconductivity to electric power systems - superconducting generators, motors, transformers, transmission cables and magnetic storage. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. C L. Wadhwa, Electrical power system. New Age international publishers.

2. B.R. Gupta: Power system Analysis and Design.

**Course outcomes:**

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

1. Student will be able to analyse voltage stability
2. Understand distribution automation and SCADA
3. Able to apply FACTS devices
4. Able to audit electrical utilities.
5. Understand superconductivity and applications
6. Understand the methods to charge for the transmission line uses and for the power losses in transmission system.
7. Work on the relatively newer components of Power Systems in industry, like SCADA, FACTS and Superconductors.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |
| 7 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

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| --- | --- |
| Course Title: **POWER SYSTEM PLANNING & RELIABILITY** | Course Code :  **EE 601** |
| Semester : **3rd Semester** | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **M.Tech Power System & Dual Degree (B.Tech Electrical +M.Tech Power System)** | |

**Pre-requisites:**

EE 401 – Power System Analysis, EE 418 – Power System Planning.

**Course Objectives:**

1. Understand the effect of the load variation on the existing power system and how the increase/decrease in the load in the future will require efficient and reliable planning.
2. Study the importance of Reliability analysis for Power System Development
3. Learn the different aspects of planning of a power system in terms of the different types of generating capacity
4. Analyse systems through Reliability concepts of outage and generation capacity.
5. Make students familiar with the various techniques used to evaluate Reliability of different components of Power System.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Load Forecasting** | 8 | 20 |
| Classification and characteristics of loads. Approaches to load forecasting. Forecasting methodology. Energy forecasting. |  |  |
| UNITS-2: **Basic Reliability Concepts** | 8 | 20 |
| General reliability function, Markov Chains and processes and their applications, simple series and parallel system models. |  |  |
| UNITS-3: **Static Generating Capacity Reliability Evaluation** | 8 | 20 |
| Outage definitions, loss of load probability methods, loss of energy probability method. Frequency and duration methods, load forecasting uncertainty. |  |  |
| UNIT-4: **Spinning Generating Capacity Reliability Evaluation** | 6 | 20 |
| Spinning capacity evaluation, load forecast uncertainty. |  |  |
| UNIT 5: **Transmission System Reliability Evaluation** | 6 | 20 |
| Average interruption rate method. The frequency and duration method. Stormy and normal weather effects. Inter-connected Systems Generating Capacity Reliability Evaluation: Introduction, The loss of toad approach. Reliability evaluation in two and more than two interconnected systems. Interconnection benefits. |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. Roy Billinton and Ronald N. Allan -Reliability Evaluation of power system volume-I
2. Roy Billinton and Ronald N. Allan -Reliability evaluation of power System volume-II
3. J Endreny - Reliability modelling in electric power system.
4. A.S. Pabla - Electric power distribution

**Course outcomes:**

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

1. Perform reliability analysis on electrical systems.
2. Evaluate possible sources of unreliability in the system and its possible causes.
3. Perform analysis using the Reliability concept for systems under study.
4. Plan an electrical system with proper reliability analysis while taking into consideration the future loads.
5. Evaluate Reliability of different components of Power System in industry, like Static Generating Capacity, Spinning Generating Capacity and Transmission Capacity.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **Restructured Power System** | Course Code : EE 609 |
| Semester : III | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: M.Tech **POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Pre-requisites:**

Graduate level Electrical Engineering Course of Indian Universities.

**Course Objectives:**

1. To understand the restructuring of the power industry.
2. To understand the working of restructured power systems as market model and to manage the congestion of the transmission lines.
3. To understand the working of the restructured systems in which the price of electricity may be different at different nodes.
4. To understand the concepts of ancillary services in restructured power systems.
5. To understand how to charge for the transmission network and for the losses in transmission system.
6. Make the students familiar with the various types of management models used in Restructured Power Systems, like – Transmission Congestion Management, Ancillary Service Management, LMP, FTR, etc.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Introduction** | 6 | 20 |
| Introduction to restructuring of power industry, issues involved in deregulation, objectives of deregulation of various power systems across the world. Fundamentals of Economics. Consumer behaviour, Supplier behaviour, Market equilibrium, Various costs of production, Perfectly competitive market |  |  |
| UNIT-2: **The Philosophy of Market Models** | 6 | 20 |
| . Comparison of various market models, Electricity vis-à-vis other commodities, Congestion Management, Ancillary Services, Market architecture, **Transmission Congestion Management**. Classification, Calculation of ATC, ATC calculation using PTDF and LODF based on DC model |  |  |
| UNIT-3: **Locational Marginal Prices (LMP) and Financial Transmission Rights (FTR**) | 8 | 20 |
| Mathematical preliminaries: Convexity, Duality, Perturbation analysis, Sensitivity analysis, KKT necessary conditions for optimality LMP, Lossless DCOPF model for LMP calculation Loss compensated DCOPF model for LMP calculation  Accuracy comparison of both the models Introduction to Financial Transmission Rights, Risk Hedging Functionality Of financial Transmission Rights |  |  |
| UNIT-4: **Ancillary Service Management** | 8 | 20 |
| Types of ancillary services, Load-generation balancing related services Issues in reactive power management, Black start capability service |  |  |
| UNIT 5: **Pricing of transmission network usage and loss allocation** | 8 | 20 |
| Postage stamp method, Incremental postage stamp method, Contract path method, MW-Mile method, Power flow tracing Proportionate sharing principle, Graph theoretic approach  Simultaneous equations approach, Merits and de-merits of different paradigms, Introduction to loss allocation Classification of loss allocation methods, Pro-rata methods   Incremental methods, Power flow tracing based allocation Comparison between various methods |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1 Fundamentals of Power System economics Daniel Kirschen and Goran Strbac, John Wiley & Sons Ltd, 2004.

2 Making competition work in electricity Sally Hunt, John Wiley & Sons, Inc., 2002.

3 Operation of restructured power systems Kankar Bhattacharya, Jaap E. Daadler,  Math H.J. Bollen, Kluwer Academic Pub., 2001.

**Course outcomes:**

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

1. Understand the need of restructuring of the power industry and the behaviour of affected parties.
2. Understand how the electricity is different from other commodities and how the mathematical tools be used to manage the congestion of the transmission lines using PTDF and LODF.
3. Understand the basics of the methods to determine the electricity price at different nodes.
4. Understand the concept of ancillary services in restructured power systems which are required to run the power system in a smooth manner.
5. Understand the methods to charge for the transmission line uses and for the power losses in transmission system.
6. Understand and use different types of Management models used in the Restructured Power Systems used nowadays in the industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

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| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

**Model Question Paper:**

**M.TECH (PS) – III Semester / DUAL DEGREE (EE + PS) – IX Semester Restructured Power System (EE-608)**

**Time: 3 Hours Maximum Marks: 60**

***Instructions to candidates:*** Attempt over all 5 questions selecting one question from each unit. All questions carry equal marks.



UNIT-I

Que.1 What were the factors responsible for the restructuring of power industry.In what respect the consumers be benefitted with restructuring of power industry, when compared with the vertically integrated power system?

OR

Que.2 Differentiate between the marginal and the average cost of the production? In deciding the production level which cost is more beneficial,explain with a suitable example. How the marginal concept is applicable to consumers?

UNIT-II

Que.3. What are the possible ways in which buyers and sellers can trade electrical energy? On this basis discuss various market models for trading of electrical energy, with their merits and the demerits in reference to competition in the electricity market.

OR

Que.4. A system is having three buses. The line reactance in between bus 1 and bus 2 is 0.2 ohms, between bus 2 and bus 3 is .3 ohms and between bus 3 and 1 is .4 ohms. Net generation at bus 1 and bus 2 is 500 MW and 200 MW respectively. The net load on bus 3 is 700 MW. Using DC model, determine power flow on various lines. Under this operating condition what capacity is available for transaction of power from bus 1 to bus 3, if the power flow limit for line 1-2, 2-3, 3-1 is 700 MW, 600 MW and 500 MW respectively.

UNIT-III

Que.5 (a). Write short notes on any two of the following:

1. Risk Hedging, (ii) Perturbation analysis, (iii) Duality.

Que.5 (b). Discuss the accuracy in Lossless and loss compensated DCOPF methods of LMP calculation.

OR

Que.6. Consider a three bus power system having bus L, M and N. Bus L and N are generator buses and the bus M and N are load buses. All the three buses are connected by transmission lines having same impedances. Generator G1 at bus L is having capacity 500 MW with a price bid of Rs. 1400/= per MWh. The capacity of generator G2 at bus N is 400 MW with a price bid of Rs. 1800/= per MWh. Load at bus M is 50 MW and load at bus N is 200 MW. The capacity of line LM is 300 MW, capacity of line MN is 400 MW and the capacity of line LN is 100 MW. Assuming lossless lines determine the LMP on each bus.

UNIT-IV

Que.7. What do you understand by the ancillary services? Why these services has got importance in restructured systems.Which functions fall in the category of ancillary services? How these ancillary services were managed in vertically integrated systems?

OR

Que.8. Compare various sources of reactive power on the basis of their ability to provide voltage support, speed of response, cost. What are various issues in these services and how the system operator can procure these services?

UNIT-V

Que.9. Explain power flow tracing proportionate sharing principle for pricing of transmission network usage. How it is advantageous to other methods?

OR

Que.10. Loss allocation was never a problem in vertically integrated power system. Explain. What are various methods of loss allocation in restructured power system? Describe.

**Guidelines for Question Paper Setting:**

1. The question paper must be prepared based on the blue print without changing the weigh age of model fixed for each unit.
2. The question paper pattern provided should be adhered to
3. The paper should have 10 questions in all, wherein it will have 2 questions from each unit.
4. Student shall be asked to attempt in all 5 questions, 1 Question from each unit.
5. Student shall be given Internal choice in every Unit.
6. Questions should not be set from the recapitulation topics.

|  |  |
| --- | --- |
| Course Title:  **SOLAR RADIATION AND ENERGY CONVERSION** | Course Code : EE 611 |
| Semester : III | Core / Elective : Elective |
| Teaching Scheme in Hrs (L:T:P) : **3:0:1** | Credits : **3 Credits** |
| Type of course :  **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **M.Tech Electrical Engineering** | |

**Outcomes**

* To familiarize students with the characteristics of solar radiation, its global distribution, and conversion methods of solar energy to heat and power.

##### Objectives

* The characteristics and world distribution of solar radiation.
* The solar radiation and measurement techniques.
* The methods of calculation of solar radiation availability at a given location.
* The fundamentals of thermal and direct conversion of solar energy to power.

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| **UNIT I - ENERGY RESOURCES AND SOLAR SPECTRUM** | 6 | 20 |
| World energy resources - Indian energy scenario - Environmental aspects of energy utilization. Renewable energy resources and their importance - Global solar resources. Solar spectrum – Electromagnetic spectrum, basic laws of radiation. Physics of the Sun - Energy balance of the earth, energy flux, solar constant for earth, green house effect. |  |  |
| **UNIT II - SOLAR RADIATION AND MEASUREMENT** | 6 | 20 |
| Solar radiation on the earth surface - Extraterrestrial radiation characteristics, Terrestrial radiation, solar insolation, spectral energy distribution of solar radiation. Depletion of solar radiation - Absorption, scattering. Beam radiation, diffuse and Global radiation. Measurement of solar radiation – Pyranometer, Pyrheliometer, Sunshine recorder. Solar time - Local apparent time (LAT), equation of time (E). |  |  |
| **UNIT III - SOLAR RADIATION GEOMETRY AND CALCULATIONS** | 8 | 20 |
| Solar radiation geometry - Earth-Sun angles – Solar angles. Calculation of angle of incidence - Surface facing due south, horizontal, inclined surface and vertical surface. Solar day length – Sun path diagram – Shadow determination. Estimation of Sunshine hours at different places in India. Calculation of total solar radiation on horizontal and tilted surfaces. Prediction of solar radiation availability. |  |  |
| **UNIT IV - SOLAR THERMAL ENERGY CONVERSION** | 8 | 20 |
| Thermodynamic cycles – Carnot – Organic, reheat, regeneration and supercritical Rankine cycles - Brayton cycle – Stirling cycle – Binary cycles – Combined cycles. Solar thermal power plants - Parabolic trough system, distributed collector, hybrid solar-gas power plants, solar pond based electric-power plant, central tower receiver power plant. |  |  |
| **UNIT V - SOLAR ELECTRICAL ENERGY CONVERSION** | 8 | 20 |
| Solar photovoltaic energy conversion - Principles - Physics and operation of solar cells. Classification of solar PV systems, Solar cell energy conversion efficiency, I-V characteristics, effect of variation of solar insolation and temperature, losses. Solar PV power plants. |  |  |
| **TOTAL** | **36** | **100** |

**REFERENCES**

1. Foster .R, Ghassemi M., Cota A., “*Solar Energy”*, CRC Press, 2010.
2. Duffie .J.A, Beckman W.A. “*Solar Engineering of Thermal Processes”*, 3rd ed., Wiley, 2006.
3. De Vos .A, “*Thermodynamics of Solar Energy Conversion”*, Wiley-VCH, 2008.
4. Garg .H.P, Prakash .J, “*Solar Energy Fundamentals and Applications”*, Tata McGraw-Hill, 2005.
5. Kalogirou .S, “*Solar Energy Engineering”,* Processes and Systems, Elsevier, 2009.
6. Petela .R, “*Engineering Thermodynamics of Thermal Radiation for Solar Power”*, McGraw-Hill Co., 2010.
7. Yogi Goswami .D, Frank Kreith, Jan F. Kreider, “*Principles of Solar Engineering”*, Second Edition, Taylor & Francis, 2003.
8. Andrews .J, Jelley .N, “*Energy Science”*, Oxford University Press, 2010.

|  |  |
| --- | --- |
| Course Title: **Operation and Control of Power System** | Course Code : EE 603 |
| Semester : III | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: M.Tech **POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Pre-requisites:**

Power System Analysis, Control System.

**Course Objectives:**

1. Help the learner to understand optimal power system constraints
2. Understand the optimal unit commitment problem and solution
3. Learn about optimal generation scheduling
4. Learn about load frequency control
5. Learn power system security and AGC
6. Make students familiar with various techniques used for Optimal Power System operation, like Optimal Generation Scheduling, Optimal Unit Commitment, etc.

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Optimal Power System Operation** | 7 | 20 |
| System constraints. Generator operating cost. Input-Output and incremental fuel characteristics of a generating unit. Optimal operation of generators on a bus bar, algorithm and flow chart. Optimal unit commitment, constraints in unit commitment, spinning reserve, thermal and hydro constraints. |  |  |
| UNIT-2: **Unit Commitment Solution methods** | 7 | 20 |
| Priority list method and dynamic programming method. Reliability consideration, Patton’s security function, security constrained optional unit commitment, start-up considerations. |  |  |
| UNIT-3: **Optimal Generation Scheduling** | 6 | 20 |
| Development of transmission loss and incremental loss equations. Optimal generation scheduling including transmission losses, algorithm and flow chart. Optimal load flow solution. Hydrothermal coordination. |  |  |
| UNIT-4: **Load Frequency Control** | 9 | 20 |
| Control of real and reactive power of generator. Turbine speed governing system, Modelling of speed governing system. Methods of frequency control: flat frequency, flat tie line and tie line load bias control. Block diagram representation of load frequency control of an isolated system, steady state analysis, dynamic response. Introduction to Two – area load frequency control. |  |  |
| UNIT 5: **Power System Security & Automatic Generation Control** | 7 | 20 |
| Introduction to power system security, System monitoring, contingency analysis, System state classification, security control, Speed governing characteristic of a generating unit. Load sharing between parallel operating generators. Introduction to automatic generation control of an area by computer (description of block diagram). |  |  |
| **TOTAL** | **36** | **100** |

**Reference:**

1. C.L. Wadhwa, Electrical power system. New Age international publishers.
2. B.R. Gupta: Power system Analysis and Design
3. P.S. Murthy, Operation Control of Power System.

**Course outcomes:**

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

1. Student will be able to analyse various constraints of optimal power system operation
2. Solve the unit commitment problem
3. Solve the optimal generation scheduling
4. Understand the speed governing system of steam turbine and analyse steady state and dynamic response.
5. Understand power system security and AGC
6. Suggest and implement methods for various aspects of Optimal Power System operation in the Power System industry.

**Mapping Course Outcomes with Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | S | S | S | S | S | M | M | M | M | M | S |
| 2 | S | S | S | S | S | M | M | M | M | M | S |
| 3 | S | S | S | S | S | M | M | M | M | M | S |
| 4 | S | S | S | S | S | M | M | M | M | M | S |
| 5 | S | S | S | S | S | M | M | M | M | M | S |
| 6 | S | S | S | S | S | M | M | M | M | M | S |

S: Strong relationship M: Moderate relationship

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 to 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 5 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 2, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

|  |
| --- |
| **Composition of Educational Components:** |

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy) such as:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Educational Component** | **Weightage (%)** |
| 1 | Remembering and Understanding | 35 |
| 2 | Applying the knowledge acquired from the course | 25 |
| 3 | Analysis and Evaluation | 40 |

|  |  |
| --- | --- |
| Course Title: **Basic PLC – Rexroth Bosch course** | Course Code : EECP(T) |
| Semester : V | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **3:0:0** | Credits : **3 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **36** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: B.Tech **POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Theory:**

|  |  |
| --- | --- |
| **Topic and Contents** | **Hours** |
| UNIT-1: **Automation Systems** | **4.5** |
| 1. **Overview of Automation System:** What is Automation, Different devices used in Automation, Role of PLC in automation system, Scope of Automation field in present and future, Comparison between Automated and Manual Operated Systems. 2. **Overview of Switchgears**: What is a Relay and its applications, Introduction to Switching devices like Contactors, Solenoids, MCB’s, etc. Symbolic representation of different electrical & electronic components in wiring diagram. 3. **Introduction to Different Communication Protocols/Field Buses:** Ethernet, RS232, Profibus DP, Canopen, Devicenet, Sercos II & III, Modbus, Profinet, Ethercat. 4. **Different types of Signals:** Digital signal, Analog signal. 5. Overview of Limit Switches, Proximity Switches & Reed switches. | 1.5  1  1  0.5  0.5 |
| UNIT-2: **Programmable Logic Controller** | **5** |
| 1. **Introduction to PLC**: Comparison of PLC & PC, What is a PLC, How does a PLC work, Applications of PLC, Block Diagram of PLC, Processing cycle of PLC, Different types of PLC’s available in the market. 2. **Programmable Logic Controller:** Specifications of PLC, on board/Inline/Remote IO’s, Memory Allocation in PLC, what is Scan time of PLC, IO-handling capacity of different PLC, Remote connectivity in PLC, Internal Structure of PLC, Hardware Details of the PLC, Wiring and Connection Techniques, Safety Measures for handling the PLC, Diagnosis of PLC Status and other hardware connected to PLC. 3. **Network settings/Communication settings** | 2  2  1 |
| UNIT-3: **PLC Programming** | **21** |
| 1. **Introduction to PLC Software**: Overview of Software/Software at a glance, Hardware Configuration, Communication Settings for PLC. 2. **PLC Programming**: Building simple logic in PLC (AND/OR/NOT), Online & Offline Change, overview of different types of Data types in PLC programming, Standard format for addressing the variables, Standard Time formats, Rules for Declaration of Variable names, Working with Digital Signals/IO’s, Relay Logic, Difference between Function & Function Blocks, Introduction to Timer, Counters, Triggers & Flip-Flops, Exercises based on Timers, Counters, Flip Flops & Triggers, Usage of Mathematical Operators, Comparators, Conversion Operators, Multiplexers & Logical Gates in the PLC Program, Exercises based on the above operators, Compilation & Downloading the program to PLC, Trouble Shooting the PLC programming errors. Local & Global Variables, Working with Analog Signals/IO’s, developing a program for process control, Declaration in Tabular Format, Display of Address and Comments in Logic. Jump & Return Command, Commands like Run, Stop, Reset, Reset Original, Breakpoint etc., Developing User Defined Function Blocks & Functions in the PLC program, Conditional & Unconditional Calling in PLC Program, Task Configuration, Visualization, Developing user defined Data Types in PLC program, Password Management, Different Methods to take the PLC Program Backup (Source Code Download/Upload, Archive/Restore & Export/Import), Library Management, Target Settings, Running the PLC program in Simulation Mode, Master/Slave Configuration, Data Exchange between the Master & Slave PLC. | 1  20 |
| **TOTAL** | **30.5** |

|  |  |
| --- | --- |
| Course Title: **Basic PLC Lab – Rexroth Bosch course** | Course Code : EECP(L) |
| Semester : V | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : 0**:0:2** | Credits : 1 **Credit** |
| Type of course : **Practical** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | ESE : **40 Marks** |
| Programmes: B.Tech **POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Practical Lab:**

|  |  |  |
| --- | --- | --- |
|  | **Topic and Contents** | **Hours** |
|  |  |  |
| 1. | Tank filling device simulator | **1** |
| 2. | Supervise equipment | **1** |
| 3. | Pump Control | **1** |
| 4. | Selective Band Switch | **1** |
| 5. | Gate Control System | **1** |
| 6. | Star Delta Starting Up | **1** |
| 7. | Starter Control | **1** |
| 8. | Dahlander Pole Changing | **1** |
| 9. | Furnace Door Control | **1** |
| 10. | Reaction Vessel | **1** |
| 11. | Pump Control 2 | **1** |
| 12. | Roadworks Traffic Lights | **1** |
| 13. | Cleaning System | **1** |
| 14. | Buffer Store Simulation | **1** |
| 15. | Automatic Tablet Filler | **1** |
| 16. | Changing Floor | **1** |
|  | **Total** | **16** |

|  |  |
| --- | --- |
| Course Title: **Advanced PLC Lab – Rexroth Bosch course** | Course Code : EECAP(L) |
| Semester : VI | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : 0**:0:3** | Credits : **2 Credits** |
| Type of course : **Practical** | Total Contact Hours : **30** |
| Continuous Internal Evaluation : **60 Marks** | ESE : **40 Marks** |
| Programmes: B.Tech **POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Practical Lab:**

|  |  |  |
| --- | --- | --- |
|  | **Topic and Contents** | **Hours** |
|  |  |  |
| 1. | Embossing Machine | **2** |
| 2. | Bending Tool | **2** |
| 3. | Drilling Tool | **2** |
| 4. | Pipe-funding machine | **2** |
| 5. | Two-door access control system | **2** |
| 6. | Mix Equipment | **2** |
| 7. | Level Control | **2** |
| 8. | Compressed Air Network | **2** |
| 9. | **Aim:** There are 3 mixing devices on a processing line A, B, C. After the process begin mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 second after A. Mixer-C is to start 5 seconds after B. All then remain ON until a master enable switch is turned off. Write PLC ladder diagram, timing diagram and realize the same. | **2** |
| 10. | **Aim:** An indicating light is to go ON when a count reaches 23.The light is then go off when a count of 31 is reached. Design, construct, and test PLC circuits for this process. | **2** |
| 11. | **Aim:** In certain process control application when the count reaches 25, a paint spray is to run for 40 seconds. Design, construct and test PLC circuits for this process. | **2** |
| 12. | **Aim:** Three conveyors feed a main conveyor. The count from each feeder conveyor is fed into an input register in the PLC. Construct a PLC program to obtain the total count of parts on the main conveyor. Use a time to update the total every 15 seconds. Design, construct, and test PLC circuits for this process. | **2** |
| 13. | **Aim:** In certain process control application o/p is ON if the count is less than 34 or more than 41. Implement the same using PLC ladder diagram 2. | **2** |
| 14. | **Aim:** A conveyor is supposed to have exactly 45 parts on it. You have three indicating lights to indicate the conveyor count status: less than 45, yellow: exactly 45, green: and more than 45, red. The count of parts on the conveyor is set at 45 each morning by an actual count of parts. There are two sensors on the conveyor, one is actuated by parts entering the conveyor, and the other is actuated by parts leaving. Design a PLC program to carry out this process. | **2** |
| 15. | Water Level Controlling | **2** |
| 16. | A Low-cost PLC Based Automatic Liquid Filling and Sorting System | **2** |
| 17. | Modular Automated Testing Unit Sequencing And Controlling | **2** |
| 18. | Low Cost PLC based Automated Sorting and Pressing by Servo-Pneumatic Pressure Control | **2** |
| 19. | Automated Multi-storey Car-Parking System | **2** |
|  | **Total** | **38** |

|  |  |
| --- | --- |
| Course Title: **Advanced PLC & Basics of SCADA** | Course Code : EECAP(T) |
| Semester : VI | Core / Elective : **Core** |
| Teaching Scheme in Hrs (L:T:P) : **1:0:0** | Credits : **1 Credits** |
| Type of course : **Lecture** | Total Contact Hours : **12** |
| Continuous Internal Evaluation : **40 Marks** | ESE : **60 Marks** |
| Programmes: B.Tech **POWER SYSTEM + DUAL DEGREE EE + PS** | |

**Theory:**

|  |  |
| --- | --- |
| **Topic and Contents** | **Hours** |
| UNIT-1: **Introduction to HMI** | **1** |
| What is HMI, Applications or usage of HMI, Role of HMI in Automation, Interfacing HMI with different devices, Hardware Details of HMI, Technical Specifications of HMI, Wiring and Connection Techniques, Various models of HMI available in market, Editing various display options using the keys. |  |
| UNIT-2: **Programming of HMI** | **6** |
| Overview of HMI software, Hardware Configuration, Network Settings or Communication Settings, Developing Different Screens on HMI, Writing Plain Text on the screen, Developing Headers & Footers for the Screen, Configuring the function keys of HMI for screen change or for giving inputs, Linking the variables directly on the screen, Password Management (for screen change & for editing the values), Developing user defined text list, Screen Change using PLC variables, Displaying Alarm Messages on the Screen during fault, Configuring Help Screen for Troubleshooting the errors or faults, Downloading and Uploading the program to or from the HMI respectively using bus interface or USB drive. |  |
| UNIT-3: **Basics of SCADA** | **5** |
| SCADA: Introduction, Basic idea of SCADA programming, Applications of SCADA. |  |
| **Total** | **12** |

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL** **MACHINES** | Course Code :  **EE 214** |
| Semester : **IV** | Core / Elective : **Elective** |
| Teaching Scheme in Hrs (L:T:P) : **3:1:0** | Credits : **4 Credits** |
| Type of course : **Lecture + Assignments** | Total Contact Hours : **48** |
| Continuous Internal Evaluation : **40 Marks** | SEE : **60 Marks** |
| Programmes: **B.Tech Mechanical Engineering** | |

**Pre-requisites:**

Basic Electrical Engineering

**Course Objectives:**

1. Help the learner to understand basic principle and operation of energy conversion principle.
2. Understand the principle of operation of transformer.
3. Learn about different type of connection in poly-phase transformer.
4. Understand the basic principle construction, operation rotating machine
5. Make students familiar with the DC electromagnetic conversion devices, their structures and working, such that students can use them easily in the industry afterwards.
6. Understand the basic principle construction, operation performance characteristics of induction machines
7. Understand the basic principle construction, operation performance characteristics of synchronous machines

**Course Content:**

|  |  |  |
| --- | --- | --- |
| **Topic and Contents** | **Hours** | **Marks** |
| UNIT-1: **Transformer** | 10 | 20 |
| **Single Phase Transformer:** Construction, types, Principle, EMF equation, Ideal Transformer, Equivalent circuits & phasor diagrams, OC and SC tests, Sumpner’s back-to-back test, efficiency. Voltage regulation, parallel operation, autotransformers.  **Three Phase Transformer:** Single unit or bank of single-phase units, poly-phase connections, Open delta and V connections, tertiary winding |  |  |
| UNITS-2: **Basic Concepts of Rotating** **Electrical Machines** | 08 | 20 |
| Basic principles of electromechanical energy conversion. Energy balance. Construction & Principle of AC & DC Machines. Concepts of Armature & Field Winding, Concentrated & Distributed Winding. |  |  |
| UNITS-3: **DC Machines** | 10 | 20 |
| Classifications of DC Machines, EMF equation, Back EMF, types, production of torque, armature reaction and inter-poles, characteristics of shunt, series and compound Machine, DC motor starting. Speed Control of DC Motor: Armature voltage and field current control methods, Ward Leonard method. Braking, losses and efficiency. |  |  |
| UNIT-4: **Induction Motor** | 10 | 20 |
| Types: squirrel cage and slip ring induction motor, basic principles, induction motor as a transformer. Equivalent circuits, torque equation, torque-slip curves, no load and block rotor tests, Effect of rotor resistance. Cogging, Crawling. Methods of starting and speed control of squirrel cage and slip ring motor, cascade connection.  **Single-Phase Induction Motor:** Revolving field theory, starting methods, equivalent circuits. |  |  |
| UNIT 5: **Synchronous Machine** | 10 | 20 |
| **Synchronous Motor:** Excitation systems, Equation of induced emf, theory of cylindrical rotor and salient pole machines, two reactance theory, phasor diagrams, power developed, synchronization, parallel operation, hunting and its prevention, types.  **Synchronous Generator:** V-curves, starting methods, performance calculations, applications, synchronous condenser, synchronous induction motor. |  |  |
| **TOTAL** | **48** | **100** |

**Reference:**

1. P.S.Bimbhra, Electrical Machinery, 2000, Khanna publishers New Delhi.

1. J.Nagrath and D.P.Kothari, Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

2. GopalK.Dubey, Fundamental of Electrical Drives, 2001 Narosa Publishing House, New Delhi

3. Fitzrald,Kingsley and Umans Electrical Machines 2000, TATA MCGRAW HILL Publication New Delhi.

4. Advance Electrical Technologies by H.Cotton

5. Alexander S. Langsdorf, “Theory of Alternating current Machinery” Second Edition, TATA McGRAW-HILL, 1983.

**Course outcomes:**

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

1. Explain principles of electromechanical energy conversion
2. Armature reaction, commutation
3. parallel operation of generators
4. Speed Control of DC Motor: Armature voltage and field current control methods
5. Voltage regulation, effect of frequency, parallel operation of transformers
6. Use various types of DC electrical machines in the industry
7. Understand principle, construction, laying of armature and field windings, types, generation of EMF, methods of starting, steady state and transient behaviour of induction motors.
8. Understand steady state and transient behaviour, synchronization and parallel operation of synchronous machines.
9. Understand principle, construction, methods of starting of synchronous motors, steady state and transient behaviour and application of synchronous motor, its operation with variable load operation with variable excitation, performance evaluation.
10. Work on AC rotating electrical machines in industry, and will also be able to test them.

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Mid Term Test | Student | Two tests | 20 | Midterm Answer books | 1 to 5 |
| Weekly Test | Two Weekly Test | 10 | Weekly Test Copies | 1 TO 5 |
| Graded  Assignments | Two Assignments | 10 | Log of record | 1 to 4 |
| **Total** | **40** |  |  |
| ESE | End Sem Evaluation | End of the course | 60 | Answer scripts at BTE | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 5,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom’s taxonomy)

|  |  |
| --- | --- |
| Course Title: **ELECTRICAL** **MACHINES LAB** | Course Code : EE 264 |
| Semester : IV | Core / Elective : Elective |
| Teaching Scheme in Hrs (L:T:P) : **0:0:2** | Credits : **1 Credits** |
| Type of course : **Experiment + File** | Total Contact Hours : **20** |
| Continuous Internal Evaluation : **60 Marks** | SEE : **40 Marks** |
| Programmes: **B.Tech Mechanical Engineering** | |
|  | |

**Pre-requisites:**

EE 214: Electrical Machines.

**Course Objectives:**

1. Help the learner to understand basic principles, operation and design of electrical drives.
2. Understand the connection of voltmeter, ammeter and wattmeter and use of tacho-generator
3. Understand practical use of starters and speed control methods
4. Understand losses occurring at various stages
5. Impart learning about various speed control methods for DC & AC electrical machines.
6. Learn about various tests done on transformers to obtain their parameters.

**Course Content:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. No.** | **Topic and Contents** | | **Hours** | **Marks** |
|  | Speed control of D.C. shunt motor by (a) Field current control method and plot the curve for speed vs field current. (b) Armature voltage control method and plot the curve for speed vs armature voltage. | | 2 |  |
|  | Speed control of a D.C. Motor by Ward Leonard method and to plot the curve for speed vs applied armature voltage. | | 2 |  |
|  | To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency. | 2 | |  |
|  | To perform back-to-back test on two identical 1-phase transformers and find their efficiency and parameters of the equivalent circuit. | | 2 |  |
|  | To perform parallel operation of two 1-phase transformers and determine their load sharing. | | 2 |  |
|  | To perform the load test on single phase D.C. generator. | | 2 |  |
|  | To plot the O.C.C. and S.C.C. of an alternator and to determine its regulation by synchronous impedance method. | | 2 |  |
|  | To synchronize an alternator across the infinite bus (RSEB) and summarize the effects of variation of excitation on load sharing | | 2 |  |
|  | To plot the V-curve for a synchronous motor for different values of loads | | 2 |  |
|  | To perform the load test on a 3-phase induction motor and determine its performance characteristics (a) Speed vs load curve (b) pf vs load curve (c) Efficiency vs load curve (d) Speed vs torque curve | | 2 |  |
|  | **TOTAL** | | **20** |  |

**Reference:**

1. Electrical and Electronics measurements and measuring instruments. A.K.SAWHNEY – Dhanpat Rai and Sons
2. Electrical measurements and measuring instruments by Rajendra Prasad - Khanna Publishers
3. A course in Electronics and Electrical measurements and instrumentation by J.B.GUPTA - Kataria Publications
4. Electrical measurements and measuring instruments by Rajendra Prasad – Khanna Publishers

**Course outcomes:**

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

1. Student will be able to measure the AC and DC electrical quantities(voltage, current and energy)
2. Measurement of power loss in motors and find efficiency
3. Determine the parameters of its equivalent circuit its voltage regulation and efficiency of machines
4. Determine the load, speed and current characteristics
5. Perform parallel operation of transformers and DC machines
6. Work on basic transformers and DC electrical machines, and obtain their parameters and do their speed control.
7. Find out the parameters of an alternator using O.C.C., S.C.C. and V-curve.
8. Calculate the parameters of a three-phase induction motor through no-load and blocked-rotor tests, and determine its various characteristics.

**Course Objectives:**

1. To understand the starting, speed control and braking of AC rotating electrical machines.
2. To develop an ability to find heating and cooling characteristics of electric motors.
3. To learn the various tests done on transformers to find out its parameters.
4. To learn the various tests done to find out the parameters of an AC rotating electrical machine.

**Course Assessment and Evaluation:**

The Course will be delivered through lectures, class room interaction, exercises and self-study cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **What** | | **To whom** | **When/where**  **(Frequency in the course)** | **Max Marks** | **Evidence collected** | **Contributing to course outcomes** |
| **DIRECT ASSMENT** | CIE | Practical Performance | Student | 1 experiment/ week for 10 experiments | 40 | Lab Record | 1to 5 |
| Project | 1 Project in the lab | 20 | Project + Project Report | 1 to 5 |
|  | **Total** | **60** |  |  |
| ESE | End Sem Evaluation | End of the course | 40 | Viva + Final performance | 1 to 5 |
| **INDIRECT ASSESSMENT** | Student feedback | | Students | Middle of the course | -NA- | Feedback forms | 1 to 4, delivery  of the course |
| End of Course survey | | End of course | Questionnaire | 1 to 9,  Effectiveness  of delivery of  instructions  and  assessment  methods |

**CIE** – Continuous Internal Evaluation **ESE** –End Semester Examination