
Department of

**Electrical and Electronics Engineering**

# Minutes of 6th BOS Meeting

## Venue

CARD ROOM, VOC Block

Vels Institute of Science, Technology and Advanced Studies, Pallavaram Chennai – 600117

## Date &Time

20.06.2022 & 11.00am


## MINUTES OF BOARD OF STUDIES

The Board of Studies meeting for the Programme B.E– EEE, School of Engineering, VISTAS was held on 20th June 2022 at 11am in CARD room, VOC Block to discuss the **revision of UG Program Curriculum & Syllabus** of B.E EEE **for the regulation 2022** which to be followed from the academic year 2022-2023.

**Members:**

| S. No | Name of the Board Member | Designation | Institute / Industry |
|---|---|---|---|
| **Internal Members** | | | |
| 1 | **Dr.R.Krishnakumar** | Professor &Head | Department of EEE, Vels Institute of Science, Technology and Advanced Studies |
| 2 | **Dr. N. Shanmuga Sundaram** | Associate Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 3 | **Dr. K. Sasikala** | Associate Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 4 | **Mrs. A. Wisemin Lins** | Assistant Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 5 | **Mrs. B. Rubini** | Assistant Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 6 | **Dr. S. Vijayaraj** | Assistant Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| **External Expert Members** | | | |
| 1 | **Dr. S.Chandramohan,** | Professor | Department of Electrical and Electronics Engineering, College of Engineering, Guindy, Anna University, Chennai. |
| 2 | **Dr.R.Kathiravan** | Assistant Executive Engineer | Assistant Executive Engineer / CERC/TANGEDCO, 144, Anna Salai, Chennai-0 |
| **Student Member** | | | |
| 1 | **Mr. Domeson Sampath(Alumni)** | Senior Engineer | VVDN Technologies Pvt. Ltd, Chennai. |

**AGENDA OF THEMEETING**

| ItemNo. | Particulars |
|---|---|
| **BoS/2022/EEE /UG/6.1** | Review and confirm minutes of 5th BOS meeting held on 18.03.2022 |
| **BoS/2022/ EEE /UG/6.2** | To review Revision for new syllabus for B.E Electrical and Electronics Engineering from regulation 2018 to Regulation 2022 |
| **BoS/2022/ EEE /UG/6.3** | Feedback from Stakeholders to ensure that the syllabus of the courses include the state-of-the-art technologies focusing on skill development, employability, and entrepreneurship |
| **BoS/2022/ EEE /UG/6.4** | To review number of new courses for regulation 2022 |
| **BoS/2022/EEE/UG/6.5** | To review the AICTE policy for CBCS and OBE from the Academic Year 2022-2023. |

**MINUTES OF THE MEETING**

Dr.R.KrishnaKumar, Professor and Head of the department, Electrical and Electronics Engineering, Chairman, BoS started the meeting with a warm welcome and introduced the BOS members, and thanked them for accepting the invitation for the 6th BoS meeting.

**Item No:1 BoS/2022/ EEE /UG/ 6.1**

Review and confirm minutes of 5th BOS meeting held on 18.03.2022

The fifth BoS Meeting for B.E.-Electrical and Electronics Engineering under regulation 2022 was held on 16-07-2021 and confirmed the following points

- To implement the guidelines and suggestions of the new education policy
- First year Syllabi for the 2022 regulation
- Value Added Courses for Second and Third Year Students
- Admission Details
- Department Vision, Mission in line with Institute's vision and Mission

**Minutes are reviewed and confirmed**

**Item No:2 BoS/2022/ EEE /UG/ 6.2**

To review Revision for new syllabus for B.E Electrical and Electronics Engineering from regulation 2018 to Regulation 2022

- To develop the curriculum and syllabi based on the guidelines of AICTE and the principles of Outcome Based Education (OBE).
- To implement the guidelines and suggestions of the new education policy.
- To consider the Competencies and Performance Indicators of the B.E. EEE programme defined as per the recommendations of the AICTE Examination Reforms Policy.
- To enhance the Course Outcomes (CO) of all the courses by focusing on skill development, employability, and entrepreneurship.
- To consider the mapping of CO to the Program Outcomes (PO) and Programme Specific Outcomes (PSO) of all the courses using the defined Competencies and Performance Indicators.

**% of Syllabus Revision in the Program:**

**B.E-Electrical and Electronics Engineering- 26.04%**

| S. No. | Available Course | | Revised Course | | % of Syllabus Revised |
|---|---|---|---|---|---|
| | Code | Name | Code | Name | |
| 1. | 18CBEE24 | Basic Electrical Engineering | 22CBEE24 | Basic Electrical and Electronics Engineering | 40% |
| 2. | 18PBEE21 | Physics Laboratory | 22PBEE21 | Physics Laboratory | 70% |
| 3. | 18CBEE25 | Engineering Graphics And Design | 22CBEE25 | Engineering Graphics And Design | 60% |
| 4. | 18CBEE36 | Electrical Machines – I | 22CBEE36 | Electrical Machines – I | 69% |
| 5. | 18CBEE42 | Measurements and Instrumentation | 22CBEE42 | Measurements and Instrumentation | 60% |
| 6. | 18CBEE43 | Digital Electronics | 22CBEE43 | Digital Electronics | 40% |
| 7. | 18CBEE45 | Linear Integrated circuits | 22CBEE45 | Linear Integrated circuits | 32% |
| 8. | 18CBEE51 | Power Electronics | 22CBEE51 | Power Electronics | 36% |
| 9. | 18CBEE53 | Control Systems | 22CBEE52 | Control Systems | 42% |
| 10. | 18CBEE6A | Electrical and Hybrid Vehicles | 22CBEE6A | Electrical and Hybrid Vehicles | 64% |

| | | | | | |
|---|---|---|---|---|---|
| 11. | 18EBEE7C | Fundamentals of Nano science | 22EBEE7C | Fundamentals of Nano science | 40% |
| 12. | 18EBEE7D | Micro Electro Mechanical Systems | 22EBEE7D | Micro Electro Mechanical Systems | 40% |
| 13. | 18EBEE7B | Robotics and Automation | 22EBEE7B | Robotics and Automation | 40% |
| 14. | 18EBEE7F | Microprocessor Microcontroller | 22EBEE7F | Microprocessor Microcontroller | 48% |
| 15. | 18EBEE7A | Microcontroller based System Design | 22EBEE7A | Microcontroller based System Design | 40% |
| 16. | 18EBEE7E | Computational Electromagnetic | 22EBEE7E | Computational Electromagnetic | 55% |
| 17. | 18EBEE5B | Computer Architecture | 22EBEE5B | Computer Architecture | 60% |
| 18. | 18EBEE6B | Digital Control system | 22EBEE6B | Digital Control system | 40% |
| 19. | 18EBEE8A | Wind and Solar Energy System | 22EBEE8A | Wind and Solar Energy System | 31% |
| 20. | 18EBEE8C | Biomedical Instrumentation | 22EBEE8C | Biomedical Instrumentation | 36% |
| 21. | 18EBEE8B | Electric Vehicle Mechanics And Control | 22EBEE8B | Electric Vehicle Mechanics And Control | 40% |
| 22. | 18EBEE8D | Power Quality and FACTS | 22EBEE8D | Power Quality and FACTS | 47% |
| 23. | 18EBEE8E | Electrical Energy Conservation and Auditing | 22EBEE8E | Electrical Energy Conservation and Auditing | 40% |
| 24. | 18EBEE8F | PLC and Distributed Control System | 22EBEE8F | PLC and Distributed Control System | 40% |
| 25. | 18EBEE5B | Electrical Materials | 22EBEE5B | Electrical Materials | 40% |

**Minutes are reviewed and confirmed**

**Item No:3 BoS/2022/ EEE /UG/ 6.3**

Feedback from Stakeholders to ensure that the syllabus of the courses include the state-of-the-art technologies focusing on skill development, employability, and entrepreneurship.

- **Alumni:** The curriculum is well structured and the syllabus has been updated to improve the hands on knowledge. Industrial interaction can be improved and more credits can be given for Internship and Projects. The curriculum of B.E. – Electrical and Electronics Engineering, should consider more hands-on exposure to link theory along with practice.

- **Industry and Academic Experts:** Syllabus is updated with courses that include the recent technological advancements. Blended learning, Internship, MOOCs and Project based courses can improve the hands on knowledge and exposure of the students. Industry based projects and mini projects can to improve the quality of students work and give them better exposure. Value Added Courses has been introduced in collaboration with industries. This will create good placement and industrial exposure to the students of B.E EEE

The Competencies and Performance Indicators (PI) are well defined for both the programmes. The CO-PO mapping is based on Knowledge Levels and is well justified.

**Minutes are reviewed and confirmed**

**Item No:4 BoS/2022/ EEE /UG/ 6.4**

To review number of new courses for regulation 2022

**New Courses Introduced:**

| S. No | Name of the Course |
|---|---|
| 1. | Basics of Civil and Mechanical Engineering |
| 2. | Student Induction Program |
| 3. | Universal Human Values – 2 |
| 4. | Constitution of India |
| 5. | Gender Sensitivity related course |
| 6. | Power System Protection lab |
| 7. | Electrical System Design |
| 8. | Restructured Power Systems |
| 9. | Smart Grid |
| 10. | SCADA AND DCS |
| 11. | Python Programming |
| 12. | Electrical Machines-III |
| 13. | Optimization Techniques |

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|---|---|
| 14. | Project Management |
| 15. | Organizational Behaviour |
| 16. | Artificial Intelligence and Machine Learning |
| 17. | Engineering Economics |

**Item No:5 BoS/2022/ EEE /UG/ 6.5**

AICTE Examination Reforms Policy, effective from the Academic Year 2022-2023 be approved.

- Resolved that the Curriculum & Syllabus for the B.E – Electrical and Electronics Engineering programme (Regulation 2022), designed as per outcome-based education guidelines of Model Curriculum of AICTE, effective from the Academic Year 2022-2023 be approved.

- Resolved that the Curriculum & Syllabus for the B.E – Electrical and Electronics Engineering programme (Regulation 2022), designed as per outcome-based education guidelines of Model Curriculum of AICTE, effective from the Academic Year 2022-2023 be approved.

**Minutes are reviewed and confirmed**

The Board of Studies resolved to approve the above suggestions for B.E. Electrical and Electronics Engineering brought forward by the Chairman incorporating the above changes. The meeting was concluded at 12.30 pm with a vote of thanks by **Dr. R.KrishnaKumar**, Head of Department, Electrical and Electronics Engineering

| S. No | Name of the Board Member | Designation | Signature |
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VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
INSTITUTION WITH UGC 12B STATUS
*Marching Beyond 30 Years Successfully*

# B.E

# Electrical and Electronics Engineering

## Curriculum and Syllabus

(Based on Choice based credit system)
Effective from the academic year

**2022-2023**

## Department of Electrical and Electronics Engineering

## School of Engineering


**SCHOOL OF ENGINEERING**

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

## VISION

To impart quality higher education in the field of Electrical and Electronics Engineering and to create globally competent engineers with aptitude for research, innovation and entrepreneurship and prepare them to serve the industrial and societal needs.

## MISSION

| Mission No. | Mission Statements |
|---|---|
| **M1** | To fortify the students with sound technical competency by providing state of the art teaching and learning. |
| **M2** | To impart industry oriented training to enable students to meet day-to-day changes of the field. |
| **M3** | To increase the employability and entrepreneurship skills of students through personality development programmes and soft-skills training. |
| **M4** | To provide good research atmosphere that would enable students and faculties with opportunities to do research, consultancy and constructive contribution and to be of ethical value to the society. |

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

**After few years of completion of B.E Electrical and Electronics Engineering Programme, the graduates will**

| PEO No. | Program Educational Objective Statements |
|---|---|
| **PEO 1** | Demonstrate their knowledge in Analysis, Design and Configuring of Electrical, Electronics and other allied systems. |
| **PEO 2** | Keep up with technological developments, acquire software and hardware proficiency in the field of Electrical and Electronics Engineering to provide scientific solution to future challenges. |
| **PEO 3** | Upgrade the potential to pursue higher education and research in his/her professional career. |
| **PEO 4** | Possess befitting technical skills to contribute to nurturing society in the ethical, economical and environmental contexts. |

**PROGRAMME OUTCOMES (POs):**

**PO1:** **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2:** **Problem analyses:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3:** **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4:** **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5:** **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6:** **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7:** **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8:** **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9:** **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10:** **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11:** **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12:** **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

| PSO No. | Program Specific Outcome Statements |
|---|---|
| **PSO 1** | Learners can apply the knowledge acquired in the field of Electrical and Electronics Engineering to Analyze, Design, and solve problems in various systems. |
| **PSO 2** | Graduates can develop sustainable solutions for societal requirements by choosing future ready methods. |

| COMETENICES AND PERFORMANCE INDICATORS | | | |
|---|---|---|---|
| **PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.** | | | |
| 1.1 | Demonstrate competence in mathematical modelling | 1.1.1 | Apply mathematical techniques such as Calculus, Linear Algebra, Probability theory and Random process, Fourier series, Fourier Transform, Laplace Transform, and Z-Transform to solve problems. |
| | | 1.1.2 | Apply advanced mathematical techniques to model and solve Electrical and Electronics engineering problems. |
| 1.2 | Demonstrate competence in basic sciences | 1.2.1 | Apply laws of natural science to an engineering problem. |
| 1.3 | Demonstrate competence in engineering fundamentals | 1.3.1 | Apply fundamental engineering concepts to solve engineering problems |
| 1.4 | Demonstrate competence in specialized engineering knowledge to the program | 1.4.1 | Apply Electrical and Electronics engineering concepts to solve engineering problems. |
| **PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.** | | | |
| 2.1 | Demonstrate an ability to identify and formulate complex engineering problem | 2.1.1 | 2.1.1 Articulate problem statements and identify objectives |
| | | 2.1.2 | 2.1.2 Identify engineering systems, variables, and parameters to solve the problems |
| | | 2.1.3 | 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem |
| 2.2 | Demonstrate an ability to formulate a solution plan and methodology for an engineering problem | 2.2.1 | Reframe complex problems into interconnected sub-problems |
| | | 2.2.2 | Identify, assemble and evaluate information and resources. |
| | | 2.2.3 | Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions |

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| | | 2.2.4 | Compare and contrast alternative solution processes to select the best process. |
| 2.3 | Demonstrate an ability to formulate and interpret a model | 2.3.1 | Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate interms of applicability and required accuracy. |
| | | 2.3.2 | Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required. |
| 2.4 | Demonstrate an ability to execute a solution process and analyze results | 2.4.1 | Apply engineering mathematics and computations to solve mathematical models |
| | | 2.4.2 | Produce and validate results through skillful use of contemporary engineering tools and models |
| | | 2.4.3 | Identify sources of error in the solution process, and limitations of the solution. |
| | | 2.4.4 | Extract desired understanding and conclusions consistent with objectives and limitations of the analysis |
| **PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.** | | | |
| 3.1 | Demonstrate an ability to define a complex/ open- ended problem in engineering terms | 3.1.1 | Recognize that need analysis is key to good problem definition |
| | | 3.1.2 | Elicit and document, engineering requirements from stakeholders |
| | | 3.1.3 | Synthesize engineering requirements from a review of the state-of-the-art |
| | | 3.1.4 | Extract engineering requirements from relevant engineering Codes and Standards such as IEEE, JEET-Springer,Elsevier etc. |
| | | 3.1.5 | Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues |
| | | 3.1.6 | Determine design objectives, functional requirements and arrive at specifications |

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| 3.2 | Demonstrate an ability to generate a diverse set of alternative design solutions | 3.2.1 | Apply formal idea generation tools to develop multiple engineering design solutions |
| | | 3.2.2 | Build models/prototypes to develop a diverse set of design solutions |
| | | 3.2.3 | Identify suitable criteria for the evaluation of alternate design solutions |
| 3.3 | Demonstrate an ability to select an optimal design scheme for further development | 3.3.1 | Apply formal decision-making tools to select optimal engineering design solutions for further development |
| | | 3.3.2 | Consult with domain experts and stakeholders to select candidate engineering design solution for further development |
| 3.4 | Demonstrate an ability to advance an engineering design to defined end state | 3.4.1 | Refine a conceptual design into a detailed design within the existing constraints (of the resources) |
| | | 3.4.2 | Generate information through appropriate tests to improve or revise the design |
| **PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.** | | | |
| 4.1 | Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding | 4.1.1 | Define a problem, its scope and importance for purposes of investigation |
| | | 4.1.2 | Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation |
| | | 4.1.3 | Apply appropriate instrumentation and/or software tools to make measurements of physical quantities |
| | | 4.1.4 | Establish a relationship between measured data and underlying physical principles. |
| 4.2 | Demonstrate an ability to design experiments to solve open-ended problems | 4.2.1 | Design and develop an experimental approach, specify appropriate equipment and procedures |
| | | 4.2.2 | Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives |
| 4.3 | Demonstrate an ability to analyze data and reach a valid conclusion | 4.3.1 | Use appropriate procedures, tools and techniques to conduct experiments and collect data |
| | | 4.3.2 | Analyze data for trends and correlations, stating possible errors and limitations |

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| | | 4.3.3 | Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions |
| | | 4.3.4 | Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions |
| **PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.** | | | |
| 5.1 | Demonstrate an ability to identify/ create modern engineering tools, techniques and resources | 5.1.1 | Identify modern engineering tools and techniques and resources for engineering activities. |
| | | 5.1.2 | Create/adapt/modify/extend tools and techniques to solve engineering problems |
| 5.2 | Demonstrate an ability to select and apply discipline- specific tools, techniques and resources | 5.2.1 | Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs. |
| | | 5.2.2 | Demonstrate proficiency in using discipline-specific tools |
| 5.3 | Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem | 5.31 | Discuss limitations and validate tools, techniques and resources |
| | | 5.3.2 | Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use. |
| **PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.** | | | |
| 6.1 | Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare | 6.1.1 | Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level |

| | | | |
|---|---|---|---|
| 6.2 | Demonstrate an understanding of professional engineering regulations, legislation and standards | 6.2.1 | Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public |
| **PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.** | | | |
| 7.1 | Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts | 7.1.1 | Identify risks/impacts in the life-cycle of an engineering product or activity |
| | | 7.1.2 | Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability |
| 7.2 | Demonstrate an ability to apply principles of sustainable design and development | 7.2.1 | Describe management techniques for sustainable development |
| | | 7.2.2 | Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline |
| **PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.** | | | |
| 8.1 | Demonstrate an ability to recognize ethical dilemmas | 8.1.1 | Identify situations of unethical professional conduct and propose ethical alternatives |
| 8.2 | Demonstrate an ability to apply the Code of Ethics | 8.2.1 | Identify tenets of the IEEE professional code of ethics. |
| | | 8.2.2 | Examine and apply moral & ethical principles to known case studies |
| **PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.** | | | |
| 9.1 | Demonstrate an ability to form a team and define a role for each member | 9.1.1 | Recognize a variety of working and learning preferences; appreciate the value of diversity on a team |
| | | 9.1.2 | Implement the norms of practice (e.g., rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal. |
| 9.2 | Demonstrate effective individual and team operations--communication, problem-solving, conflict resolution and leadership skills | 9.2.1 | Demonstrate effective communication, problem-solving, conflict resolution and leadership skills |
| | | 9.2.2 | Treat other team members respectfully |
| | | 9.2.3 | Listen to other members |
| | | 9.2.4 | Maintain composure in difficult situations |

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|---|---|---|---|
| 9.3 | Demonstrate success ina team-based project | 9.3.1 | Present results as a team, with smooth integration of contributions from all individual efforts |
| **PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions** | | | |
| 10.1 | Demonstrate an ability to comprehend technical literature and document project work | 10.1.1 | Read, understand and interpret technical and non-technical information. |
| | | 10.1.2 | Produce clear, well-constructed, and well-supported written engineering documents. |
| | | 10.1.3 | Create flow in a document or presentation - a logical progression of ideas so that the main point is clear. |
| 10.2 | Demonstrate competence in listening, speaking, and presentation | 10.2.1 | Listen to and comprehend information, instructions, and viewpoints of others |
| | | 10.2.2 | Deliver effective oral presentations to technical and non-technical audiences |
| 10.3 | Demonstrate the ability to integrate different modes of communication | 10.3.1 | Create engineering-standard figures, reports and drawings to complement writing and presentations |
| | | 10.3.2 | Use a variety of media effectively to convey a message in a document or a presentation |
| **PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.** | | | |
| 11.1 | Demonstrate an ability to evaluate the economic and financial performance of an engineering activity | 11.1.1 | Describe various economic and financial costs/benefits of an engineering activity |
| | | 11.1.2 | Analyze different forms of financial statements to evaluate the financial status of an engineering project |
| 11.2 | Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity | 11.2.1 | Analyze and select the most appropriate proposal based on economic and financial considerations. |
| 11.3 | Demonstrate an ability to plan/manage an engineering activity within time and budget constraints | 11.3.1 | Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. |
| | | 11.3.2 | Use project management tools to schedule an engineering project, so it is completed on time and on budget. |
| **PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.** | | | |

| | | | |
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| 12.1 | Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps | 12.1.1 | Describe the rationale for the requirement for continuing professional development |
| | | 12.1.2 | Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap |
| 12.2 | Demonstrate an ability to identify changing trends in engineering knowledge and practice | 12.2.1 | Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current |
| | | 12.2.2 | Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field. |
| 12.3 | Demonstrate an ability to identify and access sources for new information | 12.3.1 | Source and comprehend technical literature and other credible sources of information |
| | | 12.3.2 | Analyze sourced technical and popular information for feasibility, viability, sustainability, etc. |
| **PSO 1:Apply the knowledge acquired in the field of Electrical and Electronics Engineering to Investigate, Analyze, Design and solve problems in various systems** | | | |
| 13.1 | Demonstrate an ability to investigate the problems in the field of electrical and electronics engineering | 13.1.1 | Apply fundamentals of electrical concepts to solve electrical and electronics engineering problems |
| | | 13.1.2 | Able to find solutions for proper functioning of circuits, systems and products. |
| 13.2 | Demonstrate an ability to analyze, design and evaluate problems in various systems | 13.2.1 | Able to locate and investigate the problem |
| | | 13.2.2 | Select and use the suitable tools and methodology for identification of the problem |
| | | 13.2.3 | Able to eliminate the problem with optimum efforts for proper functioning of circuits, systems and products |
| **PSO 2: Ability to develop sustainable solutions to complex problems in industry and society** | | | |
| 14.1 | Demonstrate an ability to develop solutions for electrical and electronics engineering problems in industrial practices | 14.1.1 | Describe the reason for choosing solutions based on engineering principles |

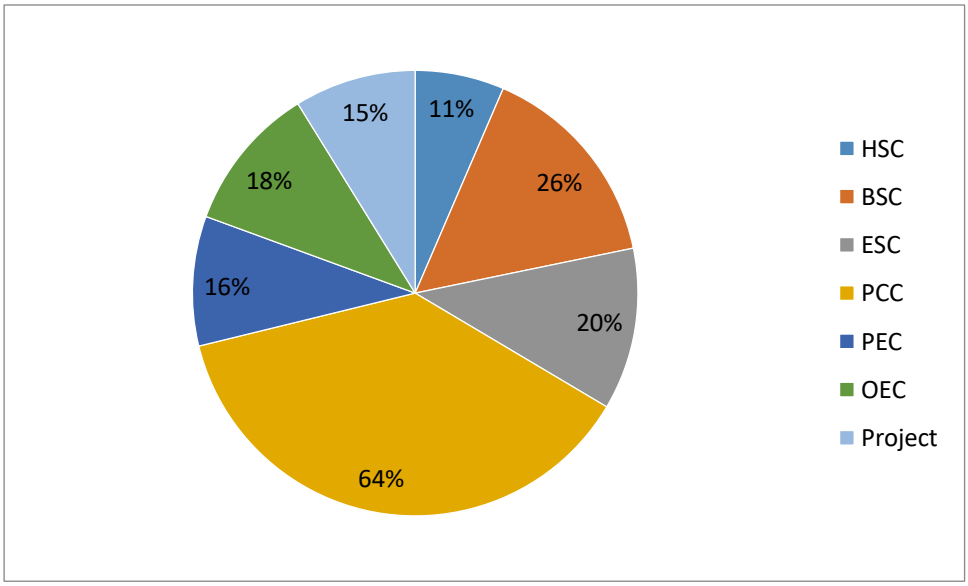
| | | | |
|---|---|---|---|
| 14.2 | Demonstrate an understanding of the impact of electrical and electronics engineering on social, environmental and in economic contexts | 14.2.1 | Design solutions for engineering problems by considering it's effect and society and environment |
| | | 14.2.2 | Recognize the economic impact of the various process and methods in designing solutions |

**BOARD OF STUDIES**

| EXTERNAL MEMBERS | | |
|---|---|---|
| **SL.NO.** | **Name & Designation** | **Name of the Institute & Address** |
| 1 | **Dr. S.Chandramohan,**<br>Professor, Department of Electrical and Electronics Engineering | Professor, Department of Electrical and Electronics Engineering, College of Engineering, Guindy, Anna University, Chennai. |
| 2 | **Dr.R.Kathiravan**, Assistant Executive Engineer | Assistant Executive Engineer / CERC/TANGEDCO, 144, Anna Salai, Chennai-02 |
| 3. | **Mr. Domeson Sampath** (Alumni),<br>Senior Engineer | VVDN Technologies Pvt. Ltd, Chennai. |
| **INTERNAL MEMBERS** | | |
| 1 | **Dr. R. Krishnakumar**,<br>Professor &Head | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 2 | **Dr. N. Shanmuga Sundaram,**<br>Associate Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 3 | **Dr. K. Sasikala**,<br>Associate Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 4. | **Dr.Vijayaraj**<br>Assistant Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |
| 5. | **Mrs. A. Wisemin Lins**,<br>Assistant Professor | Department of EEE, Vels Institute of Science, Technology and Advanced Studies. |

## CREDIT DISTRIBUTION

| S. No | Course Category | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | HSC | - | 3 | 2 | 2 | 2 | 2 | - | - | 11 |
| 2 | BSC | 8 | 8 | 4 | 6 | - | - | - | - | 26 |
| 3 | ESC | 10 | 7 | 3 | - | - | - | - | - | 20 |
| 4 | PCC | - | - | 15 | 15 | 15 | 11 | 8 | - | 64 |
| 5 | PEC | - | - | - | - | 3 | 7 | 3 | 3 | 16 |
| 6 | OEC | - | - | - | - | 3 | 3 | 6 | 6 | 18 |
| 7 | Project | - | | - | - | - | - | 5 | 10 | 15 |
| 8 | MC | - | - | - | - | - | - | - | - | - |
| | **TOTAL** | 18 | 18 | 24 | 23 | 23 | 23 | 22 | 19 | 170 |



## LIST OF ABBREVIATIONS

| Course code | Definitions |
|---|---|
| L | Lecture |
| T | Tutorial |
| P | Practical |
| C | Credits |
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| HSC | Humanities and Social Sciences including Management courses |
| PCC | Professional core courses |
| PEC | Professional Elective courses |
| OEC | Open Elective courses |
| MC | Mandatory courses |
| PROJ | Project |

**B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING**
**COURSES OF STUDY AND SCHEME OF ASSESSMENT**
**(MINIMUM CREDITS TO BE EARNED: 170 )**

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER I** | | | | | | | | |
| 22CBEE11 | Chemistry | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE12 | Mathematics – I (Calculus and Differential Equations) | 3 | 1 | - | 4 | 40 | 60 | 100 |
| 22CBEE13 | Programming for Problem solving | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE14 | Basics of civil and Mechanical Engineering | 3 | - | - | 3 | 40 | 60 | 100 |
| 22PBEE13 | Workshop/Manufacturing Practices | 1 | - | 4 | 3 | 40 | 60 | 100 |
| 22PBEE11 | Chemistry Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE12 | Programming for problem solving Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22_____ | Student Induction Program | - | - | - | - | - | - | - |
| 22PBEE14 | Universal Human Values- Understanding harmony | 2 | - | - | - | - | - | 100 |
| **Total** | | **15** | **1** | **8** | **18** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER II** | | | | | | | | |
| 18CBEE21 | English | 2 | - | - | 2 | 40 | 60 | 100 |
| 22CBEE22 | Physics ( Waves and Optics and introduction to quantum mechanics) | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE23 | Mathematics II (Linear Algebra, Transform, Calculus and Numerical Methods) | 3 | 1 | - | 4 | 40 | 60 | 100 |
| 22CBEE24 | Basic Electrical and Electronics Engineering | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE25 | Engineering Graphics and Design | 1 | - | 4 | 3 | 40 | 60 | 100 |
| 22PBEE23 | English Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE21 | Physics Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE22 | Basic Electrical and Electronics Engineering Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE24 | Constitution of India | 2 | - | - | - | | | 100 |
| **Total** | | **14** | **1** | **10** | **18** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER III** | | | | | | | | |
| 22CBEE31 | Mathematics III (Fourier series and transforms) | 3 | 1 | - | 4 | 40 | 60 | 100 |
| 22CBEE33 | Engineering Mechanics | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE35 | Analog Electronics | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE34 | Electric Circuit Analysis | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE36 | Electrical Machines-I | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE32 | Electromagnetic Theory | 3 | - | 2 | 4 | 40 | 60 | 100 |
| 22PBEE32 | Electric Circuits Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE31 | Electrical Machines-I Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22SUPD31 | Personality Development I | 2 | - | - | 2 | 40 | 60 | 100 |
| 22SUPD31 | Basic life skills | 2 | - | - | - | | | 100 |
| **Total** | | **22** | **1** | **6** | **24** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER IV** | | | | | | | | |
| 22CBEE41 | Mathematics IV (Probability and Statistics) | 3 | 0 | - | 3 | 40 | 60 | 100 |
| 22CBEE42 | Measurement and Instrumentation | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE43 | Digital Electronics | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE44 | Electrical Machines-II | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE45 | Linear Integrated Circuits | 3 | - | 2 | 4 | 40 | 60 | 100 |
| 22PBEE41 | Analog and Digital Electronics Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE42 | Electrical Machines-II Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22SUPD41 | Personality Development II | 2 | - | - | 2 | 40 | 60 | 100 |
| 22CBEE46 | Environmental Science and Engineering | 3 | - | - | 3 | 40 | 60 | 100 |
| 22_____ | Gender Institution and society | 2 | - | - | - | | | 100 |
| **Total** | | **22** | **0** | **6** | **23** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER V** | | | | | | | | |
| 22CBEE51 | Power Electronics | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE52 | Control Systems | 3 | 1 | - | 4 | 40 | 60 | 100 |
| 22_____ | Professional Elective – I | 3 | - | - | 3 | 40 | 60 | 100 |
| 22_____ | Open Elective – I | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE53 | Transmission and Distribution | 3 | - | 2 | 4 | 40 | 60 | 100 |
| 22PBEE51 | Measurements and Control System Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE52 | Power Electronics laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22SUPD51 | Personality Development III | 2 | - | 0 | 2 | 40 | 60 | 100 |
| | Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra /Mathworks) - Minimum 4 weeks | - | - | 4 | 2 | | | 100 |
| **Total** | | **17** | **1** | **10** | **23** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER VI** | | | | | | | | |
| 22CBEE61 | Power System Analysis | 3 | 1 | - | 4 | 40 | 60 | 100 |
| 22CBEE6A | Professional Elective – II | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE6B | Professional Elective – III | 3 | - | 2 | 4 | 40 | 60 | 100 |
| 22EBEE6C | Open Elective – II | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE62 | Solid State Drives | 3 | - | - | 3 | 40 | 60 | 100 |
| 22PBEE61 | Electrical Drives Lab | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE62 | Power Systems Laboratory | - | - | 2 | 1 | 40 | 60 | 100 |
| 22SUPD61 | Personality Development - IV | 2 | - | - | 2 | 40 | 60 | 100 |
| 22IBEE61 | Summer Internship (4 weeks) | - | - | 4 | 2 | | | 100 |
| **Total** | | **17** | **1** | **10** | **23** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER VII** | | | | | | | | |
| 22_____ | Open Elective – III | 3 | - | - | 3 | 40 | 60 | 100 |
| 22_____ | Open Elective – IV | 3 | - | - | 3 | 40 | 60 | 100 |
| 22_____ | Professional Elective– IV | 3 | - | - | 3 | 40 | 60 | 100 |
| 22CBEE71 | Special Electrical Machines | 3 | - | - | 3 | 40 | 60 | 100 |
| 22EBEE7F | Microprocessor Microcontroller | 3 | - | - | 3 | 40 | 60 | 100 |
| 22PBEE71 | Power System Protection lab | - | - | 2 | 1 | 40 | 60 | 100 |
| 22PBEE72 | Microprocessor Microcontroller Lab | - | - | 2 | 1 | 40 | 60 | 100 |
| 22RBEE71 | Project Phase I | - | - | 8 | 5 | 40 | 60 | 100 |
| **Total** | | **15** | **-** | **12** | **22** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER VIII** | | | | | | | | |
| 22_____ | Professional Elective– V | 3 | - | - | 3 | 40 | 60 | 100 |
| 22_____ | Open Elective – V | 3 | - | - | 3 | 40 | 60 | 100 |
| 22_____ | Open Elective – VI | 3 | - | - | 3 | 40 | 60 | 100 |
| 22RBEE81 | Project Phase II | - | - | 20 | 10 | 40 | 60 | 100 |
| **Total** | | **9** | **-** | **20** | **19** | | | |

**CA - Continuous Assessment, SEE - Semester End Examination**

Total Credits: 170

## LIST OF COURSES

### Basic Science Courses

| Code No | Course | Hours/Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| BSC-01 | Chemistry | 3 | 1 | - | 3 |
| BSC-02 | Mathematics – I (Calculus and Differential Equations) | 3 | 1 | - | 4 |
| BSC-03 | Chemistry Laboratory | - | - | 4 | 1 |
| BSC-04 | Physics (Waves and Optics, and Introduction to Quantum Mechanics) | 3 | 1 | - | 3 |
| BSC-05 | Mathematics – II (Linear Algebra, Transform Calculus and Numerical Methods) | 3 | 1 | - | 4 |
| BSC-06 | Physics Laboratory | - | - | 4 | 1 |
| BSC-07 | Mathematics – III (Fourier Series and Transforms) | 3 | 1 | - | 4 |
| BSC-08 | Mathematics – IV (Probability and Statistics) | 3 | 0 | - | 3 |
| BSC-09 | Environmental Science and Engineering | 3 | - | - | 3 |

### Humanities and Social Sciences Including Management

| Code No | Course | Hours/Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| HSC-01 | English | 2 | - | - | 2 |
| HSC-02 | English Laboratory | - | - | 2 | 1 |
| HSC-03 | Personality Development I | 2 | - | - | 2 |
| HSC-04 | Personality Development II | 2 | - | - | 2 |
| HSC-05 | Personality Development III | 2 | - | - | 2 |
| HSC-06 | Personality Development IV | 2 | - | - | 2 |

## Engineering Science Courses

| Code No | Course | Hours/Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| ESC-01 | Programming for Problem Solving | 3 | - | - | 3 |
| ESC-02 | Programming for Problem Solving Laboratory | - | - | 4 | 1 |
| ESC-03 | Basic civil and Mechanical Engineering | 3 | - | - | 3 |
| ESC-04 | Workshop/Manufacturing Practices | 1 | - | 4 | 3 |
| ESC-05 | Engineering Graphics and Design | 1 | - | 4 | 3 |
| ESC-06 | Basic Electrical and Electronics Engineering | 3 | 1 | - | 3 |
| ESC-07 | Basic Electrical and Electronics Engineering Laboratory | - | - | 2 | 1 |
| ESC-08 | Engineering Mechanics | 3 | - | - | 3 |

## Professional Core Courses

| Code No | Course | Hours/Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| PCC-01 | Electrical Circuit Analysis | 3 | - | - | 3 |
| PCC-02 | Analog Electronics | 3 | - | - | 3 |
| PCC-03 | Electrical Machines – I | 3 | - | - | 3 |
| PCC-04 | Electromagnetic Theory | 3 | 1 | - | 4 |
| PCC-05 | Electric Circuits Laboratory | - | - | 3 | 1 |
| PCC-06 | Electrical Machines- I Laboratory | - | - | 3 | 1 |
| PCC-07 | Measurements and Instrumentation | 3 | - | - | 3 |
| PCC-08 | Digital Electronics | 3 | - | - | 3 |
| PCC-09 | Electrical Machines – II | 3 | - | - | 3 |
| PCC-10 | Linear Integrated Circuits | 3 | 1 | - | 4 |
| PCC-11 | Analog and Digital Electronics laboratory | - | - | 3 | 1 |
| PCC-12 | Electrical Machines – II | - | - | 3 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| | Laboratory | | | | |
| PCC-13 | Power Electronics | 3 | - | - | 3 |
| PCC-14 | Control Systems | 3 | 1 | - | 4 |
| PCC-15 | Transmission and Distribution | 3 | 1 | - | 4 |
| PCC-16 | Measurements and Control Systems Laboratory | 3 | - | - | 1 |
| PCC-17 | Power Electronics Laboratory | - | - | 3 | 1 |
| PCC-18 | Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/Mathworks) - Minimum 4 weeks | - | - | 4 | 2 |
| PCC-19 | Power System Analysis | 3 | - | - | 4 |
| PCC-20 | Solid State Drives | 3 | - | - | 3 |
| PCC-21 | Electrical Drives laboratory | - | - | 2 | 1 |
| PCC-22 | Power Systems Laboratory | - | - | 2 | 1 |
| PCC-23 | Summer Internship | - | - | 4 | 2 |
| PCC-24 | Special Electrical Machines | - | - | 2 | 3 |
| PCC-25 | Power System Protection laboratory | - | - | 2 | 1 |
| PCC-26 | Microprocessor Microcontroller | 3 | - | - | 3 |
| PCC-27 | Microprocessor Microcontroller Lab | - | - | 2 | 1 |

**PROFESSIONAL ELECTIVES**

| | SEMSESTER-V(ELECTIVE-I) | | | | |
|---|---|---|---|---|---|
| **COURSE CODE** | **Course** | **Lecture** | **Tutorial** | **Practical** | **Credits** |
| PEC-01 | Electrical Machine Design | 3 | - | - | 3 |
| PEC-02 | Power plant Engineering | 3 | - | - | 3 |
| PEC-03 | Computer Architecture | 3 | - | - | 3 |
| PEC-04 | Computational Electromagnetic | 3 | - | - | 3 |

| | SEMSESTER-VI (ELECTIVE-II) | | | | |
|---|---|---|---|---|---|
| | **Course** | **Lecture** | **Tutorial** | **Practical** | **Credits** |
| PEC-05 | Power System Protection and Switch Gear | 3 | - | - | 3 |
| PEC-06 | Electrical and Hybrid Vehicles | 3 | - | - | 3 |
| PEC-07 | Digital Control Systems | 3 | - | - | 3 |
| PEC-08 | Control Systems Design | 3 | - | - | 3 |
| PEC-09 | Advanced control systems | 3 | - | - | 3 |

| | SEMSESTER-VI (ELECTIVE-III) | | | | |
|---|---|---|---|---|---|
| | **Course** | **Lecture** | **Tutorial** | **Practical** | **Credits** |
| PEC-10 | Power Quality and FACTS | 3 | - | - | 3 |
| PEC-11 | Wind and Solar Energy Systems | 3 | - | - | 3 |
| PEC-12 | Computer aided Power system Analysis | 3 | - | - | 3 |
| PEC-13 | Power Electronics for renewable energy system | 3 | - | - | 3 |

| | SEMSESTER-VII (ELECTIVE-IV) | | | | |
|---|---|---|---|---|---|
| | **Course** | **Lecture** | **Tutorial** | **Practical** | **Credits** |
| PEC-14 | Smart Grid | 3 | - | - | 3 |
| PEC-15 | Power System Operation and Control | 3 | - | - | 3 |
| PEC-16 | High Voltage Engineering | 3 | - | - | 3 |
| PEC-17 | Power System Dynamics and Control | 3 | - | - | 3 |
| PEC-18 | Electrical System Design | 3 | - | - | 3 |

| | SEMSESTER-VIII (ELECTIVE-V) | | | | |
|---|---|---|---|---|---|
| | **Course** | **Lecture** | **Tutorial** | **Practical** | **Credits** |
| PEC-19 | HVDC Transmission Systems | 3 | - | - | 3 |
| PEC-20 | Electrical Energy Conservation and Auditing | 3 | - | - | 3 |
| PEC-21 | Industrial Electrical Systems | 3 | - | - | 3 |
| PEC-22 | Biomedical Instrumentation | 3 | - | - | 3 |
| PEC-23 | Restructured Power Systems | 3 | - | - | 3 |
| PEC-24 | SCADA AND DCS | | | | |

**OPEN ELECTIVES**

| | Course | Lecture | Tutorial | Practical | Credits |
|---|---|---|---|---|---|
| OEC-01 | Electrical Machines-III | 3 | - | - | 3 |
| OEC-02 | Electrical Materials | 3 | - | - | 3 |
| OEC-03 | Fundamentals of nano science | 3 | - | - | 3 |
| OEC-04 | Micro Electro Mechanical System | 3 | - | - | 3 |
| OEC-05 | Electric Vehicle Mechanics and Control | 3 | - | - | 3 |
| OEC-06 | Optimization Techniques | 3 | - | - | 3 |
| OEC-07 | Principles of management and professional ethics | 3 | - | - | 3 |
| OEC-08 | Project Management | 3 | - | - | 3 |
| OEC-09 | Organizational Behaviour | 3 | - | - | 3 |
| OEC-10 | Robotics and Automation | 3 | - | - | 3 |
| OEC-11 | Microcontroller based System Design | 3 | - | - | 3 |
| OEC-12 | Total Quality Management | 3 | - | - | 3 |
| OEC-13 | PLC and distributed Control Systems | 3 | - | - | 3 |
| OEC-14 | Engineering Economics | 3 | - | - | 3 |
| OEC-15 | Artificial Intelligence And Machine Learning | 3 | - | - | 3 |

**Mandatory Courses**

| Code No | Course | Hours/Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| MC-01 | Student Induction Program | - | - | - | - |
| MC-02 | Universal Human Values | 2 | - | - | - |
| MC-03 | Constitution of India | 2 | - | - | - |
| MC-04 | Basic life skills | 2 | - | - | - |
| MC-05 | Gender sensitivity Related course | 2 | - | - | - |

**Project Work**

| Code No | Course | Hours/Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| Project | Project Phase I | - | - | 8 | 5 |
| Project | Project Phase II | - | - | 20 | 10 |

| Course code | Definitions |
|---|---|
| L | Lecture |
| T | Tutorial |
| P | Practical |
| C | Credits |
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| HSC | Humanities and Social Sciences including Management courses |
| PCC | Professional core courses |
| PEC | Professional Elective courses |
| OEC | Open Elective courses |
| MC | Mandatory courses |
| PROJ | Project |

# SEMESTER I

| BSC-01 | CHEMISTRY | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To learn about the molecular orbital's, ionic interactions and periodic properties.
- Rationalize periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity.
- List major chemical reactions that are used in the synthesis of molecules.

**UNIT I ATOMIC AND MOLECULAR STRUCTURE, INTERMOLECULAR FORCES AND POTENTIAL ENERGY SURFACES** **9 hours**

Molecular orbitals of diatomic molecules and plots of the multicentre orbital's. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene, benzene and aromaticity. Valence Bond Theory and the energy level diagrams for transition metal ions and their magnetic properties. Ionic, dipolar and van Der Waals interactions, potential energy surfaces of H3, H2F and HCN.

**UNIT II SPECTROSCOPIC TECHNIQUES AND APPLICATIONS** **9 hours**

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational, rotational spectroscopy of diatomic molecules, Morse equations and Mossbauer spectroscopy. Applications. Diffraction and scattering

**UNIT III USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA** **9 hours**

Thermodynamic functions: energy, entropy , free energy and fugacity. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

**UNIT IV PERIODIC PROPERTIES** **9 hours**

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, diagonal relationship, anomalous behaviour of Lithium, carbon and Nitrogen, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

**UNIT V ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE** **9 hours**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, Coupling reaction and ring openings. Synthesis of a commonly used drug molecule.

**TOTAL : --45 hours**

**TEXT BOOKS:**


T1: Benjamin C. Kuo, "Automatic Control Systems", 7th edition PHI Learning Private Ltd, 2010. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
T2: Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
T3: Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.


**REFERENCE BOOKS:**


R1: Physical Chemistry, by P. W. Atkins
R2: Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp.
R3: University chemistry, by B. H. Mahan.

**WEB LINKS:**

1. https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/
2. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
3. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Thermodynamics/Chemical_Energetics/Free_Energy_and_Equilibrium
4. https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Descriptive_Chemistry/Periodic_Trends_of_Elemental_Properties/Periodic_Properties_of_the_Elements
5. https://www.bcebhagalpur.ac.in/wp-content/uploads/2020/03/Organic-Reactions-Synthesis-of-Drug-Molecule.pdf

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. | K4 |
| CO2: | Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques. | K4 |
| CO3: | Analyze bulk properties and processes using thermodynamic considerations. | K4 |
| CO4: | Classify the properties and reactivity of different types of elements based on the periodic table. | K4 |
| CO5: | Apply the basic terms involved in an Organic reactions and synthesis of a drug molecule | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | 2 | 1 | - | 1 | - | 1 | 1 | - | 1 | 2 | - |
| **CO2** | - | 2 | 1 | 1 | 1 | - | - | - | 1 | - | - | - | - | - |
| **CO3** | - | 1 | 1 | 1 | - | - | - | - | - | 1 | - | - | - | - |
| **CO4** | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | 1 |
| **CO5** | - | 1 | - | 1 | - | - | 1 | - | - | - | - | - | - | 1 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | ✓ | |

| BSC-02 | MATHEMATICS-I (CALCULUS AND DIFFERENTIAL EQUATIONS) | 3 | 1 | 0 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- Explain the prospective engineers about the techniques in calculus and Differential equations
- Build the student towards tackling more advanced level of multivariable calculus and applications.

**UNIT I CALCULUS 12 hours**

Evolutes and involutes; Beta and Gamma functions and their properties; Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule

**UNIT II SEQUENCES AND SERIES 12 hours**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions

**UNIT III MULTIVARIABLE CALCULUS: DIFFERENTIATION 12 hours**

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

**UNIT IV MULTIVARIABLE CALCULUS: INTEGRATION 12 hours**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar)-Theorems of Green, Gauss and Stokes (statement only)

**UNIT V ORDINARY DIFFERENTIAL EQUATIONS 12 hours**

Differential equation of first order and Higher degree- equations solvable for p, solvable for x, solvable for y and Clairaut's type- Second order linear differential equations with constant and variable coefficients, method of variation of parameters.

**TOTAL : --60 hours**

**TEXT BOOKS:**


T1: G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition,Pearson, Reprint, 2002.

T2: Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,


**REFERENCE BOOKS:**


R1: Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
R2: Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
R3: D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
R4: N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

R5: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.


**WEB LINKS:**

1. https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Apply Rolle's Theorem that is fundamental to application of analysis to Engineering problems. | K3 |
| CO2: | Develop the tool of power series for learning advanced Engineering Mathematics | K3 |
| CO3: | Make Use of differential calculus to Notions of curvature and to improper integrals. | K3 |
| CO4: | Examine functions of several variables that is essential in most branches of engineering. | K4 |
| CO5: | Determine the essential tool of differential equations in engineering. | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 1 | 2 | - | - | - | 2 | 3 | 1 | - | 3 | 2 |
| **CO2** | 2 | 3 | 2 | 1 | 3 | - | - | - | 2 | 3 | 1 | - | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 1 | 3 | - | - | - | 2 | 3 | 1 | - | 3 | 2 |
| **CO4** | 2 | 3 | 2 | 1 | 3 | - | - | - | 2 | 3 | 1 | - | 3 | 2 |
| **CO5** | 2 | 2 | 1 | 1 | 3 | - | - | - | 2 | 3 | 1 | - | 3 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| ESC-01 | PROGRAMMING FOR PROBLEM SOLVING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the basic concepts of programming – Flow chart, Pseudocode.
- To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations.
- To understand the concepts of arrays, basic sorting and searching algorithms.
- To find the order of time complexity of basic algorithms

**UNIT I INTRODUCTION TO PROGRAMMING 9 hours**

Introduction to Programming (Flow chart/pseudo code, compilation etc.), Variables (including data types), Input / Output - Arithmetic expressions and precedence, Conditional Branching and Loops - Writing and evaluation of conditionals and consequent branching - Iteration and loops

**UNIT II ARRAYS AND BASIC ALGORITHMS 9 hours**

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, Finding roots of equations, Notion of order of time complexity through example programs

**UNIT III FUNCTIONS AND POINTERS 9 hours**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers - Defining pointers, Use of Pointers in self-referential structures

**UNIT IV STRUCTURES AND UNIONS 9 hours**

Structures - Defining structures and Array of Structures, Structures containing Pointers, Unions - Storage classes: auto, static, extern, register – Dynamic memory allocation

**UNIT V STRING FUNCTIONS AND FILES 9 hours**

Strings - library string functions, pointers in strings, pointers and function arguments, Files - file Operations, processing a file, Preprocessor directives, use of typedef, Command line arguments, Enumerated data types.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill
T2: Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill


**REFERENCE BOOKS:**


R1: Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, PrenticeHall of India
R2: YashavantKanetkar, “Let Us C”, BPB Publications
R3: Ashok.N.Kamthane, “Computer Programming”, Pearson Education (India)


**WEB LINKS:**

. https://www.edx.org/course/c-programming-getting-started

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Construct a pictorial representation with a stepwise procedure for solving complex problems | K3 |
| CO2: | Develop a high level programming code using c languages | K3 |
| CO3: | Evaluate the various functional operations for solving problem. | K5 |
| CO4: | Make use of various c operations like array, pointer, strings and searching method | K3 |
| CO5: | Develop a C module for a given set of instruction. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | 3 | 2 | 1 | 3 | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO5** | 2 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | ✓ | |

| ESC-03 | BASIC CIVIL AND MECHANICAL ENGINEERING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To provide the students an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs.
- To help students acquire knowledge in the basics of surveying and the materials used for Construction.
- To provide an insight to the essentials of components of a building and the infrastructure Facilities.
- To explain the component of power plant units and detailed explanation to IC engines their Working principles.
- To explain the Refrigeration & Air-conditioning system.

**UNIT I PART A: OVERVIEW OF CIVIL ENGINEERING 5 hours**

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings

**UNIT I PART B : OVERVIEW OF MECHANICAL ENGINEERING 4 hours**

Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only)

**UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 9 hours**

Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only)

**UNIT III BUILDING COMPONENTS AND INFRASTRUCTURE 9 hours**

Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering. Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management - Introduction to Highways and Railways - Introduction to Green Buildings.

**UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9 hours**

Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants- Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of Boilers-Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps, Concept of hybrid engines. Industrial safety practices and protective devices

**UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM**

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Properties of air - water mixture, concepts of psychometric and its process.

**TOTAL : --45 hours**

**TEXT BOOKS:**

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018

**REFERENCE BOOKS:**

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.
2. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd, 2013.
3. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
4. Shantha Kumar SRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.

**Web Links:**

5. https://nptel.ac.in/courses/105106201
6. https://geekztrainerblog.wordpress.com/basic-civil-and-mechanical-engineering/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1 | Understanding profession of Civil and Mechanical engineering. | K2 |
| CO2 | Summarise the planning of building, infrastructure and working of Machineries. | K2 |
| CO3 | Apply the knowledge gained in respective discipline | K3 |
| CO4 | Illustrate the ideas of Civil and Mechanical Engineering applications. | K2 |
| CO5 | Appraise the material, Structures, machines and energy. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 1 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 1 |
| **CO2** | 1 | 2 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 1 | 2 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 1 | 2 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 |
| **CO5** | 2 | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | | ✓ | | ✓ | |

| ESC-04 | WORKSHOP / MANUFACTURING PRACTICES LABORATORY | 1 | 0 | 4 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
- To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

## LIST OF EXPERIMENTS

### MECHANICAL ENGINEERING PRACTICE

**1. Welding**

To make single V, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

**2. Basic Machining**

To make Simple Turning and Taper turning in the lathe.

**3. Fitting Work**

To make square, hexagonal, V joint in bench fitting as per the given dimensions and Tolerances.

**4. Sheet Metal Work**

To make simple Cubical blocks, Rectangular trays in sheet metal with the jigs as per the given dimensions.

### CIVIL ENGINEERING PRACTICE

**1. Buildings**

a. Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**2. Plumbing Works**

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

### ELECTRICAL & ELECTRONICS

1. To make fluorescent lamp wiring.
2. To make stair case wiring.
3. To make residential wiring.
4. To measure Peak-peak, rms, period, frequency using CRO.
5. To solder components devices and circuits by using general purpose PCB.

**TOTAL: 45 hours**

**TEXT BOOKS:**


**T1:** Jeyachandran K., Natarajan S. & Balasubramanian S., A Primer on Engineering Practices Laboratory, Anuradha Publications, 2007.

**T2:** Jeyapoovan T., Saravanapandian M. & Pranitha S., Engineering Practices Lab Manual, Vikas Publishing House Pvt.Ltd, 2006.

**T3:** Bawa H.S., Workshop Practice, Tata McGraw, 2007.

**REFERENCES:**

**R1:** Rajendra Prasad A. &Sarma P.M.M.S., Workshop Practice, Sree Sai Publication, 2002.

**WEBLINKS:**

**W1:** http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3783

**W2:** https://www.slideshare.net/jeandedieuiyakaremye3/workshop-practice-ii-lecture-notes

**COURSE OUTCOMES:**

| | | |
|---|---|---|
| **CO1** | Experiment with facing, Turning and various types of fitting joint | **K 1** |
| **CO2** | Develop the half lap joint, TEE Lap joint carpentry and welding. | **K 5** |
| **CO3** | Practice casting, moulding, & smithy trades | **K 2** |
| **CO4** | Developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering | **K 5** |
| **CO5** | Make a Basic pipe connections for Mixed pipe material connection and Pipe connections with different joining components | **K 1** |

**MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 3 | 1 | 2 | - | 2 | - | 2 | - | 1 | 2 | 1 | 2 |
| **CO2** | 3 | 1 | 3 | 1 | 3 | - | 2 | - | 2 | - | 1 | 2 | 2 | 2 |
| **CO3** | 3 | 1 | 3 | 1 | 2 | - | 2 | - | 3 | - | 1 | 2 | 1 | 1 |
| **CO4** | 3 | 1 | 2 | 1 | 2 | - | 2 | - | 2 | - | 1 | 2 | 1 | 1 |
| **CO5** | 3 | 1 | 3 | 1 | 2 | - | 2 | - | 1 | - | 1 | 2 | 2 | 2 |
| | 3 | 1 | 2.8 | 1 | 2.2 | - | 2 | - | 2 | - | 1 | 2 | 1.4 | 1.6 |

**ASSESSMENT METHODS**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Observation** | **Record** |
|---|---|---|---|---|---|
| | | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Viva** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | ✓ | ✓ | |

| BSC-03 | CHEMISTRY LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.
- The students will learn to:

  •Estimate rate constants of reactions from concentration of reactants/products as a function of time.

  •Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc

  •Synthesize a small drug molecule.

**Any Eight Experiments**

1. Determination of the rate constant of a reaction.
2. Determination of the partition coefficient of a substance between two immiscible liquids.
3. Determination of surface tension and viscosity.
4. Thin layer chromatography.
5. Determination of chloride content in water.
6. Determination of cell constant and conductance of solutions.
7. Synthesis of a polymer/drug.
8. Determination of saponification / acid value of an oil.
9. Determination of redox potentials and emf by Potentiometric method.
10. Estimate the adsorption of acetic acid by charcoal.

**TEXT BOOKS:**


T1: S. Sundaram and K. Raghavan “Practical Chemistry”, S. Viswanathan. Co. 3rd edition 2011.
T2: Gnanaprakasam, Ramamurthy, “Organic Chemistry Lab Manual” S. Viswanathan Pvt. Ltd. 3rd edition 2011.


**REFERENCE BOOKS:**


R1: Vogel’s – “Textbook of qualitative organic Analysis”, Longmann, 12th edition, 2011
R2: J. N. Gurtu and R. Kapoor “Advanced experimental Chemistry”, S. Chand and Co. 6th edition, 2010.


**WEB LINKS:**

1. https://www.khanacademy.org/science/ap-chemistry beta/x2eef969c74e0d802:kinetics/x2eef969c74e0d802:introduction-to-rate-law/v/experimental-determination-of-rate-laws
2. https://www.youtube.com/watch?v=qdmKGskCyh8
3. https://www.youtube.com/watch?v=7_6_dKlo67k

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Estimate the rate constants of reactions and partition coefficient of immiscible liquids. | K5 |
| CO2: | Find the viscosity and to test the purity of the compound. | K3 |
| CO3: | Estimate the amount of chlorine content present in drinking water and to know the conductance of a solution. | K5 |
| CO4: | Develop a small drug molecule and to know the saponification of an oil. | K3 |
| CO5: | Find out the unknown element by Potentiometric method and to remove some of the toxic chemical by charcoal method. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 1 | 1 | 3 | 2 | 1 | 1 | - | - | - | - | - | 3 | 3 |
| **CO2** | - | 1 | 1 | 3 | - | - | - | - | - | - | - | - | 1 | - |
| **CO3** | - | 1 | 1 | 3 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 |
| **CO4** | - | 1 | 1 | 3 | - | - | - | - | - | - | - | - | 1 | - |
| **CO5** | - | 1 | 1 | 3 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Observation** | **Record** |
|---|---|---|---|---|---|
| | | ✓ | ✓ | ✓ | ✓ |
| **MCQ** | **Projects** | **Viva** | **Demonstration / Presentation** | | |
| | | ✓ | ✓ | | |

| ESC-02 | PROGRAMMING FOR PROBLEM SOLVING LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- To design and develop C Programs for various applications

**Any Eight Experiments**

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems
7. String operations
8. Simple functions
9. Solving Numerical methods problems
10. Recursive functions
11. Pointers and structures
12. File operations

**TEXT BOOKS:**


T1: Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill, 4 th Edition, 2018.

T2: T2: E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill. 3 rd Edition, 2015.


REFERENCE BOOKS:


R1: Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”,Prentice Hall of India

R2: Yashavant Kanetkar, “Let Us C”, BPB Publications, BPB Publications, 18 th edition,2021.

R3: Ashok. N.Kamthane, “Computer Programming”, Pearson Education India, 3 rd edition, 2015.


**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Determine the advanced features of the C language | K5 |
| CO2: | Develop the model data using primitive and structured types. | K5 |
| CO3: | Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files. | K4 |
| CO4: | Develops the ability to analyze a problem, develop an algorithm to solve it. | K5 |
| CO5: | Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general. | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | 2 | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | 3 |
| **CO3** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 2 |
| **CO4** | 2 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 2 |
| **CO5** | 2 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | 3 | 1 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Observation** | **Record** |
|---|---|---|---|---|---|
| | | ✓ | ✓ | ✓ | ✓ |
| **MCQ** | **Projects** | **Viva** | **Demonstration / Presentation** | | |
| | | ✓ | ✓ | | |

| MC-02 | UNIVERSAL HUMAN VALUES : UNDERSTANDING HARMONY | 2 | 0 | 0 | 0 |
|---|---|---|---|---|---|

**Course Objectives**

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act

**UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 6 hours**

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

**UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF 6 hours**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity indetail, Programsto ensure Sanyam and Health

**UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP 6 hours**

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha )- from family to worldfamily!.

**UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE 6 hours**

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence

(Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

**UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS** **6 hours**

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identifythescopeandcharacteristicsofpeople-friendlyandeco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations

**TOTAL : 30 hours**

**TEXT BOOKS:**

T1.R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics Excel Books, New Delhi, 2010

**REFERENCE BOOKS :**

R1: Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins,USA

R2: E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs,Britain.

R3: Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

R4: Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society | K2 |
| CO2: | Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body. | K4 |
| CO3: | Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society | K2 |
| CO4: | Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature. | K2 |
| CO5: | Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work. | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | 3 | 2 | 3 | 1 | - | 3 | 2 | - |
| **CO2** | - | - | - | - | - | 3 | 2 | 2 | 3 | 1 | - | 3 | 2 | - |
| **CO3** | - | - | - | - | - | 3 | 3 | 2 | 3 | 1 | - | 3 | 2 | - |
| **CO4** | - | - | - | - | - | 3 | 2 | 2 | 3 | 1 | - | 3 | 2 | - |
| **CO5** | - | - | - | - | - | 3 | 3 | 3 | 3 | 1 | - | 3 | 2 | - |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

# SEMESTER II

| HSC-01 | ENGLISH | 2 | 0 | 0 | 2 |
|---|---|---|---|---|---|

**Course Objectives**

- To acquire ability to speak effectively in real life situations.
- To write letters and reports effectively in formal and business situations.
- To develop listening skills for academic and professional purposes.
- To gain effective speaking and listening skills in communication.
- To develop the soft skills and interpersonal skills to excel in their career.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment procedures.

**UNIT I VOCABULARY BUILDING 6 hours**

General Vocabulary –Nouns--Compound nouns, Synonyms , Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations.-Instructions.

**UNIT II BASIC WRITING 6 hours**

Sentences structures –Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations, Blending and Clipping, Framing questions- Yes/No types and "Wh" questions, Summarizing, Precise writing, Paragraph Writing.

**UNIT III IDENTIFYING COMMON ERRORS IN ENGLISH 6 hours**

Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives& Gerund , Checklist.

**UNIT IV NATURE AND STYLE OF SENSIBLE WRITING 6 hours**

Situational Dialogues, Process description, Definitions, Numerical Expressions, Recommendation, Information Transfer- Flow chart Bar chart and Pie chart, ,Writing introduction and conclusion.

**UNIT V WRITING PRACTICES 6 hours**

Active voice and Passive voice, ,Making negative sentences ,Tenses,Letter Writing- Formal & Informal Letters, Report Writing- Letter Report, Accident Report, Investigation Report and Survey, Essay writing, Reading Comprehension Passages.

**TOTAL : -30 hours**

**TEXT BOOKS:**


T1: K. R. Dhanalakshmi and N S Raghunathan, Personality Enrichment, Margham Publications, 2012

T2: R. S. Agarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishers, 2017


**REFERENCE BOOKS:**


R1: D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021

R2: A.K Gupta, Logical and Analytical Reasoning (English), Ramesh Publishing House, 2022


**WEB LINKS:**

1. https://ehlion.com/magazine/technical-english/
2. https://www.kkcl.org.uk/pdf/KKCL_Technical_English_for_Engineers_Brochure.pdf

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Discuss the basic, email, business, telephone and meeting etiquettes. | K2 |
| CO2: | Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance. | K3 |
| CO3: | Work with fractions, decimals and square roots. | K3 |
| CO4: | Analyze the cause, effect and course of action in logical problems. | K4 |
| CO5: | Solve problems on the letter and symbol series. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 1 | - | - | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 1 |
| **CO2** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 1 |
| **CO3** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO4** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO5** | 2 | 1 | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| BSC-04 | PHYSICS (WAVES, OPTICS AND INTRODUCTION TO QUANTUM MECHANICS) | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To learn the basic ideas of waves, lasers and quantum mechanics.
- To apply these fundamental principles to solve practical problems involving optical systems used in engineering applications.

**UNIT I WAVES, NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES** **9 hours**

Characteristics of a waves - Longitudinal and Transverse waves - Transverse wave on a string, the wave equation on a string- Longitudinal wave equation.- Acoustics waves - Characteristics of musical sound - Noise pollution - Acoustics of buildings - Reverberation - Reverberation time – Sabine's reverberation time.

**UNIT II LIGHT AND WAVE OPTICS** **9 hours**

Light as an electromagnetic wave - Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection – Dispersion - Dispersive power of prism - Dispersion of a diffraction of grating and their resolving power - Huygens' Principle - Superposition of waves - Young's double slit experiment - Newton's rings - Michelson interferometer - Mach Zehnder interferometer.

**UNIT III LASERS** **9 hours**

Einstein's theory of matter radiation interaction and coefficients - Amplification of light by population inversion - Different types of lasers: Gas lasers (He-Ne, CO2) – Solid - state lasers (Ruby, Nd-YAG) – Semiconductor lasers - Properties of laser beams - Applications of lasers in Science, Engineering and Medical fields.

**UNIT IV INTRODUCTION TO SOLIDS AND SEMICONDUCTORS** **9 hours**

Free electron theory of metals - Density of states - Types of electronic materials: Metals, Semiconductors and Insulators – Direct and Indirect band gap - Intrinsic and Extrinsic semiconductors - Dependence of Fermi level on carrier concentration and temperature - Hall Effect – Determination of Hall coefficient – Applications.

**UNIT V QUANTUM MECHANICS** **9 hours**

Blackbody radiation – Planck's radiation law (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans Law from Planck's theory – Compton effect – Theory and experimental verification – Properties of matter waves – Schrödinger's wave equation–Time independent and time dependent equations – Physical significance of wave function – Particle in a one-dimensional box

**TOTAL : --45 hours**

**TEXT BOOKS:**


T1: A text book of waves and oscillations, BrijLal and N. Subrahmanyam, Vikas Publishing, New Delhi.

T2: A text book of optics, M. N. Avadhanulu, BrijLal and N. Subrahmanyam, S. Chand & Co. Pvt Ltd. New Delhi.

T3: Modern Physics, R. Murugesan and Kiruthiga Sivaprakash, S. Chand & Co. Pvt Ltd. New Delhi.

**REFERENCE BOOKS:**


R1: Vibrations and waves in physics, I. G. Main, Cambridge University Press, 1993.
R2: The physics of vibrations and waves, H. J. Pain, Wiley, 2006.
R3: Optics, E. Hecht, Pearson Education, 2008.
R4: Optics, A. Ghatak, McGraw Hill Education, 2012.
R5: Principles of Lasers, O. Svelto, Springer Science & Business Media, 2010.


**WEB LINKS:**

1. https://nptel.ac.in/courses/115102124
2. https://nptel.ac.in/courses/108106181
3. https://nptel.ac.in/courses/122106034

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Demonstrate the basic concepts of characteristics of waves. | K2 |
| CO2: | Analyze the dispersion of a diffraction of grating and their resolving power. | K4 |
| CO3: | Apply the laser operation principles to quantum mechanics and photonics. | K3 |
| CO4: | Analyze the time independent Schrodinger wave equation for a particle in a box. | K4 |
| CO5: | Identify different kinds of electronic materials and their energy band structures | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | - | 2 | 1 |
| **CO2** | 2 | 2 | 1 | 2 | 2 | - | - | 1 | - | - | - | - | 2 | 2 |
| **CO3** | 3 | 2 | 1 | 2 | 2 | 2 | - | 1 | 1 | - | - | - | 3 | 3 |
| **CO4** | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| **CO5** | 3 | 3 | 2 | 2 | 2 | - | 1 | 1 | 1 | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | ✓ | |

| BSC-05 | MATHEMATICS-II (LINEAR ALGEBRA, TRANSFORM, CALCULUS AND NUMERICAL METHODS) | 3 | 1 | 0 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- To solve the prospective engineers with techniques in Transform calculus and linear algebra.
- To Learn advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

**UNIT I MATRICES 12 hours**

Algebra of matrices- Inverse and rank of a matrix-System of linear equations- Symmetric, skew-symmetric and orthogonal matrices-Eigenvalues and eigenvectors- Diagonalization of matrices-Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

**UNIT II TRANSFORM CALCULUS 12 hours**

Laplace Transform -Properties of Laplace Transform- Laplace transform of periodic functions. Finding inverse Laplace transform by different methods-convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method.

**UNIT III NUMERICAL METHODS-I 12 hours**

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

**UNIT IV NUMERICAL METHODS-II 12 hours**

Ordinary differential equations: Taylor's series-Euler and modified Euler's methods-Runge- Kutta method of fourth order for solving first and second order equations.

**UNIT V NUMERICAL METHODS-III 12 hours**

Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation-Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods)

**TOTAL : --60 hours**

**TEXT BOOKS:**


T1: D. Poole, " Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
T2: N.P. Bali and M. Goyal, " A text book of Engineering Mathematics" , Laxmi Publications,
T3: B.S. Grewal, " Higher Engineering Mathematics" , Khanna Publishers, 2010.
T4: Sivaramakrishna Das.P and Vijayakumari.C, Numerical Analysis, 2014, Pearson Education limited in south Asia.


**REFERENCE BOOKS:**


R1: V. Krishnamurthy, V. P. Mainra and J. L. Arora, " An introduction to Linear Algebra" , Affiliated East-West press, 2005.

R2: Chapra, S. C and Canale, R. P., "Numerical Methods for Engineers",Tata McGraw-Hill, New Delhi, 5th Edition, 2007.

R3: Sankara Rao K, "Numerical Methods for Scientisits and Engineers",Printice Hall of India,New Delhi, 3rd Edition,2007 .

**WEB LINKS:**

1. https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/
2. https://nptel.ac.in/courses/111106051
3. https://nptel.ac.in/courses/111104137
4. https://nptel.ac.in/courses/111105123
5. https://archive.nptel.ac.in/courses/111/105/111105123/
6. https://nptel.ac.in/courses/111107105
7. https://nptel.ac.in/courses/111106101

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Develop the essential tool of matrices in engineering. | K3 |
| CO2: | Analyze the Laplace transforms and its properties | K4 |
| CO3: | Explain the applications of interpolation, numerical differentiation and numerical integration | K5 |
| CO4: | Apply the knowledge on numerical solution of ordinary differential equations | K3 |
| CO5: | Identify with the boundary value problem for Partial differential equations. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 1 | - | - | - | - | 2 | - | - | 1 | 1 |
| **CO2** | 3 | 2 | 1 | 1 | 1 | - | - | - | - | 2 | - | - | - | 1 |
| **CO3** | 3 | 3 | 1 | 2 | 1 | - | - | - | - | 2 | - | - | 3 | 1 |
| **CO4** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | 2 | - | - | 3 | 1 |
| **CO5** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | 2 | - | - | 3 | 1 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | ✓ | |

| ESC-06 | BASIC ELECTRICAL AND ELECTRONICS ENGINEERING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To obtain basic knowledge on electrical quantities such as current, voltage, power and energy.
- To provide employability skill of adequate working knowledge on basic DC and AC circuits used in electrical and electronic devices. To understand the working principle, construction, applications of DC machines, AC machines & measuring instruments.

**UNIT I DC CIRCUITS 12 hours**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, Analysis of simple circuits with dc excitation, Wye↔Delta Transformation, Superposition, Thevenin and Norton Theorems.

**UNIT II AC CIRCUITS 12 hours**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

**UNIT III TRANSFORMERS 12 hours**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

**UNIT IV ELECTRICAL MACHINES & POWER CONVERTERS 12 hours**

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Construction of Single phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. DC-DC buck and boost converters, duty ratio control. Single phase Bridge Rectifier, Single Phase voltage source inverters.

**UNIT V BASICS OF ELECTRONICS 12 hours**

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics. Binary Number System — Boolean Algebra theorems– Logic gates- Introduction to sequential Circuits– Flip-Flops.

**TOTAL : --60 hours**

**TEXT BOOKS:**


T1: D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
T2: D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
T3: John Bird, “Electrical Circuit theory and technology”, Routledge; 5th edition,2013


**REFERENCE BOOKS:**


R1: L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
R2: E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
R3: V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989


**WEB LINKS:**

1. https://www.electricaltechnology.org/category/basic-electrical-fundamentals
2. https://www.electrical4u.com/electrical-engineering-articles/basic-electrical

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand and analyse DC circuits | K2 |
| CO2: | Understand and analyse AC circuits | K2 |
| CO3: | Explain the construction, operation and characteristics of transformer and classify the types of three –phase transformer connections. | K3 |
| CO4: | Understand and Examine the various electrical machines and converter circuits | K2 |
| CO5: | Identify the basics of electronics | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 1 | 1 | 1 | 2 | 1 | - | - | 1 | - | 1 | 2 | 2 |
| **CO2** | 3 | 3 | 1 | 1 | 2 | - | - | - | - | 1 | - | 2 | 3 | 3 |
| **CO3** | 2 | 1 | 2 | 2 | 1 | 3 | 3 | 2 | - | 2 | 1 | 1 | 3 | 3 |
| **CO4** | 2 | - | 1 | 1 | 1 | 3 | 2 | 1 | - | 2 | 2 | 1 | 3 | 3 |
| **CO5** | 2 | 1 | 1 | 1 | 1 | 2 | - | - | - | 1 | - | 1 | 3 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | | ✓ | ✓ |

| ESC-05 | ENGINEERING GRAPHICS AND DESIGN | 1 | 0 | 4 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To familiarize the students in basic concept of conic sections, projections and developments of objects.
- To develop the imagination and drafting skills of students and pictorial projections.

**UNIT I DIMENSIONING AND GEOMETRICAL CONSTRUCTION 12 hours**

BIS - Lettering - Two systems of dimensioning, Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12 hours**

Orthographic projection- Principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS 12 hours**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method

**UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12 hours**

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section - Auxiliary Views. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones

**UNIT V ORTHOGRAPHIC PROJECTION AND ISOMETRIC PROJECTION 12 hours**

General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

**TOTAL : --60 hours**

**TEXT BOOKS:**


T1: Bhatt N.D. and Panchal V.M., —Engineering Drawing, Charotar Publishing House, 50th Edition, 2010.

T2: Parthasarathy N.S. and Vela Murali, —Engineering Drawing, Oxford University Press, New Delhi, 1 stEdition,2015


**REFERENCE BOOKS:**


R1: Natarajan K.V., —A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 31st Edition,2018.

R2: Basant Agrawal and Agrawal C.M., —Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2013.

**WEB LINKS:**

1. https://nptel.ac.in/courses/112103019
2. https://alison.com/course/diploma-in-engineering-drawing-and-computer-graphics

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Sketch the drawing standards, conventions and practices in engineering drawing | K1 |
| CO2: | Draw the orthographic projections of points, straight lines and plane surfaces for solving some of the engineering problems in day-to-day applications | K1 |
| CO3: | Sketch the orthographic projections for the points, straight lines or solids using the change of position method. | K1 |
| CO4: | Draw projections of sectioned solids and development of lateral surfaces and apply the concept to simple sheet metal work. | K6 |
| CO5: | Draw the isometric projections for the given solids and combination of solids using box method and create 3D models | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | - | 2 | - | - | - | - | 3 | - | 2 | 2 | 1 |
| **CO2** | 2 | 3 | 2 | - | 2 | - | - | - | - | 3 | - | 3 | 2 | 3 |
| **CO3** | 2 | 2 | 2 | - | 2 | - | - | - | - | 3 | - | 2 | 2 | 2 |
| **CO4** | 2 | 2 | 2 | - | 2 | - | - | - | - | 3 | - | 2 | 2 | 2 |
| **CO5** | 2 | 2 | 2 | - | 2 | - | - | - | - | 3 | - | 3 | 2 | 2 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | | ✓ | | ✓ | ✓ |

| HSC-02 | ENGLISH LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- To enable the student to explore the knowledge in communication skills.
- To gain knowledge in the process of Placement Interviews, Group Discussions and other recruitment procedures.

**List of Experiments**

1. Introduction to English sounds
2. Consonants and vowels
3. Syllable and Stress
4. Intonation
5. Communication Skills
6. Summarizing
7. Report Writing
8. Information Transfer
9. Presentation Skills
10. Group Discussion
11. Letter Writing
12. Cover letter and Resume

**TEXT BOOKS:**

T1: Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.
T2: M.AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

**REFERENCE BOOKS:**

R1: Practical English Usage. Michael Swan. OUP. 1995.
R2: Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
R3: Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

**WEB LINKS:**

1. https://ehlion.com/magazine/technical-english/
2. https://www.kkcl.org.uk/pdf/KKCL_Technical_English_for_Engineers_Brochure.pdf

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly. . | K5 |
| CO2: | Use appropriate pronunciation and rhythm of spoken language in oral communication | K4 |
| CO3: | Draft and interpret the written communication in officialcontexts like narrative, descriptive, creative, critical and analytical reports. | K5 |
| CO4: | Implied meanings of different genres of texts and critically analyze and evaluate them for ideas, as well as for method of oral presentation. . | K4 |

| | | |
|---|---|---|
| CO5: | Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions , negotiation and conversations. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | - | 2 | - | 2 | - | - | - | - | - | - | 2 |
| **CO2** | 3 | 2 | 1 | 1 | 3 | 1 | 3 | 3 | - | - | - | - | - | 3 |
| **CO3** | 3 | 2 | 1 | 1 | 3 | 1 | 3 | 3 | - | - | - | - | - | 3 |
| **CO4** | 3 | 2 | 1 | 1 | 3 | 1 | 3 | 3 | - | - | - | - | - | 3 |
| **CO5** | 3 | 2 | 1 | 1 | 3 | 1 | 3 | 3 | - | - | - | - | - | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| | | ✓ | ✓ | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | ✓ | |

| BSC-06 | PHYSICS LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- To enable the student to explore the field of Properties of Matter and Optics.
- To gain knowledge in the scientific methods and learn the process of measuring different Physical variables.

**Any Eight Experiments**

1. Determination of Rigidity Modulus – Torsional pendulum
2. Determination of wavelength and particle size using laser
3. Ultrasonic Interferometer
4. Determination of band gap of a semiconductor material
5. Hooke's law – Determination of spring constant
6. Determination of Young's Modulus – Uniform Bending
7. Determination of Young's Modulus – Non Uniform Bending
8. Determination of Viscosity of a liquid - Poiseuille's method
9. Spectrometer – Grating
10. Deflection Magnetometer - Tan A position
11. Deflection Magnetometer - Tan B position
12. Potentiometer - Calibration of low range Voltmeter

**TEXT BOOKS:**


T1: C. C. Ouseph, U. J. Rao, V. Vjiayendran, Practical Physics,1st Edition, 2015.
T2: Biswajit Saha, Practical Physics Book, LAP LAMBERT Academic Publishing, 1st Edition, 2020.


**REFERENCE BOOKS:**


R1: G.L. Squires, Practical Physics, 4th Edition, Cambridge University Press, 2001.
R2: D. Chattopadhyay, P.C. Rakshit, B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.


**WEB LINKS:**

1. http://amrita.olabs.edu.in/?sub=1&brch=5&sim=155&cnt=2
2. https://vlab.amrita.edu/index.php?sub=1&brch=280&sim=1509&cnt=4

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Measure the wavelength and particle size of semiconductor diode laser. | K3 |
| CO2: | Analyze the wavelength of spectral lines using spectrometer | K4 |
| CO3: | Estimate the band gap energy of given semiconductor material. | K5 |
| CO4: | Determine the compressibility of the liquid using ultrasonic interferometer. | K5 |
| CO5: | Measure the Young's modulus of the given solid materials. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 1 | 1 | 3 | 2 | 2 | 1 | - | - | - | - | - | 1 | 3 |
| **CO2** | - | 1 | 1 | 2 | - | - | - | - | - | - | - | - | 1 | 2 |
| **CO3** | - | 1 | 1 | 3 | 2 | 2 | 1 | - | - | - | - | - | 2 | 3 |
| **CO4** | - | 1 | 1 | 3 | - | - | - | - | - | - | - | - | - | 1 |
| **CO5** | - | 1 | 1 | 3 | 1 | 2 | 1 | - | - | - | - | - | 1 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Observation** | **Record** |
|---|---|---|---|---|---|
| | | ✓ | ✓ | ✓ | ✓ |
| **MCQ** | **Projects** | **Viva** | **Demonstration / Presentation** | | |
| | | ✓ | ✓ | | |

| | | | | | |
|---|---|---|---|---|---|
| **ESC-07** | **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** | **0** | **0** | **2** | **1** |

| | LABORATORY | | | | |
|---|---|---|---|---|---|

**Course Objectives**

- To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.

**List of Experiments**

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification
3. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line- line voltage, phase-to-neutral voltage, line and phase currents).
5. Load Characteristics of a DC Motor
6. Torque - Slip Characteristic of an Induction motor
7. Three phase induction motors – Direction reversal by change of phase-sequence of connections. 8. Demonstration of DC-DC Converter
9. Demonstration of DC-AC converter.
10. Demonstration of AC-DC converter

**TEXT BOOKS:**

T1: D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
T2: D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.

**REFERENCE BOOKS:**

R1: L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
R2: E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
R3: V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989 Text book 1

**WEB LINKS:**

1. https://www.electricaltechnology.org/category/basic-electrical-fundamentals
2. https://www.electrical4u.com/electrical-engineering-articles/basic-electrica

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the basic safety precautions and learn to make use of measuring instruments | K2 |
| CO2: | Analyse the steady state response of R-L, R-C circuits | K3 |
| CO3: | Experiment with loading of transformer to measure the primary and secondary voltages, currents and power and classify the different types of transformer connections | K3 |
| CO4: | Understand and Experiment with single phase induction motor and three phase induction motor | K2 |
| CO5: | Demonstrate DC-DC, DC-AC and AC-DC converters | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 1 | 1 | 2 | 2 | - | - | - | - | - | - | - | 1 | 1 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 1 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Observation** | **Record** |
|---|---|---|---|---|---|
| | | ✓ | ✓ | ✓ | ✓ |
| **MCQ** | **Projects** | **Viva** | **Demonstration / Presentation** | | |
| | | ✓ | ✓ | | |

| MC-03 | CONSTITUTION OF INDIA | 2 | 0 | 0 | 0 |
|---|---|---|---|---|---|

**Course Objectives**

- The purpose of the course is to acquaint the students with basic principles of the Constitution of India and its working.
- To help students be familiar with the historical and significant aspects of the constitution of India.
- To make students aware of their fundamental duties and rights.
- To know about central and state government functionalities in India.

**UNIT I NATURE, OBJECT AND SCOPE OF THE CONSTITUTION 6 hours**

Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

**UNIT II FUNDAMENTAL RIGHTS 6 hours**

Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

**UNIT III DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES 6 hours**

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

**UNIT IV FEDERAL STRUCTURE 6 hours**

Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

**UNIT V AMENDMENT AND EMERGENCY PROVISIONS 6 hours**

Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

**TOTAL : 30 hours**

**TEXT BOOKS:**


**T1:** V.N. Shukla, Constitutional Law of India
**T2:** D.D. Basu, Commentary on the Constitution of India
**T3:** J.N. Pandey, Constitution of India
T4: Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi.
T5: R.C.Agarwal, (1997) “Indian Political System”, S.Chand and Company, New Delhi.
T6: Maciver and Page, “Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.
T7: K.L.Sharma, (1997) “Social Stratification in India: Issues and Themes”, Jawaharlal Nehru University, New Delhi.


**REFERENCES BOOKS:**


R1: V.D. Mahajan, Constitutional Law of India
R2: H.M. Seervai, Constitution of India
R3: Sharma, Brij Kishore, “Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
R4: U.R.Gahai, “Indian Political System “, New Academic Publishing House, Jalaendhar.
R5: R.N. Sharma, “Indian Social Problems “, Media Promoters and Publishers Pvt. Ltd.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Elaborate the constitution of India and its salient features | K2 |
| CO2: | Know the fundamental rights and duties | K2 |
| CO3: | Discuss the Parliamentary Form of Government in India. | K2 |
| CO4: | Recognize the Directive Principles of State Policy. | K3 |
| CO5: | Understand and abide the rules of the Indian constitution and to appreciate different culture among the people. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | - | 1 | - | - | - | 2 | 3 | - |
| **CO2** | - | - | - | - | - | 3 | 2 | 2 | - | - | - | 3 | 3 | - |
| **CO3** | - | - | - | - | - | 3 | 2 | 2 | 1 | - | - | 3 | 3 | - |
| **CO4** | - | - | - | - | - | 3 | 2 | 2 | 1 | - | - | 3 | 3 | - |
| **CO5** | - | - | - | - | - | 3 | 3 | 2 | 1 | - | - | 3 | 3 | - |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

# SEMESTER III

| BSC-07 | Mathematics-III<br>(Fourier Series and Transforms) | 3 | 1 | 0 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- To learn the concept of Fourier Series and Transforms for various functions in the given interval.
- To Solve the boundary value problems using finite and infinite transforms

**UNIT I FOURIER SERIES** **12 hours**

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

**UNIT II FOURIER TRANSFORM** **12 hours**

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

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS** **12 hours**

Formation of partial differential equations - singular integrals- Solutions of standard types of first order partial differential equations – Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous functions.

**UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS** **12 hours**

Classification PDE-Method of separation of variables – One dimensional wave equation and One dimensional heat equation of heat conduction – Steady state solution of two-dimensional heat equation of heat conduction (square plate only)

**UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS** **12 hours**

Z-transform –Introduction- properties – Inverse Z-transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

**TOTAL : --60 hours**

**TEXT BOOKS:**


T1: Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi,43rd Edition, 2013.

T2: Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 6th reprint,2008.

T3: Sivaramakrishna Das. P & Vijayakumari. C , A Text book of Engineering Mathematics-III limited in south Asia.


**REFERENCE BOOKS:**


R1: Bali.N.P. and Manish Goyal 'A Textbook of Engineering Mathematics', Laxmi Publications, 9th edition,2011.

R2: Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition, 2011.

R3: Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education,3rd Edition, 2012.

**WEB LINKS:**

1. https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/
2. https://nptel.ac.in/courses/111107098
3. https://nptel.ac.in/courses/111106046
4. https://nptel.ac.in/courses/111106111
5. https://www.youtube.com/watch?v=lkAvgVUvYvY
6. https://www.youtube.com/watch?v=1JnayXHhjlg

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Develop Fourier series for different types of functions | K3 |
| CO2: | Analyze the transforms for various functions. | K4 |
| CO3: | Identify the basic concepts of Partial differential equations for solving standard Partial differential equations | K3 |
| CO4: | Analyze the student with Fourier series techniques in solving heat flow problem used in various situations. | K4 |
| CO5: | Identify the applications of z-transforms and its properties for various functions. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 | 1 | 1 | 2 |
| **CO2** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | 2 | 1 | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | 2 | 1 | 3 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | ✓ | |

| ESC-08 | ENGINEERING MECHANICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy.
- He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

**UNIT I BASICS AND STATICS OF PARTICLES 9 hours**

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

**UNIT II EQUILIBRIUM OF RIGID BODIES 9 hours**

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

**UNIT III PROPERTIES OF SURFACES AND SOLIDS 9 hours**

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

**UNIT IV DYNAMICS OF PARTICLES 9 hours**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies

**UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 9 hours**

Frictional force – Laws of Coulomb friction – simple contact friction – Rolling resistance – Belt friction. Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

**TOTAL : --45 hours**

**TEXT BOOKS:**

T1: Beer, F.P and Johnson Jr. E.R. “Vector Mechanics for Engineers”, Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 1997.
T2: Rajasekaran. S, Sankarasubramanian. G., “Fundamentals of Engineering Mechanics”, Vikas Publishing House Pvt. Ltd., 2000.

**REFERENCE BOOKS:**

R1: Hibbeller, R.C., “Engineering Mechanics”, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
R2: Palanichamy, M.S., Nagam, S., “Engineering Mechanics – Statics and Dynamics”, Tata McGraw-Hill, 2001.
R3: Irving H. Shames, “Engineering Mechanics – Statics and Dynamics”, IV Edition – Pearson Education Asia Pvt. Ltd., 2003.
R4: Ashok Gupta, “Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)”, Pearson Education Asia Pvt., Ltd., 2002.

**WEB LINKS:**

1. https://nptel.ac.in/courses/112103109
2. https://www.real-world-physics-problems.com/engineering-mechanics-

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Solve engineering problems dealing with force, displacement, velocity and acceleration. | K6 |
| CO2: | Evaluate problems on equilibrium of rigid bodies | K5 |
| CO3: | Determine the areas and volumes of surface and solids | K5 |
| CO4: | Explain dynamics of particles and their relationships between motions | K5 |
| CO5: | Analyze friction and elements of rigid body dynamics | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 1 | 2 | 2 | 2 | 2 | - | 2 | - | - | - | - | 2 | 1 |
| **CO2** | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | - | - | - | - | 3 | 2 |
| **CO3** | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | - | - | - | - | 3 | 2 |
| **CO4** | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | - | - | - | - | 2 | 3 |
| **CO5** | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | - | - | - | - | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | | ✓ | | ✓ | |

| PCC-02 | ANALOG ELECTRONICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- Be familiar with the structure of basic electronic devices.
- Understand the working principle and applications of electronic devices.
- Exposed to the working of amplifiers and oscillators

**UNIT I DIODE CIRCUITS 9 hours**

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier, Display devices- LED, Laser diodes,Zener Diode characteristics - Zener Reverse characteristics – Zener as regulator

**UNIT II BJT CIRCUITS 9 hours**

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits; common-emitter, common-base and common collector configuration; Power Transistors, opto couplers

**UNIT III MOSFET CIRCUITS 9 hours**

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

**UNIT IV DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS 9 hours**

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

**UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9 hours**

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien Bridge, Hartley, Colpitts and Crystal oscillators.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.

T2: J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

T3: P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.

T4: P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.

T5: S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.


**REFERENCE BOOKS:**


R1: TheodreF.Boghert, “Electronic Devices & Circuits” Pearson Education, VI Edition, 2003

R2: Rashid, “Microelectronic circuits” Thomson Publication, 1999.

R3: Singh, B.P. and Rekha Sing, “Electronic Devices and Integrated Circuits” Pearson Education, 2006.

R4: Salivahanan.S,Sureshkumar.N “Electronic Devices & Circuits” Tata McGraw-Hill Education, 2011.

**WEB LINKS:**

1. https://www.electronics-tutorials.ws/transistor/tran_1.html
2. https://www.electronics-tutorials.ws/oscillator/oscillators.html

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the working principle of basic electronic devices and their applications | K2 |
| CO2: | Analyse the characteristics of various configurations of transistors | K4 |
| CO3: | Understand the characteristics of MOSFET and model its small signal equivalent circuits. | K2 |
| CO4: | Explain the working of multistage amplifier and operational amplifier | K2 |
| CO5: | Understand the working and analyse various types of feedback amplifiers and oscillator circuits. | K2,K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 1 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | 3 | 1 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| PCC-01 | ELECTRIC CIRCUIT ANALYSIS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To impart knowledge on solving circuit equations using network theorems and to understand the phenomenon of resonance in coupled circuits.
- To develop skill on obtaining the transient response of circuit and analyse three phase circuits to work in the field of electrical engineering.

**UNIT I NETWORK THEOREMS 9 hours**

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfertheorem, Reciprocity theorem, Compensation theorem. Analysis with dependent currentand voltage sources. Concept of duality and dual networks

**UNIT II RESONANCE AND COUPLED CIRCUITS 9 hours**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Selfand mutual inductance – Coefficient of coupling – Dot Rule – Conductively Coupled coils - Analysis of coupled circuits - Tuned circuits – Single tuned circuits – Doubled tuned Circuits

**UNIT III TRANSIENT RESPONSE ANALYSIS 9 hours**

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input

**UNIT IV THREE PHASE CIRCUITS 9 hours**

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced& un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

**UNIT V TWO PORT NETWORK AND NETWORK FUNCTIONS 9 hours**

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections oftwo port networks.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits

T2: Analysis”, McGraw Hill publishers, edition, New Delhi, 2013.

T3: Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”,

T4: Second Edition, McGraw Hill, 2013.

T5: Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.


**REFERENCE BOOKS:**


R1: Chakrabarti A, “Circuits Theory (Analysis and synthesis), DhanpathRai& Sons, New Delhi, 1999.

R2: Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.

R3: Joseph A. Edminister, MahmoodNahri, “Electric circuits”, Schaum’s series, McGraw- Hill, New Delhi, 2010.

R4: M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi,2015.

R5: Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.

R6: Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.

R7: Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

**WEB LINKS:**

1. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic
2. https://www.circuitbasics.com/circuit-analysis/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Apply network theorems to reduce the AC and DC network | K 3 |
| CO2: | Understand resonance and coupled circuits | K 2 |
| CO3: | Analyse the transient response for DC and AC circuits | K4 |
| CO4: | Examine 3- phase circuits for calculating impedance, voltage, current, power, phase shift and power factor. | K 4 |
| CO5: | Analyze two port networks and its parameters | K 4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| PCC-03 | ELECTRICAL MACHINES – I | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To impart the knowledge on magnetic circuits and the concepts of induced emfs in both stationary and rotating machines
- Imparting knowledge on Electrical machines and transformers will improve the skills required to work in the field of Electrical Engineering

**UNIT I MAGNETIC FIELDS AND MAGNETIC CIRCUITS 9 hours**

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines

**UNIT II ELECTROMAGNETIC FORCE AND TORQUE 9 hours**

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

**UNIT III DC MACHINES 9 hours**

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

**UNIT IV DC MACHINE - MOTORING AND GENERATION 9 hours**

Armature circuit equation for motoring and generation, Types of field excitations – separately excited, 61 shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DCmachines

**UNIT V TRANSFORMERS 9 hours**

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer-construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers – construction principle, applications and comparison with two winding transformer - Scott connection, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Cooling of transformers.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.

T2: P.C. Sen'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013.

T3: Nagrath, I.J. and Kothari.D.P., Electric Machines', McGraw-Hill Education, 2004

**REFERENCE BOOKS:**

R1: Theodore Wildi, "Electrical Machines, Drives, and Power Systems", PearsonEducation., (5th Edition)**,** 2002**.**

R2: B.R. Gupta ,'Fundamental of Electric Machines' New age International Publishers,3rdEdition ,Reprint 2015.

R3: S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rdEdition,2009.

R4: Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.Surinder Pal Bali, 'Electrical Technology Machines & Measurements, Vol.II, Pearson,2013.

R5: Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixthedition, McGraw Hill Books Company, 2003.

**WEB LINKS:**

1. https://www.electricaltechnology.org/2020/04/dc-machine-types-working.
2. https://circuitglobe.com/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the operation of magnetic circuits | K 2 |
| CO2: | Understand the principles of induced emfs and torque in stationary and rotating machines | K 2 |
| CO3: | Analyze the operation of dc machines. | K4 |
| CO4: | Analyze the differences in operation of different dc machine configurations | K 2 |
| CO5: | Analyze the single phase and three phase transformers circuits. | K 4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 1 | 1 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 1 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| PCC-04 | ELECTROMAGNETIC THEORY | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- Understand the concept of electric fields. Understand the concept of magnetic fields Develop the theory of electrical machines and to develop the platform based on employability skills.
- To know the application of Gauss law and ampere's circuit law.

**UNIT I ELECTROSTATICS-I 12 hours**

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields – Gradient,Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Fielddue to discrete and continuous charges – Gauss's law and applications.

**UNIT II ELECTROSTATICS-II 12 hours**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization –Dielectric strength - Electric field in multiple Dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

**UNIT III MAGNETOSTATICS 12 hours**

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due tostraight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in freespace, conductor, magnetic materials Magnetization, Magnetic field in multiple media –Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

**UNIT IV ELECTRODYNAMIC FIELDS 12 hours**

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

**UNIT V ELECTROMAGNETIC WAVES 12 hours**

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

**TOTAL : --60 hours**

**TEXT BOOKS:**

T1: Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition,2015.

T2: William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.

T3: Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

**REFERENCE BOOKS:**

R1: V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.

R2: J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications',Second Edition, Khanna Publishers.

R3:Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.

R4:S.P.Ghosh, LipikaDatta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.

R5:K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint : 2015

**WEB LINKS:**

1. https://onlinecourses.nptel.ac.in/noc20_ee93/announcements?force=true
2. www.vlab.co.in

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the basic mathematical concepts related to electromagnetic vector fields. | K2 |
| CO2: | Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density. | K3 |
| CO3: | Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density | K3 |
| CO4: | Understand the concepts related to Faraday's law, induced EMF and Maxwell's equations. | K2 |
| CO5: | Apply Maxwell's equations to solutions of problems relating to transmission lines and uniform plane wave propagation. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 2 | 3 |
| **CO4** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| PCC-05 | ELECTRIC CIRCUITS LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**COURSE OBJECTIVE:**

1. To simulate various electric circuits using Simulation Software
2. To gain practical experience on electric circuits and verification of theorems.

**LIST OF EXPERIMENTS**

1. Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental verification of electrical circuit problems using Norton's theorem.
4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of oscilloscopes and measurement of sinusoidal voltage, frequency and time period.
7. Simulation of R- L and R-C electric circuit transients.
8. Design and Simulation of series resonance and parallel resonance circuit.
9. Experimental determination of power in three phase circuits by two-watt meter method
10. Simulation of three phase balanced and unbalanced star, delta networks circuits

**TOTAL: 45 h**

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Analyze the various electrical circuits using circuit laws | K4 |
| CO2: | Understand and apply network theorems to various electrical circuits | K2 |
| CO3: | Determine transient response of RL and RC electrical circuit | K5 |
| CO4: | Determine power and power factor in three phase circuits | K5 |
| CO5: | Design and Simulate series resonance , parallel resonance and three phase balanced, unbalanced, star and delta circuits. | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| | | ✓ | ✓ | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | ✓ | |

| | | | | | |
|---|---|---|---|---|---|
| **PCC-06** | **ELECTRICAL MACHINES -I LABORATORY** | **0** | **0** | **2** | **1** |

**COURSE OBJECTIVE:**

1. To have knowledge about the working of various types of motors using loads.
2. To understand the operation of transformer with and without applying load and determine its efficiency.To gain knowledge in the operation of three phase transformer.
3. To perform hopkinsons and sumpner's test to determine the efficiency of the motor.

**LIST OF EXPERIMENTS**

1. Load test on DC shunt Motor
2. Load test on DC series Motor
3. Load test on DC compound Motor
4. Open circuit and load characteristics of DC shunt Generator
5. Load test on single-phase Transformer
6. Speed control of DC shunt Motor
7. Load characteristics of DC compound Generator
8. Open circuit and short circuit test on single phase Transformer
9. Swinburne's test on DC Motor
10. Hopkinson's test on DC Machine

**TOTAL: 30 hours**

**COURSE OUTCOME:**

| | | |
|---|---|---|
| CO1 | Select range of apparatus based on the rating of single phase transformers and machines | K3 |
| CO2 | Understand steady state performance characteristics of DC machines | K2 |
| CO3 | Determine the performance characteristics of DC machines and transformers | K5 |
| CO4 | Demonstrate the speed control of DC shunt motors | K2 |
| CO5 | Determine the efficiency of DC machines by conducting variable tests | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 2 | - | - | - | - | 2 | - | 1 | 2 | 1 |
| **CO2** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | 1 | - | 1 | 2 | 3 |
| **CO3** | 3 | 2 | 1 | 2 | 3 | - | - | - | - | 2 | - | 1 | 3 | 3 |
| **CO4** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | 1 | - | - | 2 | 3 |
| **CO5** | 3 | 3 | 1 | 3 | 1 | - | - | - | - | 1 | - | 1 | 2 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| | | ✓ | ✓ | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | ✓ | |

| HSC-03 | PERSONALITY DEVELPOMENT-I | 2 | 0 | 0 | 2 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES:**

- To nurture and develop winning personalities and eventually leading them to become dynamic and socially responsible leaders

**UNIT I SOFT SKILLS I 6 hours**

Introduction to Personality Development – Meaning–Features of personality – Dimensions of Personality Determinants of Personality–Features and Traits– Components of self concept–Barriers– Self analysis

**UNIT II SOFT SKILLS II 6 hours**

Importance of Soft Skills – First impression–Work Place requirements–Discipline –Cleanliness Hygiene –general Appearance—Building Confidence—Concept of Thinking and Usage –Value of Time–Focus & Commitment.

**UNIT III SOFT SKILLS IN ACTION 6 hours**

Grooming – Attire – Understanding others– Stability & Maturity Development – Strength s – Weakness – Opportunities–threats – Merits of SWOT Analysis – Components – how to convert weakness into strengths – Goal settings

**UNIT IV SELF AWARENESS AND SELF ESTEEM 6 hours**

Definitions – Components of Self awareness – Developing Self awareness – Self esteem – meaning – Steps to improve self esteem.

**UNIT V SELF MOTIVATION 6 hours**

Motivation – Meaning –Techniques of self motivation–Motivation & goal setting – Motivation and emotion – Motivation at work.

**TOTAL: 30 hours**

**TEXT BOOKS:**

T1: Personality Development And Soft Skills Barun K Mitra, Oxford Publication
T2: Seven habits of Highly Effective people – Stephen R. covey

**REFERENCE BOOKS:**

R1: Emotion, motivation and Self regulation – Nathan C. Hall, McGill University, Canada Thomas Goetz, University of Konstanz, Germany http://www.emeraldgrouppublishing.com.
R2: Psychology of Self esteem – Nathaniel Branden, Nash (1st edition), Jossey – Bass (32 nd anniversary edition)

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Discuss the features, dimensions and determinants of personality | K2 |
| CO2: | Make a good first impression in professional and other situations | K3 |
| CO3: | Demonstrate confidence, punctuality and commitment as an engineer | K3 |
| CO4: | Set goals for development using SWOT analysis | K5 |
| CO5: | Develop self-awareness and improve self esteem | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | 2 | 3 | 3 | 3 | - | 2 | - | 3 |
| **CO2** | - | - | - | - | - | 3 | 2 | 3 | 3 | 3 | - | 2 | - | 3 |
| **CO3** | - | - | - | - | - | 3 | 2 | 3 | 3 | 3 | - | 2 | - | 3 |
| **CO4** | - | - | - | - | - | 3 | 2 | 3 | 3 | 3 | - | 2 | - | 3 |
| **CO5** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | - | 2 | - | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| | | | | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | ✓ | |

| MC-04 | BASIC LIFE SKILLS | 2 | 0 | 0 | 0 |
|---|---|---|---|---|---|

**Course Objectives**

- To provide value education to improve the students' character, understanding of principled life, physical health, maintaining youthfulness, measures and methods in five aspects of life.

**UNIT I PHYSICAL HEALTH 9 hours**

Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.Yogasanas: Pranamasana – HasthaUttanasana - PadaHasthasana – AswaSanjalana Asana – ThuvipathaasvaSanjalana asana – AstangaNamaskara - Bhujangasana– AthaMukthaSavasana – AswaSanjalana Asana - PadaHasthasana–HasthaUttanasana - Pranamasana.Pranayama: Naddisuddi - Clearance Practice - Benefits

**UNIT II LIFE FORCE 9 hours**

Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds).Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force -Bio-Magnetism - Mind. Maintaining youthfulness. Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid Measure and method in five aspects of life - Controlling undue Passion.Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

**UNIT III MENTAL HEALTH 9 hours**

Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits. Shanthi Meditation explanation – Benefits - Thuriya Meditation explanation – Benefit.Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

**UNIT IV VALUES 9 hours**

Human Values Self-control - Self-confidence - Honesty Contentment - Humility – ModestyTolerance - Adjustment - Sacrifice – Forgiveness Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity Social Values:Non-violence– Service Patriotism – Equality Respect for parents and elders - care and protection - Respect for teacher Punctuality - Time Management.

**UNIT V MORALITY (VIRTUES) 9 hours**

Importance of Introspection - I - Mine (Ego, Possessiveness).Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity. Improved Memory Power - Success in the Examination.

**TOTAL : 45 hours**

**TEXT BOOKS/ REFERENCE BOOKS:**


T1: Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
T2: Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
T3: Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
T4: Rev.Dr.G.U. Pope, 2016, Thirukkural, Giri Trading Agency,
T5: Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.
T6: Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
T7: Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,
T8: K. R. Dhanalakshmi and N. S. Raghunathan, " Personality Enrichment, Margham Publications
T9: D.r V. M. Selvaraj, "Personality Development" Bhavani Publications
T10: R. S. Agarwal, "Quantitative Aptitude".
T11: A.K Gupta, "Logical and Analytical Reasoning (English)", 30th Edition.


**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness. | K 2 |
| CO2: | Demonstrate foundational standing, sitting, balance postures with proper alignment andMaintain youthfulness through kaya kalpa practice. | K 3 |
| CO3: | Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them. | K 2 |
| CO4: | Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga to understand the human values. | K 3 |
| CO5: | Achieve a greater sense of awareness, wisdom, introspection, and a deeper sense of relaxation through meditation to keep up morality in life. | K 3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | 2 | 2 | 3 | - | - | 3 | 2 | - |
| **CO2** | - | - | - | - | - | 3 | 2 | 1 | 3 | - | - | 3 | 2 | - |
| **CO3** | - | - | - | - | - | 3 | 2 | 2 | 3 | - | - | 3 | 2 | - |
| **CO4** | - | - | - | - | - | 3 | 2 | 2 | 3 | - | - | 3 | 2 | - |
| **CO5** | - | - | - | - | - | 3 | 3 | 1 | 3 | - | - | 3 | 2 | - |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| | | | ✓ | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | ✓ | |

# SEMESTER IV

| BSC-08 | MATHEMATICS-IV (PROBABILITY AND STATISTICS) | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To make use of statistical techniques.
- To equip the students with standard concepts and tools at an intermediate to advanced level that will serve they well towards tackling various problems in the discipline.

**UNIT I FOURIER SERIES 12 hours**

Introduction to Probability-Conditional probability – Baye's Theorem- Random Variables-Discrete random variables-Continuous Random Variables –Probability mass function-Probability density function.

**UNIT II FOURIER TRANSFORM 12 hours**

Introduction to theoretical distribution-Discrete Distributions- Binomial, Poisson, Geometric Distributions-Continuous Distribution-Uniform, Normal, Exponential and Gamma distribution-Properties.

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12 hours**

Correlation: Types of Correlation-Methods of studying correlation- Scatter diagram method, Karl Pearson's Coefficient of correlation, Spearman's Rank Correlation Coefficient. Regression: Regression Lines and Regression equations - simple problems

**UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12 hours**

Introduction-Measures of Central tendency: Mean, Median and Mode- Measure of Dispersion- Range, Mean deviation- Standard Deviation and coefficient of variation

**UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 12 hours**

Introduction to small sample – t-test-Single mean, difference of means, and Paired t-test- F-test- Chi-square test for goodness of fit and independence of attributes.

**TOTAL : --60 hours**

**TEXT BOOKS:**


T1: N.P. Bali and Manish Goyal, A text book of engineering mathematics, laxmi publications, reprint, 2014 (Ninth Edition)

T2: S.P.Gupta, Statistical Methods. Sultan Chand & Sons, New Delhi

T3: S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, 3rd Edition, 2001.

T4: S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.


**REFERENCE BOOKS:**


R1: Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

R2: P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).

R3: W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

R4: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

**WEB LINKS:**

1. https://nptel.ac.in/courses/111105090
2. https://nptel.ac.in/courses/111105041
3. https://onlinecourses.nptel.ac.in/noc21_ma74/preview

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Apply the fundamental concepts of probability. | K3 |
| CO2: | Make use of standard distributions which can describe real life phenomenon. | K3 |
| CO3: | Utilize and critically discuss the issues surrounding of Correlation and Regression | K3 |
| CO4: | Evaluate the underlying assumptions of analysis tools of measures of central tendency and dispersion | K5 |
| CO5: | Analyze the uses and limitations of Testing of hypothesis used in engineering | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| **CO2** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 1 |
| **CO4** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | 2 | 1 | 3 | 1 |
| **CO5** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | 2 | 1 | 3 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | ✓ | |

| PCC-07 | MEASUREMENTS AND INSTRUMENTATION | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To develop the skill on functional aspects of measuring instruments.
- To educate the fundamental concepts and characteristics of measurement and errors.
- To educate the fundamental working of sensors and transducers and their applications.

**UNIT I CONCEPTS OF MEASUREMENTS 9 hou**

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data, Standards and calibration.

**UNIT II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 9 hours**

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type wattmeter – Energy meter – Megger – Instrument transformers (CT & PT).

**UNIT III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9 hours**

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

**UNIT IV STORAGE AND DISPLAY DEVICES 9 hours**

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.

**UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9 hours**

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, optical and digital transducers – Elements of data acquisition system - A/D, D/A converters – Smart sensors.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2010.

T2: J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2013.

T3: Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007

**REFERENCE BOOKS:**

R1: H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2010

R2: D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt. Ltd, 2015

R3: David Bell, 'Electronic Instrumentation & Measurements', Oxford University Press, 2013

.

**WEB LINKS:**

1. http://www.ime.cas.cn/icac/learning/learning_5
2. https://www.shivajicollege.ac.in/sPanel/uploads/econtent/a6c3907292035b2d3c32a1ec744e7667.PDF

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the functional elements of an instrument and analyze the static and dynamic characteristics of an instrument. | K2 |
| CO2: | Classify the measuring instruments based on the measuring quantity and explain its working principle. | K4 |
| CO3: | Determine the unknown component value using the bridge circuits. | K5 |
| CO4: | Classify the display devices and to explain their working principle and uses. | K4 |
| CO5: | Classify different types of transducers and their principle of operation. | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 2 | 1 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 2 | 1 | 2 | 1 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 2 | 1 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **CAT 3** |
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | ✓ | |

| PCC-08 | DIGITAL ELECTRONICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To familiarize with the different number systems, logic gates, and combinational and sequential circuits utilized in the different digital circuits and systems.
- To acquire the basic knowledge of digital logic levels and apply the knowledge to understand the digital logic families.

**UNIT I NUMBER SYSTEMS, BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS** **9 hours**

Number system, error detection, corrections & codes conversions, Boolean algebra: De-Morgan's theorem, switching functions and minimization using K-maps & Quine McCluskey method

**UNIT II COMBINATIONAL LOGIC CIRCUITS** **9 hours**

Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers, Realization of Boolean Functions using MSI devices, memories and PLA

**UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS** **9 hours**

Flip flops - SR, D, JK and T, shift registers, counters, state assignments analysis and design of synchronous sequential circuits, state diagram; state reduction

**UNIT IV ASYNCHRONOUS SEQUENCTIAL CIRCUITS** **9 hours**

Latches - SR - D ,Asynchronous sequential logic circuits-Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – introduction to design – implication table

**UNIT V LOGIC FAMILIES AND VHDL** **9 hours**

Logic families: RTL ad DTL Circuits, TTL ECL NMOS and CMOS : Introduction to VHDL :Design – combinational logic – Types – Operators – Packages – Sequential circuit – Sub programs – Test benches. (Examples: adders, counters, flip flops, FSM, Multiplexers / Demultiplexers).

**TOTAL : --45 hours**

**TEXT BOOKS:**


T1: Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, 2005.

T2: Donald D. Givone, 'Digital Principles and Design', Tata McGraw Hill, 1st Edition, 2003

T3: Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11 th Edition, 2015


**REFERENCE BOOKS:**


R1: Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 2014.

R2: Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.


**WEB LINKS:**

1. https://www.tutorialspoint.com › digital circuits
2. https://www.javatpoint.com › digital-electronics

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand and examine the structure of various number systems and its application in digital design to solve real world problems | K2,K4 |
| CO2: | Analyze and design combinational logic circuits using gates and MSI devices. | K4 |
| CO3: | Analyze and Design synchronous sequential logic circuits using Flip flops and gates | K4 |
| CO4: | Analyze and Design asynchronous sequential logic circuits using latches and gates | K4 |
| CO5: | Selection of logic families and skill development for application specific digital circuit design using VHDL | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | 1 | 3 | 2 |
| **CO3** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | 1 | 3 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | 1 | 3 | 2 |
| **CO5** | 2 | 1 | 2 | 3 | 2 | - | - | - | - | - | - | 1 | 3 | 1 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PCC-09 | ELECTRICAL MACHINES – II | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To impart the knowledge on construction and operation of AC machines
- Analyze the starting and speed control of three phase induction motor

**UNIT I SYNCHRONOUS GENERATOR 9 hours**

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams of non salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves

**UNIT II SYNCHRONOUS MOTOR 9 hours**

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

**UNIT III THREE PHASE INDUCTION MOTOR 9 hours**

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor.

**UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9 hours**

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star-delta starters– Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking

**UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9 hours**

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, ‘Electric Machinery’, Tata Mc Graw Hill publishing Company Ltd, 2003.

T2: D.P. Kothari and I.J. Nagrath, ‘Electric Machines’, Tata McGraw Hill Publishing Company Ltd, 2002.

T3: P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

**REFERENCE BOOKS:**


R1: M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD.,New Delhi, 2009.

R2: Charless A. Gross, "Electric /Machines, "CRC Press, 2010.

R3: K. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.

R4: Syed A. Nasar, Electric Machines and Power Systems: Volume I, Mcgraw -Hill College; International ed Edition, January 1995.

R5: Alexander S. Langsdorf, Theory of Alternating-Current Machinery, Tata McGraw Hill Publications, 2001.


**WEB LINKS:**

1. https://electricalvoice.com/
2. https://www.tlclam.net/synchronous-motor-vs-induction-motor/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Analyze the performance characteristics of synchronous generator and compute the emf ,mmf equation ,voltage regulation by different methods | K 4 |
| CO2: | Analyze the performance characteristics of synchronous motor by conducting suitable tests | K 4 |
| CO3: | Analyze the performance characteristics of three phase Induction motor | K 4 |
| CO4: | Analyze the starting and speed control of three phase Induction motors | K 4 |
| CO5: | Understand the construction of single phase Induction motors and special machines | K 2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 3 | 2 | 1 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 2 | 1 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | ✓ |

| PCC-10 | LINEAR INTEGRATED CIRCUITS | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- Be familiar with the fundamentals of IC fabrication.
- Understand the internal structure of opamp and its characteristics.
- Exposed to various applications of opamp.
- Impart Knowledge on the working of special and application ICs.

**UNIT I IC FABRICATION 9 hours**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities- Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs.

**UNIT II CHARACTERISTICS OF OPAMP 9 hours**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator-V/I & I/V converters.

**UNIT III APPLICATIONS OF OPAMP 9 hours**

Instrumentation amplifier, first and second order active filters, V/I & I/V converters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

**UNIT IV SPECIAL ICs 9 hours**

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltagecontrolled oscillator IC, 565-phase locked loop IC, AD633 Analog multiplier ICs.

**UNIT V APPLICATION ICs 9 hours**

AD623 Instrumentation Amplifier and its application as load cell weight measurement – ICvoltage regulators - LM78XX, LM79XX- Fixed voltage regulators its application as Linearpower supply - LM317, 723 Variable voltage regulators, switching regulator- SMPS – ICL8038 function generator IC.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: David A. Bell, ‘Op-amp & Linear ICs’, Oxford, 2013.

T2: D. Roy Choudhary, Sheil B. Jani, ‘Linear Integrated Circuits’, II edition, New Age,2003.

T3: RamakantA.Gayakward, ‘Op-amps and Linear Integrated Circuits’, IV edition,Pearson Education, 2003 / PHI. 2000.


**REFERENCE BOOKS:**


R1: Fiore,”Opamps& Linear Integrated Circuits Concepts & applications”, Cengage,2010.

R2: Floyd ,Buchla,”Fundamentals of Analog Circuits, Pearson, 2013.

R3: Jacob Millman, Christos C.Halkias, ‘Integrated Electronics - Analog and Digital circuits system’, McGraw Hill, 2003.

R4: Robert F.Coughlin, Fredrick F. Driscoll, ‘Op-amp and Linear ICs’, Pearson, 6th edition,2012.

R5: Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', Mc Graw Hill, 2016.

R6: Muhammad H. Rashid,' Microelectronic Circuits Analysis and Design' Cengage Learning, 2011

**WEB LINKS:**

1. https://www.electrical4u.com/applications-of-op-amp/
2. https://www.electronicsforu.com/technology-trends/learn-electronics/555-timer-working-specifications
3. https://www.eeeguide.com/ic-565-pll/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the basic process involved in the Fabrication of ICs | K2 |
| CO2: | Analyse the characteristics of Op-amp and perform basic arithmetic functions. | K4 |
| CO3: | Apply Op-amp circuits to perform various applications and choose appropriate ADCs& DACs for different applications | K3 |
| CO4: | Explain the working of special function ICs and its applications | K2 |
| CO5: | Understand and explain the working of voltage regulators, linear and switched power supplies | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO5** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| PCC-11 | ANALOG AND DIGITAL ELECTRONICS LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- Understand the behavior of semiconductor devices based on experimentation
- Learn the circuit behaviors of various circuits with digital and analog ICs

**List of Experiments**

1. Characteristics of Semiconductor diode and Zener diode.
2. Characteristics of a NPN Transistor.
3. Study of Logic Gates.
4. Implementation of Adder and Subtractor circuits.
5. Code converters: Binary to Gray code converter and vice-versa
6. Encoders and Decoders.
7. Multiplexers and Demultiplexers
8. Counters: Design and implementation of 3-bit synchronous and Asynchronous counters.
9. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
10. Operational Amplifier: Inverting and Non Inverting.

**TOTAL :30hours**

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the characteristics of semiconductor devices. | K5 |
| CO2: | Understand and apply boolean functions to implement adder, subtractor and Code Conversion Circuits. | K3,K4 |
| CO3: | Experiment with logic gates, Encoder and Decoder as well as Multiplexer and Demultiplexer | K3 |
| CO4: | Examine the working of synchronous and asynchronous counters | K4 |
| CO5: | Understand the working of 555 timer, inverting and non-inverting amplifiers | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| | | ✓ | ✓ | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | ✓ | |

| PCC-12 | ELECTRICAL MACHINES –II LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- To provide hands on experience with the working and operational control of both DC and AC motors

**LIST OF EXPERIMENTS:**

1. Load test on three phase Induction Motor.
2. No load and blocked rotor test on three phase Induction Motor.
3. Load test on single phase Induction Motor
4. No load and blocked rotor test on a single phase Induction Motor
5. Load test on three phase Synchronous Motor
6. Regulation of three phase Alternator by EMF and MMF methods
7. Regulation of three phase Alternator by ZPF Method
8. Load test on three phase Alternator
9. Separation of no load losses of three phase Induction Motor.
10. V and inverted V curves of three phase Synchronous Motor

**TOTAL :30hours**

**COURSE OUTCOME:**

| | | |
|---|---|---|
| CO1 | Analyze the load characteristics of Induction motor | K3 |
| CO2 | Analyze the characteristics of Synchronous motor under loading condition | K4 |
| CO3 | Analyze the characteristics of three phase Alternator under loading condition | K4 |
| CO4 | Analyze the regulation of Alternator by different methods | K4 |
| CO5 | Determine the equivalent circuit of Induction motors | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 3 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO4** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| | | ✓ | ✓ | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | ✓ | |

| HSC-04 | PERSONALITY DEVELOPMENT II | 2 | 0 | 0 | 2 |
|---|---|---|---|---|---|

**Course Objectives**

- To improve leadership quality, physical aspects of personality/posture and good team spirit in the working environment.
- To inculcate the need to lead a healthy lifestyle and manage stress. To be a socially responsible and ethical citizen.

**UNIT I SOFT SKILLS III** **6 hours**

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

**UNIT II QUANTITATIVE APTITUDE I** **6 hours**

Percentage – Profit Loss -Discount – Ratio Proportion – Time & Work – Time, Speed &Distance. Problems relating to ages- Permutation & Combination-Probability

**UNIT III QUANTITATIVE APTITUDE II** **6 hours**

Mensuration Clocks and Calendars- Boats-Simple Interest –Compound Interest- Fractions and Decimals – Square roots – Functions.

**UNIT IV ANALYTICAL PROBLEMS** **6 hours**

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

**UNIT V LOGICAL PROBLEMS** **6 hours**

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

**TOTAL : -30 hours**

**TEXT BOOKS:**


T1: K. R. Dhanalakshmi and N S Raghunathan, Personality Enrichment, Margham Publications, 2012

T2: R. S. Agarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishers, 2017


**REFERENCE BOOKS:**


R1: D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021

R2: A.K Gupta, Logical and Analytical Reasoning (English), Ramesh Publishing House, 2022


**WEB LINKS:**

1. https://www.indiabix.com/aptitude/problems
2. https://www.javatpoint.com/aptitude/quantitative

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Discuss the basic, email, business, telephone and meeting etiquettes. | K2 |
| CO2: | Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance. | K3 |
| CO3: | Work with fractions, decimals and square roots. | K3 |
| CO4: | Analyze the cause, effect and course of action in logical problems. | K4 |
| CO5: | Solve problems on the letter and symbol series. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 0 | 1 | - | - | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 1 |
| **CO2** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 1 |
| **CO3** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO4** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO5** | 2 | 1 | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| | | | | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | ✓ | |

| BSC-09 | ENVIRONMENTAL SCIENCE AND ENGINEERING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.
- To understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non – governmental organization in environmental managements

**UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 9 hours**

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Biogeographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity. Field Study of Common Plants, Insects and Birds. Field study of simple ecosystems - pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION 9 hours**

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides.Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES 9 hours**

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction – Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification –

Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9 hours**

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9 hours**

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

**TOTAL : --45 hours**

**Text Books:**


T1: De AK, Environmental Chemistry, Wiley Eastern Ltd. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, India.

T2: Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.

T3: Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).


**Reference Books:**


R1: E Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.

R2: Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.

R3: Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs

R4: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.


**Web Links:**

1. https://www.udemy.com/course/environmental-science/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understanding of issues related to environment and their impact on the human life. | K2 |
| CO2: | Analyze the solutions related to the environmental problem | K4 |
| CO3: | Analyze the pollution impacts due to Natural resources | K4 |
| CO4: | Create the awareness about different component of environment and their function and sustainable development | K6 |
| CO5: | Create awareness about human population in worldwide and their causes effect and role of information technology on control measures for sustainable | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 1 | 1 | 3 | - | 3 | 3 | - | - | - | - | - | 1 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | 2 | 3 |
| **CO5** | - | 2 | 1 | 3 | 1 | 3 | 3 | - | - | - | - | - | 1 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| BSC-09 | GENDER INSTITUTION AND SOCIETY | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

The course helps the student to understand concepts of social justice and gender justice. It provides the student with the knowledge of various institutions functioning worldwide which aim to eradicate discrimination against women. The course further aids students in understanding feminism and gender in relationto the society and to study the basic constitutional remedies available to women.

**UNIT I** **9 hours**

Social Justice and Gender Justice – Theories relating to Social Justice – Theories relating to Gender Justice – Interrelationship between Gender justice and Social Justice

**UNIT II** **9 hours**

International Conventions for protection of Women – Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) – National Commission for women – Constitutional remedies available for women under Indian Constitution.

**UNIT III** **9 hours**

United Nations Entity for Gender Equality and the Empowerment of Women (UN Women) – Association for Women's Rights in Development (AWID) –Women kind worldwide – Centre for reproductive rights – Women's Environment and Development Organization (WEDO) – Global Fund for Women

**UNIT IV** **9 hours**

International Center for Research on Women (ICRW) – European Institute for Gender Equality (EIGE) – Promundo – International Alliance of Women (IAW) – International Women's Development Agency (IWDA).

**UNIT V** **9 hours**

World Health 92rganization – Sex and Gender – Feminism – Theories relating to Feminism – Gender andsociety

**TOTAL : --45 hours**

**Text Books:**

T1. Law relating to Women and children, Mamta Rao
T2. Gender, Politics and Institutions: Towards a Feminist Institutionalism, by Mona Lena krook and FianoMackay,2010
T3. Gender Justice and Feminist Jurisprudence,
T4.Dr.Sheetal Kanwal,2015T4. Narain's Gender and society, P.Jain

**Reference Books:**

R1.Gender Justice and feminist `Jurisprudence by Dr.Ishitha ChatterjeeR2: Gender and Institutions, Moira Gatens and Alison Mackkinon
R2.Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs
R3.B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

**Web Links:**

https://www.udemy.com/course/environmental-science/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Illustrate the Concept of Social Justice and Gender Justice. | **K2** |
| CO2: | Learning the International Conventions and constitutional remedies available for women. | **K2** |
| CO3: | Identify the various gender Institutions and its functions for the development of women. | **K2** |
| CO4: | Assessing the International agencies. | **K3** |
| CO5: | Summarising the study on feminism and relation of gender and society | **K3** |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | 2 | 2 | - | - | - | 2 | 3 | - |
| **CO2** | - | - | - | - | - | 3 | 2 | 2 | - | - | - | 3 | 3 | - |
| **CO3** | - | - | - | - | - | 3 | 2 | 2 | 1 | - | - | 3 | 3 | - |
| **CO4** | - | - | - | - | - | 3 | 2 | 2 | 1 | - | - | 3 | 3 | - |
| **CO5** | - | - | - | - | - | 3 | 3 | 2 | 1 | - | - | 3 | 3 | - |

| | | | | | |
|---|---|---|---|---|---|
| **PCC-13** | **POWER ELECTRONICS** | **3** | **0** | **0** | **3** |

**Course Objectives**

- To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics.
- To provide strong foundation for further study of power electronic circuits and systems.

**UNIT I POWER SEMI-CONDUCTOR DEVICES 9 hours**

Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static characteristics: SCR, MOSFET and IGBT - Triggering and commutation circuit for SCR. Introduction to Driver and snubber circuits

**UNIT II PHASE-CONTROLLED CONVERTERS 9 hours**

2-pulse, 3-pulse and 6-pulseconverters– performance parameters –Effect of source inductance—Firing Schemes for converter–Dual converters, Applications-light dimmer

**UNIT III DC TO DC CONVERTERS 9 hours**

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles.

**UNIT IV INVERTERS 9 hours**

Single phase and three phase voltage source inverters (both1200 mode and 1800 mode)– Voltage & harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to space vector modulation –Current source inverter, Applications-Induction heating, UPS.

**UNIT V AC TO AC CONVERTERS 9 hours**

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications –welding .

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Third Edition, New Delhi, 2004.

T2: P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.

**REFERENCE BOOKS:**

R1. N. Mohan, T. M. Undeland, W.M. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Edition, 2007.

R2. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.

**WEB LINKS:**

1. https://www.springer.com/journal/43236

2. https://nptel.ac.in/courses/108102145

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices. | K 4 |
| CO2: | Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits | K 2 |
| CO3: | Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields. | K4 |
| CO4: | Formulate and analyze a power electronic design at the system level and assess the performance | K4 |
| CO5: | Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **2** | **1** | **2** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **2** |
| **CO2** | **1** | **1** | **2** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **2** |
| **CO3** | **1** | **2** | **2** | **1** | **1** | **-** | **-** | **1** | **-** | **-** | **-** | **1** | **3** | **3** |
| **CO4** | **1** | **1** | **1** | **2** | **1** | **-** | | **1** | **-** | **1** | **-** | **1** | **3** | **3** |
| **CO5** | **1** | **1** | **2** | **2** | **-** | **1** | **1** | **-** | **1** | **-** | **1** | **1** | **3** | **3** |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | ✓ |

| PCC-14 | CONTROL SYSTEM | 3 | 1 | 0 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- To make the students familiarize various representations of systems and analyze the stability of linear systems in time domain and frequency domain.
- To develop linear models mainly state variable model and Transfer function model
- To make the students design compensator based on the time and frequency domain Specifications

**UNIT I INTRODUCTION TO CONTROL SYSTEM 12 hours**

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram and Signal flow graph.

**UNIT II TIME DOMAIN ANALYSIS 12 hours**

Standard test inputs – Time responses – Time domain specifications – Stability analysis: Concept of stability – Routh Hurwitz stability criterion – Root locus: Construction and Interpretation.

**UNIT III FREQUENCY-RESPONSE ANALYSIS 12 hours**

Bode plot, Polar plot and Nyquist plot: – Frequency domain specifications Introduction to closed loop Frequency Response. Relationship between time and frequency response

**UNIT IV STATE VARIABLE ANALYSIS 12 hours**

State variable formulation – Non uniqueness of state space model – State transition matrix –Eigen values – Eigen vectors-Free and forced responses for Time Invariant and Time Varying Systems – Controllability – Observability

**UNIT V DESIGN OF FEED BACK CONTROL SYSTEM 12 hours**

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques –PID controller-Design using reaction curve and Ziegler-Nichols technique- PID control in State Feedback form.

**TOTAL : --45 hours**

**TEXT BOOKS:**


T1: Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.
T2: Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers 2010.


**REFERENCE BOOKS:**


R1: Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson, 3
R2: John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System
R3: Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5thEdition, 2010


**WEB LINKS:**

1. NPTEL Video Lecture Notes on “Control Engineering” by Prof.S.D.Agashe, IIT Bombay
2. https://www.electronicshub.org

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Develop the mathematical model of physical system and represent the system in transfer function | K3 |
| CO2: | Analyse the system in time-domain | K4 |

| | | |
|---|---|---|
| CO3: | Analyse the system in frequency domain | K4 |
| CO4: | Infer the stability of systems in time and frequency domain. | K2 |
| CO5: | Choose appropriate compensator for the given specifications. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO4** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| PCC-15 | TRANSMISSION AND DISTRIBUTION | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- To develop expressions for the computation of transmission line parameters. To obtain the equivalent circuits for the transmission lines based on distance and operating voltage for determining voltage regulation and efficiency. Also to improve the voltage profile of the transmission system.
- To analyses the voltage distribution in insulator strings and cables and methods to improve the same. To understand the operation of the different distribution schemes.

**UNIT I GENERATION AND TRANSMISSION SYSTEMS 12 hours**

Generation, Transmission & Distribution Scenario of India - Types of generation: Conventional and Non-conventional, Thermal Power Plant, Hydro Power Plant, Gas Power Plant, Nuclear Power Plant, Non-conventional Energy Sources - Load capacity factor - Connected load factor - Load duration curve - Selection of units. Various systems of transmission – Advantages of high transmission voltages - Comparison of conductor materials required for various overhead systems.

**UNIT II OVERHEAD LINES PARAMETERS 12 hours**

Electrical constants - Resistance, Inductance and capacitance of Single and 3 Phase lines - Effects of earth on capacitance - Skin effect - Proximity effect - Transposition - Bundled conductors - Corona – Factors affecting corona - Line supports.

**UNIT III OVERHEAD LINES PERFORMANCE 12 hours**

Short and medium transmission lines - Phasor diagrams - Nominal T and Pi methods - Line regulation - Efficiency. Rigorous solution for long line - ABCD constants - Ferranti effect - Tuned power lines - Surge impedance and surge impedance loading.

**UNIT IV LINE INSULATORS AND UNDERGROUND CABLES 12 hours**

Types of overhead line insulators- Potential distribution over a string of suspension insulators - Methods of increasing string efficiency. Types of cables- Capacitance and insulation resistance - Sheath effects - Grading - Stresses - Loss angle – Power loss - Breakdown voltage - Optimum cable length -Comparison between overhead lines and underground cables.

**UNIT V DISTRIBUTION SYSTEMS 12 hours**

Classification, functions and major components of substations - Feeders, distributors and service mains - Radial and ring main systems - Calculation of voltage in distributors with concentrated and distributed loads, AC 1-phase and 3-phase distribution systems.

**TOTAL : 60 hours**

**TEXT BOOKS:**

T1: Mehta V K, Rohit Mehta , "Principles of Power Systems", S.Chand & Co. Pvt. Ltd., New Delhi, 2004.

T2: Singh S N," Electric Power Generation, Transmission and Distribution", Prentice-Hall of India Pvt., Ltd, Delhi, 2003.

**REFERENCE BOOKS:**

R1: Soni M L, Gupta P V, Bhatnagar U S and Chakrabarthi A, "A Text Book on Power System Engineering", Dhanpat Rai & Co., New Delhi, 1997.

R2: Uppal S L, "Electrical Power", Khanna Publishers, New Delhi, Thirteenth Edition, 1995.

R3: Wadhwa C L, "Electrical Power Systems", New Age International Publishers, Delhi, 2006 Fourth Edition Reprint Aug, 2007.

R4: Gupta J B, “A Course in Electrical Power”, S. K. Kataria & Sons, 2003.

R5: Gupta B R, “Generation of Electrical Energy”, S.Chand & company New Delhi, Revised edition 2006

R6: Kothari D P and Nagrath J,” Power System Engineering”, Tata McGraw-Hill Publishing Company New Delhi, second Edition, 2007.

R7: Despande M V, 'Electrical Power Systems Design', Tata McGraw-Hill Publishing Company New Delhi, 2004

**WEB LINKS:**

1. https://circuitglobe.com/
2. https://eepower.com/technical-articles/utility-power-transmission-and-distribution-systems/#

**COURSE OUTCOMES**

| | | |
|---|---|---|
| **CO1:** | Analyze the parameters of transmission lines and explain the structure of electric power system. | K4 |
| **CO2:** | Illustrate and Estimate the transmission lines parameters. | K2,K5 |
| **CO3:** | Classify the Nominal T and PI model of transmission lines and explain ABCD constants | K4 |
| **CO4:** | Determine the voltage distribution in insulators string and explain types and construction of underground cables | K5 |
| **CO5:** | Classify the types of sub-stations and calculate the voltage in distributors with concentrated and distributed loads | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 3 | 2 | - | - | - | - | 2 | - | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 | 2 | - | - | - | - | 2 | - | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | - | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | - | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |

| | | | | | |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | |

| | | | | | |
|---|---|---|---|---|---|
| **PCC-16** | **MEASUREMENTS AND CONTROL SYSTEMS LABORATORY** | **0** | **0** | **2** | **1** |

**Course Objectives**

- To provide knowledge development on analysis and design of control system along with basics of instrumentation

**LIST OF EXPERIMENTS:**

1. Calibration of 1-Phase Energy Meter
2. Measurement of linear displacement using LVDT
3. Measurement of strain using strain gauge
4. Measurement of resistance using Wheatstone bridge.
5. Measurement of capacitance using Schering bridge
6. Measurement of inductance using Maxwell's bridge
7. Transfer function of AC Servomotor.
8. Stability analysis of a given system using Root locus
9. Frequency response analysis using Bode and Polar for given transfer function
10. Frequency response analysis of Nyquist plot for given transfer function
11. Study of response of 2nd order system with PID Controller using Simulink
12. Design of Lag, Lead and Lag-Lead Compensators

**Web Links:**

1. https://nptel.ac.in/courses/103105064
2. https://nptel.ac.in/courses/112102011

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Test the calibration of energy meter and determine the linear displacement and strain using LVDT and strain gauge respectively | K 6 |
| CO2: | Experiment with various bridges and determine the unknown quantity. | K 3 |
| CO3: | Experiment with AC servo Motor to determine its Transfer Function | K3 |
| CO4: | Analysis of given system using Root locus, Bode plot, Polar plot and Nyquist Plot. | K 4 |
| CO5: | Develop and analyze the response of 2nd order system with PID Controller using Simulink and also develop lag, lead and lag-lead compensators using simulink. | K 6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| CO2 | 3 | 3 | 1 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| CO5 | 3 | 3 | 1 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| Observation | attendance | Model Exam | End Semester Exams | Record work |
|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** |
| | | | | ✓ |

| PCC-17 | POWER ELECTRONICS LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- To expose students to operation and characteristics of power semiconductor devices and passive components, their practical application in power electronics
- To provide a practical exposure to operating principles, design and synthesis of different power electronic converters.

**List of Experiments**

1. Static Characteristics of SCR and TRIAC.
2. Static Characteristics of MOSFET and IGBT.
3. Single phase controlled half wave rectifier with R load and R –L load
4. Single phase controlled full wave rectifier with R load and R –L load
5. Step down and step up MOSFET based choppers
6. IGBT based single-phase PWM inverter
7. IGBT based three-phase PWM inverter
8. AC Voltage controller with R and RL Load
9. Study of performance of a Cycloconverter

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Set up testing strategies and select proper instruments to evaluate performance characteristics of Power devices and power electronics circuits and analyze their operation under different loading conditions. | K3 |
| CO2: | Practice different types of wiring and devices connections keeping in mind technical, economical, safety issues. | K5 |
| CO3: | Realize the limitations of computer simulations for verification of circuit behavior, apply these techniques to different power electronic circuits and evaluate possible causes of discrepancy in practical experimental observations in comparison to theory | K2 |
| CO4: | Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools. | K2 |
| CO5: | Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 1 | 1 | - | 1 | 1 | - | - | - | - | 1 | 2 | 2 |
| CO2 | - | 2 | 1 | - | - | - | - | 1 | - | - | - | 1 | 3 | 2 |
| CO3 | 1 | 2 | 1 | 1 | 2 | - | - | - | - | - | - | 1 | 2 | 3 |
| CO4 | 1 | - | - | - | 2 | 1 | 1 | - | 1 | 2 | - | - | 2 | 2 |
| CO5 | - | - | - | - | - | 1 | 1 | 2 | 2 | 2 | 2 | - | 2 | 3 |

**ASSESSMENT METHODS:**

| Observation | attendance | Model Exam | End Semester Exams | Record work |
|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** |
| | | | | ✓ |

| HSC-05 | PERSONALITY DEVELOPMENT III | 2 | 0 | 0 | 2 |
|---|---|---|---|---|---|

**Course Objectives**

1. To enhance the corporate readiness and continuous employability
2. To provide a proper verbal, written communication skills and interpersonal & group skills

**UNIT I VERBAL APPTITUDE I** **6 hours**

Phonetics/Neutral Accent/Pronunciation – Speech Mechanism/Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation – Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

**UNIT II VERBAL APTITUDE II** **6 hours**

Singular/plural-present tense/past tense—genders-Prepositions-conjunctions Choice of words—simple sentences—compound sentences---summarizing phrases— synonyms—Antonyms—Analogies—Similar Words

**UNIT III SOFT SKILLS** **6 hours**

Attitude—Meaning-Features of attitude-Formation-Personality Factors-Types of attitude-change in attitude-Developing Positive attitude

**UNIT IV TIME MANAGEMENT** **6 hours**

Definition –Meaning-Importance, Value of time as an important resource- comparison of Time and Money-Circle of influence and circle of control—Definition of URGENT and IMPORTANT—Time Wasters and how to reduce—Procrastination—meaning and impact- 4 Quadrants.

**UNIT V TEAM BUILDING** **6 hours**

Meaning—Aspects of team building—Process of team building—Types of Teams-Team ethics and Understanding-Team trust and commitment

**TOTAL : 30 hours**

**REFERENCE BOOKS:**


R1: Managing Soft Skills And Personality--B N Ghosh Mcgraw Hill Publications

R2: Principles and Practices of Management Shejwalkar and Ghanekar McGraw Hill Latest

R3: Time management for Busy people – Roberta roesch, TatamcGraw-Hill Edition

R4: Personality Development --Dr V M Selvaraj, Bhavani Publications


**WEB LINKS:**

1. https://www.artofliving.org/in-en/personality-development
2. https://www.managementstudyguide.com/personality-development.htm

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Articulate by understanding the rate and flow of speech. | K3 |
| CO2: | Choose words and phrases appropriately for any verbal communication. | K3 |
| CO3: | Develop a positive attitude in handling diverse situations. | K4 |
| CO4: | Prioritize important and urgent tasks using the four quadrants method. | K4 |
| CO5: | Practice team ethics and understanding when working with teams. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - |
| **CO3** | - | - | - | - | - | 2 | - | 2 | 2 | 1 | - | 1 | - | - |
| **CO4** | - | - | - | - | - | 2 | 1 | 2 | - | - | 1 | 1 | - | - |
| **CO5** | - | - | - | - | - | - | - | - | 3 | - | - | 1 | - | - |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| | | | | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | ✓ | |

# SEMESTER VI

| PCC-19 | POWER SYSTEM ANALYSIS | 3 | 1 | 0 | 4 |
|---|---|---|---|---|---|

**Course Objectives**

- To model the power system under steady state operating condition. To apply efficient numerical methods to solve the power flow problem.
- To model and analyse the power systems under abnormal (or) fault conditions to acquired knowledge based on employability skill. To model and analyse the transient behaviour of power system when it is subjected to a fault.

**UNIT I INTRODUCTION 12 hours**

Need for system planning and operational studies – basic components of a power system.- Introduction to restructuring - Single line diagram – per phase and per unit analysis – Generator - transformer –transmission line and load representation for different power system studies.- Primitive network -construction of Y-bus using inspection and singular transformation methods – z-bus.

**UNIT II POWER FLOW ANALYSIS 12 hours**

Importance of power flow analysis in planning and operation of power systems - statement of powerflow problem - classification of buses - development of power flow model in complex variables form -iterative solution using Gauss-Seidel method - Q-limit check for voltage controlled buses – power flowmodel in polar form - iterative solution using Newton-Raphson method .

**UNIT III FAULT ANALYSIS – BALANCED FAULTS 12 hours**

Importance of short circuit analysis - assumptions in fault analysis - analysis using Thevenin's theorem- Z-bus building algorithm - fault analysis using Z-bus – computations of short circuit capacity, postfault voltage and currents

**UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS 12 hours**

Introduction to symmetrical components – sequence impedances – sequence circuits of synchronous machine, transformer and transmission lines - sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.

**UNIT V STABILITY ANALYSIS 12 hours**

Importance of stability analysis in power system planning and operation - classification of powersystem stability - angle and voltage stability – Single Machine Infinite Bus (SMIB) system:Development of swing equation - equal area criterion - determination of critical clearing angle and time– solution of swing equation by modified Euler method.

**TOTAL : -60 hours**

**TEXT BOOKS:**


T1: Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition,2011.

T2: John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', Tata McGraw-Hill, Sixth reprint, 2010.

T3: P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, 'Electrical Power Systems-Analysis, Security and Deregulation', PHI Learning Private Limited, New Delhi, 2012.

**REFERENCE BOOKS:**

R1: HadiSaadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

R2: Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.

R3: Pai M A, 'Computer Techniques in Power System Analysis', Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.

R4: J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis & Design',Cengage Learning, Fifth Edition, 2012.

**WEB LINKS:**

1. https://onlinecourses.nptel.ac.in/noc22_ee17/unit?unit=94&lesson=95
2. www.electrical4u.com

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the nature of the modern power system, including the behavior of the components and sub-systems | K2 |
| CO2: | Apply load flow analysis to an electrical power network and interpret the results for analysis | K3 |
| CO3: | Analyze a network under balanced fault conditions and interpret the results | K4 |
| CO4: | Analyze a network under unbalanced fault conditions and interpret the results | K4 |
| CO5: | Analyze the transient stability of a single machine/infinite bus system using both analytical and time simulation methods | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | |

| PCC-20 | SOLID STATE DRIVES | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the steady sate behavior and select the motor according to the requirement of the load
- To design the current and speed controller for closed loop operation of drives

**UNIT I DRIVE CHARACTERISTICS 9 hours**

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor

**UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9 hours**

Steady state analysis of the single and three phase converter fed separately excited DC motor drive– continuous and discontinuous conduction– Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive

**UNIT III INDUCTION MOTOR DRIVES 9 hours**

Stator voltage control–energy efficient drive–v/f control–constant airgap flux–field weakening mode 68 – voltage / current fed inverter – closed loop control.

**UNIT IV SYNCHRONOUS MOTOR DRIVES 9 hours**

V/f control and self control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor.

**UNIT V DESIGN OF CONTROLLERS FOR DRIVES 9 hours**

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.

T2: Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

T3: R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice Hall of India, 2001.


**REFERENCEBOOKS:**


R1: John Hindmarsh and Alasdain Renfrew, “Electrical Machines and Drives System,” Elsevier 2012.

R2: Shaahin Felizadeh, “Electric Machines and Drives”, CRC Press(Taylor and Francis Group), 2013.

R3: S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 1993.

R4: S. Sivanagaraju, M. Balasubba Reddy, A. Mallikarjuna Prasad “Power semiconductor drives” PHI, 5th printing, 2013.

R5: N.K.De., P.K.SEN"Electric drives" PHI, 2012. 6. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill, 2007.

**WEB LINKS:**

1. https://www.electrical4u.com/electrical-drives/
2. https://www.electricaltechnology.org/2015/10/electrical-drives-ac-drives-vfd-dc-drives.html

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the steady state behaviour, dynamics of a motor load system and selection of suitable motor for different load profiles | K 2 |
| CO2: | Analyze the operation of the converter and chopper fed dc drive. | K 4 |
| CO3: | Analyze the operation of the induction motor drives | K 4 |
| CO4: | Analyze the operation of the synchronous motor drives | K 4 |
| CO5: | Develop the controller for Electrical Drives | K 3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 1 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO2** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | |

| PCC-21 | ELECTRICAL DRIVES LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- To develop the skill in working with AC and DC drives

**LIST OF EXPERIMENTS:**

1. Simulation of closed loop control of converter fed DC Motor
2. Simulation of closed loop control of chopper fed DC Motor
3. Simulation of VSI fed 3 phase induction Motor
4. Speed control of PMDC motor using 3 phase fully controlled converter
5. Speed control of 3 phase induction motor using PWM inverter
6. DSP based closed loop drive for Induction motor
7. DSP based chopper fed DC drive
8. PLC based drives
9. Speed control of DC shunt Motor using chopper
10. Speed control of BLDC motor using inverter

**TOTAL :30h**

**COURSE OUTCOME:**

| | | |
|---|---|---|
| CO1 | Analyze closed loop control of converter and chopper fed DC Motor | K4 |
| CO2 | Analyze the characteristics of induction motor drives | K4 |
| CO3 | Analyze closed loop speed control of ac and dc drives using converters | K4 |
| CO4 | Experiment with DSP based AC drive and DC drive | K3 |
| CO5 | Experiment with PLC based drives | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 3 | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 1 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | 2 | 1 | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 |
| **CO4** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 2 | 2 |

**ASSESMENT METHODS**

| Observation | attendance | Model Exam | End Semester Exams | Record work |
|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** |
| | | | | ✓ |

| PCC-22 | POWER SYSTEMS LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- To expose the students to the simulation and modelling using matlab software.
- To expose the students to the simulation and modelling using of transmission lines power flow analysis, fault and stability analysis and give them experimental skill

**LIST OF EXPERIMENTS:**

1. Computation of parameters and modelling of transmission lines
2. Formation of bus admittance and solution of networks
3. Formation of bus impedance and solution of networks
4. Load flow anaysis 1: solution of load flow and related problems using gauss-seidel method
5. Load flow anaysis 2: solution of load flow and related problems using load newton-raphson methods
6. Load flow anaysis iii: solution of load flow and related problems using fast decoupled method
7. Symmetrical fault analysis
8. Unsymmetrical fault analysis
9. Transient and small signal stability analysis – single machine infinite bus system
10. Transient stability analysis of multimachine power systems
11. Load – frequency dynamics of single area and two area power systems
12. Economic dispatch in power systems

**TOTAL :30h**

**TEXT BOOKS:**

T1: Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition,2011.

T2: John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', Tata McGraw-Hill, Sixth reprint, 2010.

T3: P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, 'Electrical Power Systems-Analysis, Security and Deregulation', PHI Learning Private Limited, New Delhi, 2012.

**REFERENCE BOOKS:**

**R1:** HadiSaadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

R2: Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.

R3: Pai M A, 'Computer Techniques in Power System Analysis', Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.

R4: J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis & Design',Cengage Learning, Fifth Edition, 2012.

**WEB LINKS:**

1. https://onlinecourses.nptel.ac.in/noc22_ee17/unit?unit=94&lesson=95
2. www.electrical4u.com

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the nature of the modern power system, including the behavior of the components and sub-systems | K2 |
| CO2: | Apply load flow analysis to an electrical power network and interpret the results for analysis | K3 |
| CO3: | Analyze a network under balanced fault conditions and interpret the results | K4 |
| CO4: | Analyze a network under unbalanced fault conditions and interpret the results | K4 |
| CO5: | Analyze the transient stability of a single machine/infinite bus system using both analytical and time simulation methods | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESMENT METHODS**

| **Observation** | **attendance** | **Model Exam** | **End Semester Exams** | **Record work** |
|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** |
| | | | | ✓ |

| HSC-06 | PERSONALITY DEVELOPMENT IV | 2 | 0 | 0 | 2 |
|---|---|---|---|---|---|

**Course Objectives**

- To enhance the soft skills and prepare them towards the skills needed for their career.

**UNIT I SOFT SKILLS V** **6 hours**

Assertiveness—Meaning—Importance of assertiveness- Characteristics of assertive communication-Merits –forms of assertion—Causes of misunderstanding

**UNIT II COMMUNICATION SKILLS** **6 hours**

Meaning—Elements of communication—Functions of communication—Principles of communication—Formal and Informal communication—Barriers in Communication—Characteristics of good communication—Feedback—communication systems.

**UNIT III PRESENTATION SKILLS I** **6 hours**

Meaning—Importance of Presentation-Concept of 5 w's and one H--- understanding the audience—Types of presentations—How to make effective presentation

**UNIT IV PRESENTATION SKILLS II** **6 hours**

Use of slide, PPT's. and visuals—Rules for slide presentation—precautions ---seminars and conferences-Steps to eliminate Stage fear.

**UNIT V CHANGE MANAGEMENT** **6 hours**

Definition – Necessity - Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

**TOTAL : 30 hours**

**TEXT BOOKS:**


T1: LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.

T2: Spencer Johnson, Who Moved My Cheese, Vermilion, First edition

T3: Adair, John, Effective Communication, London: Pan Macmillan Ltd., 2003.


**REFERENCE BOOKS:**


R1: Bovee, Courtland L, John V. Thill & Barbara E. Schatzman. Business Communication Today, Tenth Edition. New Jersey: Prentice Hall, 2010.


**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Be assertive in their communication. | K3 |
| CO2: | Differentiate the principles of formal and informal communication. | K4 |
| CO3: | Make an effective presentation by understanding the audience. | K3 |
| CO4: | Practice the rules of presentation using slides, PPT's and visuals. | K3 |
| CO5: | Discuss the principles of change management. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | 2 | 3 | 2 | 3 | 2 | 2 | - |
| **CO2** | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 | 2 | 2 | - |
| **CO3** | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 | 2 | 1 | - |
| **CO4** | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 | 2 | 1 | - |
| **CO5** | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 | 2 | 1 | - |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| | | | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | ✓ | |

| PCC-23 | SUMMER INTERNSHIP | 0 | 0 | 4 | 2 |
|---|---|---|---|---|---|

Minimum of two weeks in an Industry in the area of Electrical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the social, cultural, global and environmental responsibility as an engineer. | K2 |
| CO2: | Capability to acquire and apply fundamental principles of engineering. | K3 |
| CO3: | Ability to identify, formulate and model problems and find engineering solution based on a systems approach. | K3,K6 |
| CO4: | Adapt with all the latest changes in technological world. | K6 |
| CO5: | Ability to develop communication efficiently. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | - | - | - | - | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | - | - | - | - | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | - | - | - | - | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |
| **CO5** | - | - | - | - | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| | | | ✓ | | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | ✓ | |

# SEMESTER VII

| PCC-24 | SPECIAL ELECTRICAL MACHINES | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors. To impart knowledge on the Construction, principle of operation, control and performance of stepping motors.
- To impart knowledge on the Construction, principle of operation, control and performance of switched reluctance motors.
- To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- To impart knowledge on the Construction, principle of operation and performance of permanent magnet synchronous motors.

**UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9 hours**

Constructional features – Types – Axial and Radial flux motors – Operating principles – VariableReluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics –Applications.

**UNIT II STEPPER MOTORS 9 hours**

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle– Applications.

**UNIT III SWITCHED RELUCTANCE MOTORS 9 hours**

Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control– Applications.

**UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9 hours**

Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications.

**UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS 9 hours**

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.

T2: T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press,Oxford, 1989.

T3: . Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

**REFERENCE BOOKS:**

R1: R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design andApplication', CRC Press, New York, 2001.

R2: P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter PerengrinusLondon, 1982.

R3: T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press,London, 1988.

R4: E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

**WEB LINKS:**

1. https://circuitglobe.com/
2. https://eepower.com/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand and explain the construction, operation and performance characteristics of synchronous reluctance motor | K2 |
| CO2: | Understand the construction and principle of operation of stepper motor | K2 |
| CO3: | Analyze the operation of switched reluctance motor with and without sensors and control of SRM drive using controllers | K4 |
| CO4: | Analyze the magnetic circuit and understand the operation, characteristics and control of PMBLDC motor | K4 |
| CO5: | Understand the construction, operation ,performance characteristics of PMSM and its power controllers | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 3 | 2 | - | - | - | - | 3 | 2 | 3 | 3 |
| **CO2** | 3 | 2 | 2 | 2 | 3 | 2 | - | - | - | - | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 2 | 2 | 2 | 3 | 2 | - | - | - | - | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 | 2 | - | - | - | - | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 2 | 2 | 2 | 3 | 2 | - | - | - | - | 3 | 2 | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | |

| PCC | MICROPROCESSORS AND MICROCONTROLLERS | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- Impart knowledge on architecture of 8085 microprocessors and 8051 microcontrollers.
- Exposed to the interfacing of processors with peripheral ICs
- Develop an algorithm for various electrical and automation systems

**UNIT I 8085 MICROPROCESSOR 9 hours**

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

**UNIT II PROGRAMMING OF 8085 PROCESSOR 9 hours**

Instruction format and addressing modes – Assembly language Program – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions - stack.

**UNIT III 8051 MICROCONTROLLER 9 hours**

Hardware Architecture, pinouts – Functional Building Blocks of Controller – Memory organization – I/O ports and data transfer concepts–Interrupts- Data Transfer, Manipulation, Control Algorithms & I/O instructions, Programming on Microcontrollers

**UNIT IV PERIPHERAL INTERFACING 9 hours**

Architecture, configuration and interfacing with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085 and 8051. Case studies: Traffic light control, Keyboard and display interface

**UNIT V DESIGN OF CONTROLLERS FOR DRIVES 9 hours**

Simple programming exercises- key board and display interface - Control of servo motor, stepper motor control- Application to automation systems.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Sunil Mathur & Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt. Ltd, 2016.

T2: R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013.

T3: Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003


**REFERENCE BOOKS:**


R1: Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition,Prentice Hall of India, New Delhi, 2007.

R2: B.RAM,” Computer Fundamentals Architecture and Organization” New age International Private Limited, Fifth edition, 2017.

R3: Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.

R4: Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu,20165. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu, 2016

**WEB LINKS:**

1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.htm
2. https://www.elprocus.com/8051-microcontroller-architecture-and-applications/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain the architecture of 8085, its I/O port and memory organisation | K2 |
| CO2: | Develop assembly language programming using count, loop and look up table concepts. | K3 |
| CO3: | Explain the architecture of 8051 and write the assembly language programme in 8051 | K2 |
| CO4: | Identify the peripheral interfacing ICs for different applications | K3 |
| CO5: | Understand the interfacing of controllers with various electrical and automation systems. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 2 | 1 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| PCC-25 | POWER SYSTEM PROTECTION LAB | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- Ability to learn Modeling and simulation tool for Protection systems.
- Ability to learn ETAP software

**LIST OF EXPERIMENTS:**

1. Introduction to MATLAB and Electrical Transients Analyzer Program (ETAP)
2. Introduction to Power System Protection
3. Impact of induction motor starting on power system
4. Selection of circuit breaker for different branches of a given power system using ETAP
5. Introduction to Ground Grid Modeling in ETAP
6. Ground Grid Modeling of a Given System using ETAP
7. Modeling of Single-Phase Instantaneous Over-Current Relay using MATLAB
8. Modeling of a Differential Relay Using MATLAB
9. Comparison between the Step and Touch Potential of a T-Model and Square Model of Ground Grids under Tolerable and Intolerable in ETAP
10. Modeling of an Over-Current Relay using ETAP
11. Modeling of a Differential Relay Using ETAP
12. Modeling of Single-Phase Definite Time Over-Current Relay using MATLAB
13. Short-Circuit & Motor Acceleration Analysis in ETAP Software

**TOTAL :30h**

**TEXT BOOKS:**


1. Soni, M.L. , P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', DhanpatRai& Co., 1998
2. R.K.Rajput, "A Text book of Power System Engineering", Laxmi Publications, First Edition Reprint 2007.


**REFERENCE BOOKS:**


1. Wadhwa, C.L. 'Electrical Power Systems', New Age International (P) Ltd., 2000.
2. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.


**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | To understand power system protection | K2 |
| CO2: | Apply selection of circuit breaker | K3 |
| CO3: | Modeling and simulate differential relay using MATLAB | K5 |

| | | |
|---|---|---|
| CO4: | Modeling of an Over-Current Relay using ETAP | K5 |
| CO5: | Design of Ground Grid Modeling of a Given System using ETAP | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| **Observation** | **attendance** | **Model Exam** | **End Semester Exams** | **Record work** |
|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** |
| | | | | ✓ |

| PCC-26 | MICROPROCESSORS AND MICRO CONTROLLERS LABORATORY | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|

**Course Objectives**

- Provide training on programming of microprocessors and microcontrollers
- Understand the interface requirements

**LIST OF EXPERIMENTS:**

1. Simple arithmetic operations: addition / subtraction / multiplication / division using 8085
2. Multibyte BCD addition &subtraction in 8085.
3. Programming with control instructions using microprocessor
   i. Ascending / Descending order, Maximum / Minimum of numbers.
   ii. Hex / BCD code conversions.
4. Table Processing using 8085. .
5. Traffic light controller.
6. Interfacing and Programming of 8255 using 8085
7. Interfacing and Programming of 8279 using 8085
8. Programming basic instructions with 8051 Micro controller execution including Conditional jumps & looping.
9. Study on interface with A/D & D/A
10. Interfacing stepper motor using 8051

**TOTAL :30hours**

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain the concepts of 8085 Microprocessors and 8051 Microcontrollers | K2 |
| CO2: | Apply 8085 Microprocessor algorithm to develop simple programs | K3 |
| CO3: | Examine the interfacing of Microprocessors with various peripheral devices using Assembly Language Programs | K4 |
| CO4: | Apply 8051 Microcontroller algorithm to develop simple programs | K3 |
| CO5: | Examine the interfacing of Microcontrollers with various peripheral devices using Assembly Language Programs | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| | | ✓ | ✓ | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | ✓ | |

| PROJ 01 | PROJECT PHASE I | 0 | 0 | 8 | 5 |
|---|---|---|---|---|---|

**Course Objectives**

- To enable the students to understand basic concepts and broad principles of Industrial projects and apply the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach
- To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electrical &Electronics Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

**COURSE OUTCOME:**

| | | |
|---|---|---|
| CO1 | Identify a topic in advanced field of Electrical and Electronics Engineering. | K3 |
| CO2 | Understand and Study the problems in selected field through literature survey and reviews. | K2 |
| CO3 | Able to analyze the existing methodology and identify ways to develop solution for proposed methodology | K3,K4 |
| CO4 | Able to design engineering solution for the problem identified in proposed methodology | K6 |
| CO5 | Able to demonstrate the prototype, communicate effectively and present the work as team to achieve the goal. | K2,K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 3 | 1 | - | 1 | 1 | 1 |
| **CO2** | 3 | 2 | 2 | 1 | 3 | 2 | - | 1 | 3 | 3 | - | 3 | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| | | | | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | | | |

# SEMESTER VIII

| PROJECT | PROJECT PHASE II | 0 | 0 | 20 | 10 |
|---|---|---|---|---|---|

**Course Objectives**

- To enable the students to understand basic concepts and broad principles of Industrial projects and apply the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach
- To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context

The object of Project Work II and Dissertation is to enable the student to extend further the investigative study taken up under Project phase I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under phase 1;

2. Review and finalization of the Approach to the Problem relating to the assigned topic;

3. Preparing an Action Plan for conducting the investigation, including team work;

4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;

5. Final development of product/process, testing, results, conclusions and future directions;

6. Preparing a paper for Conference presentation/Publication in Journals, if possible;

7. Preparing a Dissertation in the standard format for being evaluated by the Department.

8. Final Seminar Presentation before a Departmental Committee.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Identify a topic in advanced field of Electrical and Electronics Engineering. | K3 |
| CO2: | Understand and Study the problems in selected field through literature survey and reviews. | K2 |
| CO3: | Able to analyze the existing methodology and identify ways to develop solution for proposed methodology | K3,K4 |
| CO4: | Able to design engineering solution for the problem identified in proposed methodology | K6 |
| CO5: | Able to demonstrate the prototype, communicate effectively and present the work as team to achieve the goal. | K2,K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | 1 | 2 | - | 1 | 3 | 1 | - | 1 | 1 | 1 |
| **CO2** | 3 | 2 | 2 | 1 | 3 | 2 | - | 1 | 3 | 3 | - | 3 | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| | | | | | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | | ✓ | |

# PROFESSIONAL ELECTIVE COURSES

| PEC-01 | ELECTRICAL MACHINE DESIGN | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the design of various parts of DC machines
- To understand the design of stator and rotor of induction and synchronous machines

**UNIT I INTRODUCTION** **9 hours**

Contents – Major considerations in Machine design Limitations in design Standard specifications Electrical Engineering materials High conductivity materials Insulating materials Magnetic circuit calculations mmf for air gap and iron path real and apparent flux densities in rotating machines- Choice of specific electric and magnetic loadings.

**UNIT II DC MACHINES** **9 hours**

Contents- Output equation - Main Dimensions - Choice of number of poles - Armature design - Estimation of number of conductors / turns – Coil armature slots- Conductor dimensions - Slot dimension - Design of field poles and field coil (shunt field) - Design of Commutators and Brushes

**UNIT III TRANSFORMERS** **9 hours**

Contents – Output equation - Design of core and winding of single- phase shell and core type transformer and three phase transformers -Temperature rise in transformers - Design of tank, cooling tubes and Ducts

**UNIT IV INDUCTION MOTORS** **9 hours**

Contents – Output equation, Main dimensions, Design of stator, Choice of L/D ratio - Air gap length - Design of rotor - squirrel cage and slip ring rotor.

**UNIT V SYNCHRONOUS MACHINES** **9 hours**

Contents – Output equation - Design of salient pole rotor machine - Dimensions - Short circuit ratio - Effect of Short Circuit ratio – Air gap length - Armature design - Slot dimensions - Rotor design - Design of damper winding - Design of cylindrical rotors

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, Fifth Edition, 1984.

T2: M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 2011

T3: Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.


**REFERENCES:**


R1: A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.

R2: Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited, 1981

R3: K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008

**WEB LINKS:**

1. https://cusp.umn.edu/electric-machine-design-videos
2. https://electricalattitude.com/2021/10/03/major-consideration-in-electrical-machine-design/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the important consideration in the design of electric machine and various factors which influence the design. | K 2 |
| CO2: | Design the armature and field of DC machines | K 6 |
| CO3: | Design yoke ,windings and cooling system of transformers | K 6 |
| CO4: | Design the stator and rotor of Induction motors | K 6 |
| CO5: | Design the stator and rotor of synchronous machines | K 6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | 2 | 1 |
| **CO2** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 2 | 3 |
| **CO4** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 2 | 3 |
| **CO5** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-02 | POWER PLANT ENGINEERING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand components; layout of Steam power plant, diesel power plant , components; different cycles ; methods to improve thermal efficiency of gas power plant
- To study the working principle, construction of power generation from non-conventional sources of energy.
- To learn the different instrumentation in power plant and basics of economics of power generation.

**UNIT I COAL BASED THERMAL POWER PLANTS 9 hours**

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems

**UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9 hours**

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems

**UNIT III NUCLEAR POWER PLANTS 9 hours**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of NuclearReactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

**UNIT IV POWER FROM RENEWABLE ENERGY 9 hours**

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar* Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

**UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9 hours**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria,relative merits & demerits, Capital & Operating Cost of different power plants. Pollution controltechnologies including Waste Disposal Options for Coal and Nuclear Power Plants.

**TOTAL : --45 hours**

**TEXT BOOK:**

T1: P.K. Nag, Power Plant Engineering, Tata McGraw – Hill Publishing Company Ltd., Third Edition, 2008

**REFERENCE BOOKS**

R1: M.M. El-Wakil, Power Plant Technology, Tata McGraw – Hill Publishing Company Ltd., 2010.

R2: Black & Veatch, Springer, Power Plant Engineering, 1996.

R3: Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, Standard Handbook of Power Plant Engineering, Second Edition, McGraw – Hill, 1998.

R4: Godfrey Boyle, Renewable energy, Open University, Oxford University Press in association with the Open University, 2004.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain the construction, Layout and components of a Thermal power plant. | K3 |
| CO2: | Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants. | K4 |
| CO3: | Explain the layout, construction and working of the components inside nuclear power plants | K4 |
| CO4: | Interpret the construction , layout of renewable energy power plants and its components | K2 |
| CO5: | Explain the knowledge to power plant economics and estimate the cost of electrical energy production | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-03 | COMPUTER ARCHITECHTURE | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

Course Objectives

- To learn the basic structure and operations of a computer to acquire employability skill based knowledge
- To learn the arithmetic and logic unit and implementation of fixed point and floating point arithmetic unit
- To learn the different ways of communication with I/O devices.

**UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9 hours**

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

**UNIT II ARITHMETIC FOR COMPUTERS 9 hours**

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Sub word Parallelism

**UNIT III PROCESSOR AND CONTROL UNIT 9 hours**

A Basic MIPS implementation – Building a Data path – Control Implementation Scheme – Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards – Exceptions.

**UNIT IV PARALLELISIM 9 hours**

Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures – Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors – Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

**UNIT V MEMORY & I/O SYSTEMS 9 hours**

Memory Hierarchy – memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB‘s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – USB.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.

T2: Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.


**REFERENCE BOOKS:**


R1: William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.

R2: John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
R3: John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approachll, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the basics structure of computers, operations and instructions. | K2 |
| CO2: | Design arithmetic and logic unit. | K4 |
| CO3: | Understand pipelined execution and design control unit. | K2 |
| CO4: | Understand parallel processing architectures. | K2 |
| CO5: | Understand the various memory systems and I/O communication. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 |
| **CO4** | 2 | 2 | 3 | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | 2 | 2 | 3 | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| PEC-04 | COMPUTATIONAL ELECTROMAGNETICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

1. To understand the about the fundamentals of electromagnetics,
2. To learn about the analytical methods of solving equations and to understand the applications of electromagnetic.

**UNIT I INTRODUCTION** **9 hours**

Conventional design methodology, Computer aided design aspects – Advantages, Review of basic fundamentals of Electrostatics and Electromagnetics, Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

**UNIT II ANALYTICAL METHODS** **9 hours**

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

**UNIT III FINITE DIFFERENCE METHOD** **9 hours**

. Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

**UNIT IV FINITE DIFFERENCE METHOD** **9 hours**

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

**UNIT V SPECIAL TOPICS** **9 hours**

Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method), Hybrid Methods, Coupled Circuit - Field Computations, Electromagnetic - Thermal And Electromagnetic - Structural Coupled Computations, Solution Of Equations, Method Of Moments, Poisson's Fields.

**TOTAL : -- 45 hours**

**TEXT BOOKS**

T1: P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.

**REFERENCE BOOKS:**

R1: M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the basic concepts of Electrostatics and Electromagnetics. | K2 |
| CO2: | Solve field equations using Roth's method, integral methods | K3 |
| CO3: | Explain finite difference methods and stability of FD Solutions | K5 |
| CO4: | Study the overview of FEM and Understand 2D and 3D finite elements. | K2 |
| CO5: | Explain Structural Coupled Computations, Method of Moments, and Poisson's Fields | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-05 | POWER SYSTEM PROTECTION AND SWITCH GEAR | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To educate the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system. To introduce the characteristics and functions of relays and protection schemes.
- To impart knowledge on apparatus protection. To introduce static and numerical relays. To impart knowledge on functioning of circuit breakers.

**UNIT I INTRODUCTION 9 hours**

Importance of protective schemes for electrical apparatus and power system – Qualitative review of faults and fault currents - relay terminology – definitions – essential qualities of protection. Protection against over voltages due to lightning and switching - arcing grounds - Peterson Coil - ground wires - surge absorber and diverters, Power System earthing – Neutral earthing - basic ideas of insulation coordination

**UNIT II OPERATING PRINCIPLES AND RELAY CHARACTERISTICS 9 hours**

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

**UNIT III APPARATUS PROTECTION 9 hours**

Main considerations in apparatus protection - transformer, generator and motor protection - protection of bus-bars - Transmission line protection - zones of protection – CTs, PTs and their applications in protection schemes.

**UNIT IV THEORY OF CIRCUIT INTERRUPTION 9 hours**

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

**UNIT V CIRCUIT BREAKERS 9 hours**

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

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Soni, M.L. , P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, ‘A Text Book on Power System Engineering’, Dhanpat Rai & Co., 1998.

T2: R.K.Rajput, “A Text book of Power System Engineering”, Laxmi Publications, First Edition Reprint 2007.


**REFERENCE BOOKS:**


R1: Sunil S. Rao, ‘Switchgear and Protection’, Khanna publishers, New Delhi, 1986.

R2: Wadhwa, C.L. ‘Electrical Power Systems’, New Age International (P) Ltd., 2000.

R3: Ravindranath, B. and N. Chander, ‘Power System Protection & Switchgear’, Wiley Eastern Ltd., 1977.

R4: Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.

R5: Paithankar Y.G. and S.R. Bhide, 'Fundamentals of Power System Protection', Prentice Hall of India Pvt. Ltd., New Delhi, 2003

**WEB LINKS:**

1. https://circuitglobe.com/
2. https://electrical4u.com/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the requirement of protective relaying in power system. | K2 |
| CO2: | Understand the principles of different types of protective relays | K2 |
| CO3: | Analyze the functioning of various protective systems. | K4 |
| CO4: | Analyze the protective system for the given power system components. | K4 |
| CO5: | Compare the working, merit and demerits of different type of circuit breakers. | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO2** | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO3** | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO4** | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO5** | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | | | ✓ | | |

| PEC-06 | ELECTRICAL AND HYBRID VEHICLES | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To provide knowledge of the operation and dynamics of electrical vehicles
- To impart knowledge on vehicle control for standard drive cycles of electrical vehicles (EVs)
- To estimate the energy requirement of EVs and Hybrid Electric Vehicles (HEVs)
- To provide knowledge about different energy sources and energy management in HEVs o provide knowledge of supervisory control of EVs

**UNIT I ELECTRIC VEHICLE ARCHITECTURE 9 hours**

History of evolution of Electric Vehicles - Series parallel architecture of Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

**UNIT II MECHANICS OF ELECTRIC VEHICLES 9 hours**

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of EV's - motor torque and power rating and battery capacity.

**UNIT III CONTROL OF DC AND AC MOTOR DRIVES 9 hours**

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.

**UNIT IV ENERGY STORAGE SYSTEMS 9 hours**

Battery: Principle of operation, types, models, SOC of battery, Traction Batteries and their capacity for standard drive cycles. Alternate sources: Fuel cells, Ultra capacitors, Fly wheels.

**UNIT V HYBRID VEHICLE CONTROL STRATEGY 9 hours**

HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode

**TOTAL : --45 hours**

**TEXT BOOKS:**

T1: Iqbal Husain, "Electric and Hybrid Electric Vehicles", CRC Press, 2011.

T2: Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017.

T3: . James Larminie and John Lowry, "Electric Vehicle Technology Explained", Second Edition 2012.

T4: Christopher D Rahn, Chao-Yang Wang, "Battery Systems Engineering", Wiley, 2013..

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the architecture and dynamics of EVs and HEVs | K3 |
| CO2: | Design an EV for standard drive cycle | K4 |
| CO3: | Understand the electrical motors' characteristics and its application for vehicle dynamics | K4 |
| CO4: | Workout the energy requirements and energy sources for EV application | K2 |
| CO5: | Mode of operation and control architecture | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO4** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 3 | 1 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-07 | DIGITAL CONTROL SYSTEM | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To provides students an introduction to the fundamental concepts and mathematics of control systems engineering.
- To know and study about the design and stability of digital control system

**UNIT I DISCRETE REPRESENTATION OF CONTINUOUS SYSTEMS 9 hours**

Basics of Digital Control Systems- Discrete representation of continuous systems - Sample and hold circuit- Mathematical Modeling of sample and hold circuit- Effects of Sampling and Quantization- Choice of sampling frequency- ZOH equivalent.

**UNIT II DISCRETE SYSTEM ANALYSIS AND STABILITY OF DISCRETE TIME SYSTEM 9 hours**

Z-Transform and Inverse Z Transform for analyzing discrete time systems- Pulse Transfer function- Pulse transfer function of closed loop systems- Mapping from s-plane to z plane- Solution of Discrete time systems- Time response of discrete time system- Stability analysis by Jury test- Stability analysis using bilinear transformation- Design of digital control system with dead beat response.

**UNIT III STATE SPACE APPROACH FOR DISCRETE TIME SYSTEMS 9 hours**

State space models of discrete systems- State space analysis- Lyapunov Stability-Controllability- reachability- Reconstructibility and observability analysis- Effect of pole zero cancellation on the controllability & observability.

**UNIT IV DESIGN OF DIGITAL CONTROL SYSTEM 9 hours**

Design of Discrete PID Controller- Design of discrete state feedback controller- Design of set point tracker- Design of Discrete Observer for LTI System- Design of Discrete compensator.

**UNIT V DISCRETE OUTPUT FEEDBACK CONTROL 9 hours**

Design of discrete output feedback control-Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

**TOTAL : -- 45 hours**

**TEXT BOOKS:**


T1: K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs, 1995.

T2: M. Gopal, “Digital Control Engineering”, Wiley Eastern, 1988.


**REFERENCE BOOKS:**


R1: G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley, 1998.

R2: B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston, 1980


**WEB LINKS:**

1. https://nptel.ac.in/courses/108103008
2. https://archive.nptel.ac.in/courses/108/103/108103008/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain discrete representation of continuous systems and modeling of sample and hold circuit. | K5 |
| CO2: | Apply Z-Transform and Inverse Z Transform for analyzing discrete time systems. | K3 |
| CO3: | Understand the concepts of Controllability and observability in discrete time systems | K2 |
| CO4: | Design a digital PID controller, Discrete Observer for LTI System and Discrete compensator | K6 |
| CO5: | Explain the design of periodic output feedback controller for discrete time systems | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO2** | 3 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO3** | 3 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO4** | 3 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO5** | 3 | 2 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-08 | CONTROL SYSTEM DESIGN | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To educate on model concepts and design tate and output feedback controllers and estimators.
- To design the controllers using the state space approach.
- To design the compensators in time and frequency domain.

**UNIT I DESIGN SPECIFICATIONS 9 hours**

Introduction to time domain and frequency domain design specification and its physical relevance- Effect of gain on transient and steady state response- Effect of addition of pole on system performance-Effect of addition of zero on system response.

**UNIT II DESIGN OF CLASSICAL CONTROL SYSTEM IN THE TIME DOMAIN 9 hours**

Introduction to compensator- Design of Lag, lead lag-lead compensator in time domain- Feedback and Feed forward compensator design- Feedback compensation- Realization of compensators.

**UNIT III DESIGN OF CLASSICAL CONTROL SYSTEM IN THE FREQUENCY DOMAIN 9 hours**

Compensator design in frequency domain to improve steady state and transient response- Feedback and Feed forward compensator design using bode diagram.

**UNIT IV DESIGN OF PID CONTROLLERS 9 hours**

Design of P, PI, PD and PID controllers in time domain and frequency domain for first and second order systems - Control loop with auxiliary feedback – Feed forward control.

**UNIT V CONTROL SYSTEM DESIGN IN STATE SPACE 9 hours**

Review of state space representation-Concept of controllability & observability - effect of pole zero cancellation on the controllability & observability of the system- pole placement design through state feedback-Design of Observer. Reduced order observer- Separation Principle.

**TOTAL : --45 hours**

**TEXT BOOKS:**


T1: Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.

T2: Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers 2010.


**REFERENCE BOOKS:**


R1: Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson Reference Book

R2: John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System

R3: Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5thEdition, 2010


**WEB LINKS:**

1. https://nptel.ac.in/courses/115108104
2. https://archive.nptel.ac.in/courses/107/106/107106081/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Analyze the design specification of frequency and time domain. | K4 |
| CO2: | Design of Lag, lead lag-lead compensator, Feedback and Feed forward compensator in time | K6 |
| CO3: | Design the Feedback and Feed forward compensator in frequency domain | K6 |
| CO4: | Design controllers to satisfy the desired specifications using simple controller structures | K6 |
| CO5: | Understand the concept of controllability and observability | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO4** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-09 | ADVANCED CONTROL SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To provide knowledge on design in state variable form.
- To provide knowledge in phase plane analysis To give basic knowledge in describing function analysis.
- To study the design of optimal controller. To study the design of optimal estimator including Kalman Filter

**UNIT I STATE VARIABLE DESIGN 9 hours**

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

**UNIT II PHASE PLANE ANALYSIS 9 hours**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

**UNIT III DESCRIBING FUNCTION ANALYSIS 9 hours**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

**UNIT IV OPTIMAL CONTROL 9 hours**

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

**UNIT V OPTIMAL ESTIMATION 9 hours**

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems- Kalman Filter-Application examples..

**TOTAL : -- 45 hours**

**TEXT BOOKS:**


T1: K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
T2: J. Thaler, " Automatic Control Systems", Jaico Publishing House, 1993.
T3: M.Gopal, Modern Control System Theory, New Age International Publishers, 2002.


**REFERENCE BOOKS:**


R1: William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
R2: Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
R3: K. Ogata, 'Modern Control Engineering', 4th edition, PHI, New Delhi, 2002.
R4: T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
R5: D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.


**WEB LINKS:**

1. https://nptel.ac.in/courses/108103007
2. https://www.btechguru.com/courses--nptel----advanced-control-systems-video-lecture--EE--EE100022V.html

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Design of state variable and state observer. | K6 |
| CO2: | Analyze linear and non linear systems. | K4 |
| CO3: | Analyze describing function for non linear systems. | K4 |
| CO4: | Explain time varying and LQR steady state optimal control | K5 |
| CO5: | Understand the optimal estimation using kalman filter using real time examples | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO4** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 1 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-10 | POWER QUALITY AND FACTS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To introduce the power quality problem , To educate on production of voltages sags, over voltages and harmonics and methods of control, To study overvoltage problems ,To study the sources and effect of harmonics in power system .
- To impart knowledge on various methods of power quality monitoring, To introduce the reactive power control techniques, To educate on static VAR compensators and their applications .

**UNIT I TRANSMISSION LINES AND SERIES/SHUNT REACTIVE POWER COMPENSATION 9hours**

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation, Shunt and series compensation at the mid-point of an AC line, Comparison of Series and Shunt Compensation.

**UNIT II THYRISTOR-BASED FLEXIBLE AC TRANSMISSION CONTROLLERS (FACTS) 9hours**

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch, Configurations/Modes of Operation, Harmonics and control of SVC and TCSC, Fault Current Limiter.

**UNIT III VOLTAGE SOURCE CONVERTER BASED (FACTS) CONTROLLERS 9hours**

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control, Working principle of Interphase Power Flow Controller, Other Devices: GTO Controlled Series Compensator, Fault Current Limiter.

**UNIT IV POWER QUALITY PROBLEMS IN DISTRIBUTION SYSTEMS 9hours**

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve**.**

**UNIT V DYNAMIC VOLTAGE RESTORER AND UNIFIED POWER QUALITY CONDITIONER AND DSTATCOM 9hours**

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies. Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

**TOTAL : -- 45hours**

**TEXT BOOKS:**

T1: N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
T2: K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.

**REFERENCE BOOKS:**

R1: R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.

R2: G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

**WEB LINKS:**

1. https://www.udemy.com/course/introduction-to-power-quality/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Analysis of uncompensated AC transmission lines | K4 |
| CO2: | Understand the configuration and modes of operation of thyristor based controllers | K2 |
| CO3: | Analyse the facts controllers | K4 |
| CO4: | Analyze the Power Quality problems in distribution systems | K4 |
| CO5: | Evaluating the Capabilities and Control Strategies of distribution systems | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 3 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO2** | 3 | 2 | 1 | 3 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | ✓ | | |

| PEC-11 | WIND AND SOLAR ENERGY SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To study the physics of wind power and energy
- To understand the principle of operation of wind generators
- To know the solar power resources
- To analyze the solar photo-voltaic cells
- To discuss the solar thermal power generation

**UNIT I PHYSICS OF WIND POWER 9 hours**

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions

**UNIT II WIND GENERATOR TOPOLOGIES: 9 hours**

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control

**UNIT III THE SOLAR RESOURCE AND THERMAL POWER GENERATION 9 hours**

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

**UNIT IV SOLAR PHOTOVOLTAIC 9 hours**

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

**UNIT V NETWORK INTEGRATION ISSUES 9 hours**

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

**TOTAL : --45 hours**

**TEXT BOOKS:**

T1: T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.

T2: G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004. \

**REFERENCE BOOKS:**

R1: S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.

R2: H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.

R3: G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.

R4: J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the fundamentals of wind energy system. | K3 |
| CO2: | Understand and select the drive system in the wind energy generation. | K4 |
| CO3: | Understand the concept of solar energy and equipments for the power generation. | K4 |
| CO4: | Apply the control techniques in the solar power generation. | K2 |
| CO5: | Understand the issues related to the grid-integration of solar and wind energy systems | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO5** | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 2 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-12 | COMPUTER AIDED POWER SYSTEM ANALYSIS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To introduce computer applications in the analysis of power systems
- To understand the solution methods and techniques used in power system studies

**UNIT I NETWORK FORMULATION & MODELLING 9 hours**

Need for system analysis in planning and operation of power system- One line diagram- Per unit representation - Symmetrical components - short circuits analysis for fault on machine terminals. Primitive network and its representation – bus incidence matrix – Formation of Bus admittance matrix and bus impedance matrices.- modeling of synchronous machines , transformers, loads, P-equivalent circuit of transformer with off-nominal tap ratio.

**UNIT II SHORT CIRCUIT STUDIES 9 hours**

Types of faults - Algorithms for fault calculations — sequence impedance matrices - Symmetrical and unsymmetrical fault analysis using Zbus.

**UNIT III LOAD FLOW STUDIES 9 hours**

Formulation of load flow problem - bus classification – Solution by Gauss - Seidal , Newton - Raphson and Fast decoupled methods - Comparison -. Computation of slack bus power, transmission loss and line flow

**UNIT IV ECONOMICAL OPERATION OF GENERATING STATIONS 9 hours**

Optimal operation of generators – economical scheduling of thermal plant with and without transmission losses – Loss formula derivation- unit commitment - Elementary idea of optimal load scheduling of Hydro - Thermal plants.

**UNIT V STABILITY STUDIES 9hours**

Steady state and transient stability - Swing equation and its solution by modified Euler and Runge-Kutta methods - Equal area criterion - Factors affecting stability and methods of improving stability- Causes of voltage instability – voltage stability proximity indices for two-bus system.

**TOTAL : -- 45 hours**

**TEXT BOOKS:**


T1: Hadi Saadat,"Power System Analysis", Tata McGraw-Hill Editions ,2007

T2: Gupta B R, "Power System Analysis and Design", S.Chand and company Ltd., New Delhi, 2005


**REFERENCE BOOKS:**


R1: PAI, M A,"Computer Techniques in Power System Analysis" Tata McGraw-Hill, Second edition, 2006.

R2: Wadhwa C L "Electrical Power Systems", New Age International (P) Ltd, New Delhi, Third Edition, 2003.

R3: Kothari D P, Nagrath I J, “Power System Engineering “Tata McGraw-Hill, Second edition.

R4: Nagsarkar T K, Sukhija M S, “Power system Analysis“, Oxford University Press, 2007.

**Web Links:**

1. https://nptel.ac.in/courses/108105067
2. https://www.electrical4u.com/load-flow-or-power-flow-analysis/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain about modelling of network and its formulation. | K3 |
| CO2: | Discuss about short circuit studies. | K5 |
| CO3: | Discuss about short circuit studies. | K3 |
| CO4: | Explain economical operation of generating stations. | K4 |
| CO5: | Discuss about stability studies | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 1 | 0 | - | - | - | - | - | - | - | 1 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 1 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| PEC-13 | POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To Provide knowledge about the stand alone and grid connected renewable energy systems. To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyze and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems. To develop maximum power point tracking algorithms.

**UNIT I INTRODUCTION 9 hours**

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

**UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9 hours**

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

**UNIT III POWER CONVERTERS 9 hours**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

**UNIT IV ANALYSIS OF WIND AND PV SYSTEMS 9 hours**

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

**UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9 hours**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

**TOTAL : --45 hours**

**TEXT BOOKS:**


T1: S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.

T2: B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009.


**REFERENCE BOOKS:**


R1: Rashid .M. H “power electronics Hand book”, Academic press, 2001.

R2: Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.

R3: Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.

R4: Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.

R5: Andrzej M. Trzynnadlowski, 'Introduction to Modern Power Electronics', Second edition, wiley India Pvt. Ltd, 2012.

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Able to understand the fundamentals of electric energy conversion systems. | K2 |
| CO2: | Able to analyze the fundamental and principles of electrical machine operation in renewable energy | K4 |
| CO3: | Able to understand the design and operation of solar and wind power converters | K4 |
| CO4: | Able to examine the variable speed in wind energy conversion system | K2 |
| CO5: | Able to identify the need for hybrid systems. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-14 | SMART GRID | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To learn the Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the power quality management issues in Smart Grid. The high performance computing for Smart Grid applications.

**UNIT I INTRODUCTION TO SMART GRID 9 hours**

Evolution of Electric Grid, Concept-Definitions and Need for Smart Grid-Smart grid drivers-functions, opportunities -challenges and benefits -Difference between conventional & Smart Grid -National and International Initiatives in Smart Grid.

**UNIT II SMART GRID TECHNOLOGIES 9 hours**

Technology Drivers -Smart energy resources -Smart substations -Substation Automation -Feeder Automation -Transmission systems: EMS, FACTS and HVDC -Wide area monitoring -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).

**UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9 hours**

Introduction to Smart Meters – Advanced Metering infrastructure(AMI) drivers and benefits- AMI protocols -standards and initiatives -AMI needs in the smart grid -Phasor Measurement Unit(PMU) -Intelligent Electronic Devices(IED) & their application for monitoring & protection.

**UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9 hours**

Power Quality & EMC in Smart Grid -Power Quality issues of Grid connected Renewable Energy Sources -Power Quality Conditioners for Smart Grid -Web based Power Quality monitoring -Power Quality Audit.

**UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9 hours**

Local Area Network(LAN) -House Area Network(HAN) -Wide Area Network(WAN) -Broad band over Power line(BPL) -IP based Protocols -Basics of Web Service and CLOUD Computing to make Smart Grids smarter -Cyber Security for Smart Grid.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2012.

T2: Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage,Jian zhong Wu,Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley 2012.


**REFERENCE BOOKS:**


R1: VehbiC. 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, November2011.

R2: Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang"SmartGrid –The New and Improved Power Grid: A Survey" ,IEEE Transaction on Smart Grids,vol.14,2012.

R3: James Momohe "Smart Grid: Fundamentals of Design and Analysis,", Wiley-IEEE Press , 2012.

**WEB LINKS:**

1. https://www.techopedia.com/definition/692/smart-grid

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Develop more understanding on the concepts of Smart Grid and its present developments. | K3 |
| CO2: | Examine different Smart Grid technologies. | K4 |
| CO3: | Explain about different smart meters and advanced metering infrastructure. | K5 |
| CO4: | Explain power quality management in Smart Grids. | K5 |
| CO5: | Develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO3** | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO4** | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |
| **CO5** | 2 | 2 | 1 | 2 | 2 | 2 | - | - | - | - | 2 | 2 | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | |

| PEC-15 | POWER SYSTEM OPERATION AND CONTROL | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- To study the economic operation of power system to create knowledge for employability skill.

**UNIT I INTRODUCTION** **9 hours**

System load – variation - load characteristics - load curves and load-duration curve (daily, weekly and annual) - load factor - diversity factor. Importance of load forecasting and simple techniques of forecasting. An overview of power system operation and control and the role of computers in the implementation. (Qualitative treatment with block diagram).

**UNIT II ACTIVE POWER - FREQUENCY CONTROL** **9 hours**

Basics of speed governing mechanism and modelling - speed-load characteristics – load sharing between two synchronous machines in parallel. Control area concept LFC control of a single-area system. Static and dynamic analysis of uncontrolled and controlled cases. Integration of economic dispatch control with LFC. Two-area system – modelling - static analysis of uncontrolled case - tie line with frequency bias control of two-area system - state variable model.

**UNIT III REACTIVE POWER–VOLTAGE CONTROL** **9 hours**

Basics of reactive power control. Excitation systems – modelling. Static and dynamic analysis - stability compensation - generation and absorption of reactive power. Relation between voltage, power and reactive power at a node - method of voltage control – tap changing transformer. System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

**UNIT IV COMMITMENT AND ECONOMIC DISPATCH** **9 hours**

Statement of economic dispatch problem – cost of generation – incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and λ- iteration method. (No derivation of loss coefficients). Statement of Unit Commitment problem – constraints; spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods - Priority-list methods - forward dynamic programming approach. Numerical problems only in priority-list method using full-load average production cost.

**UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9 hours**

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology – state estimation - security analysis and control. Various operating states (Normal, alert, emergency, in-extremis and restorative). State transition diagram showing various state transitions and control strategies.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.

T2: Chakrabarti & Halder, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004.


**REFERENCE BOOKS:**


R1: Kothari, D.P. and I.J. Nagrath, 'Modern Power System Analysis', Tata McGraw Hill Publishing Company Limited, New Delhi, Third Edition, 2003.

R2: Grigsby, L.L. 'The Electric Power Engineering, Hand Book', CRC Press & IEEE Press, 2001.

R3: Hadi Saadat, "Power System Analysis", 11th Reprint 2007.

R4: Kundur, P. 'Power System Stability and Control' MC Craw Hill Publisher, USA, 1994.

R5: Olle.I.Elgerd, 'Electric Energy Systems theory An introduction' Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

R6: Wadhwa, C.L."Electric Power System", New Age International Publications, 4th Edition,2005.


**WEB LINKS:**

1. www.electrical4u.com
2. https://electrical-engineering-portal.com/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the importance of load forecasting and other factors in the power system operation | K2 |
| CO2: | Analyze the modeling of single area and two area system. | K4 |
| CO3: | Understand and analyze the methods of voltage control | K2 |
| CO4: | Solve the key issues related to economic dispatch and unit commitment. | K3 |
| CO5: | Understand the importance and usage of computer control for monitoring and data acquisition in power systems. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| PEC-16 | HIGH VOLTAGE ENGINEERING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the various types of over voltages in power system and protection methods. To know about the generation of over voltages in laboratories.
- To understand the measurement of over voltage, Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics

**UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9hours**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary Over voltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against over voltages.

**UNIT II DIELECTRIC BREAKDOWN 9hours**

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – BreakdownMechanisms in solid and composite dielectrics

**UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9hours**

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

**UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9hours**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – PeakVoltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement

**UNIT V HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS AND HIGH VOLTAGE LABORATORIES 9hours**

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, McGraw Hill Education, 2013

T2: C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers, 2007.

T3: D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 1993.

**REFERENCE BOOKS:**


R1: E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication, 2000.

R2: R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011.

R3: L.L. Alston, ‘High Voltage Technology’, Oxford University Press, First Indian Edition, 2011.


**WEB LINKS:**

1. https://nptel.ac.in/courses/108104048

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the over voltage phenomenon and Protection against over voltages in electrical Power systems | K2 |
| CO2: | Understand and Analyse the various breakdown mechanisms of different dielectrics | K4 |
| CO3: | Understand and Analyze the generation of high voltage and high currents | K4 |
| CO4: | Understand and Analyse the measurement techniques of high voltages & currents with their relative merits and demerits | K4 |
| CO5: | Analyze and test the power apparatus and insulation coordination | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| PEC-17 | POWER SYSTEM DYNAMICS AND CONTROL | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the about the power system stability, to analyze the linear dynamical system
- To model synchronous machines and its controllers and to understand about the stability analysis.

**UNIT I INTRODUCTION TO POWER SYSTEM OPERATIONS 9 hours**

Introduction to power system stability, Power System Operations and Control, Stability problems in Power System, Impact on Power System Operations and control.

**UNIT II ANALYSIS OF LINEAR DYNAMICAL SYSTEM AND NUMERICAL METHODS 9 hours**

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

**UNIT III MODELING OF SYNCHRONOUS MACHINES AND ASSOCIATED CONTROLLERS 9 hours**

Modeling of synchronous machine: Physical Characteristics., Rotor position dependent model, D-Q Transformation. Model with Standard Parameters, Steady State Analysis of Synchronous Machine, Short Circuit Transient Analysis of a Synchronous Machine, Synchronization of Synchronous Machine to an Infinite Bus, Modeling of Excitation and Prime Mover Systems, Physical Characteristics and Model, Excitation System Control, Automatic Voltage Regulator, Prime Mover Control Systems, Speed Governors.

**UNIT IV MODELING OF OTHER POWER SYSTEM COMPONENTS 9 hours**

Modeling of Transmission Lines and Loads, Transmission Line Physical Characteristics, Transmission Line Modeling. Load Models - induction machine model, Frequency and Voltage Dependence of Loads, Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

**UNIT V STABILITY ANALYSIS 9 hours**

Angular stability analysis in Single Machine Infinite Bus System, Angular Stability in multimachine systems – Intra-plant, Local and Inter-area modes, Frequency Stability: Centre of Inertia Motion, Load Sharing: Governor Droop, Single Machine Load Bus System: Voltage Stability, Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs

**TOTAL : -- 45hours**

**TEXT BOOKS:**

T1: K.R. Padiyar, “Power System Dynamics, Stability and Control”, B. S. Publications, 2002

T2: P. Kundur, “Power System Stability and Control”, McGraw Hill, 1995.

**REFERENCE BOOKS:**

R1: P. Sauer and M. A. Pai, “Power System Dynamics and Stability”, Prentice Hall, 1997.

**WEB LINKS:**

1. https://nptel.ac.in/courses/108101004

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the basic considerations of stability | K2 |
| CO2: | Analyze synchronous machine mathematical expressions | K4 |
| CO3: | Modeling and Analyzing the function of excitation system. | K4 |
| CO4: | Analyze the mathematical methods for Transient stability | K4 |
| CO5: | Analyze the mathematical methods for Dynamic stability | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | ✓ | | |

| PEC-18 | ELECTRICAL SYSTEM DESIGN | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system.

**UNIT I ELEMENTARY MATERIALS SCIENCE CONCEPTS 9 hours**

Bonding and types of solids, Crystalline state and their defects, Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect.

**UNIT II DIELECTRIC PROPERTIES OF INSULATORS IN STATIC AND ALTERNATING FIELD 9 hours**

Dielectric constant of mono-atomic gases, poly-atomic molecules and solids, Internal field in solids and liquids, Properties of Ferro-Electric materials, Polarization, Piezoelectricity, Frequency dependence of Electronic and Ionic Polarizability, Complex dielectric constant of non-dipolar solids, dielectric losses

**UNIT III MAGNETIC PROPERTIES AND SUPERCONDUCTIVITY 9 hours**

Magnetization of matter, Magnetic Material Classification, Ferromagnetic Origin, Curie-Weiss Law, Soft and Hard Magnetic Materials, Superconductivity and its origin, Zero resistance and Meissner Effect, critical current density.

**UNIT IV CONDUCTIVITY OF METALS 9 hours**

Ohm's law and relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.

**UNIT V SEMICONDUCTOR MATERIALS 9 hours**

Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, Trends in materials used in Electrical Equipment.

**TOTAL : --45 hours**

**TEXT BOOKS:**


1. Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.
2. Electrical Properties of Materials, 8th Edition by Solymar, L, Oxford University PressNew Delhi.


**REFERENCE BOOKS::**


1. Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S. Chand & Company Ltd-New Delhi.
2. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the use of bonding and crystallinity in the concept of electrical materials. | K2 |
| CO2: | Make use of the dielectric properties of insulators in static and alternating fields in the related system. | K3 |
| CO3: | Apply the magnetic properties and superconductivity in the electrical system. | K3 |
| CO4: | Explain the behavior of conductivity of metals. | K5 |
| CO5: | Understand the facts of semiconductor materials by means of carrier density and band gap. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| PEC-19 | HIGH VOLTAGE DIRECT CURRENT TRANSMISSION SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the concept, planning of DC power transmission and compare with AC Power transmission.
- To study about the HVDC system control and to analyze harmonics and develop the skill of designing filters

**UNIT I INTRODUCTION** **9 hours**

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

**UNIT II ANALYSIS OF HVDC CONVERTERS** **9 hours**

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

**UNIT III CONVERTER AND HVDC SYSTEM CONTROL** **9 hours**

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

**UNIT IV REACTIVE POWER AND HARMONICS CONTROL** **9 hours**

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.

**UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS** **9 hours**

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study

**TOTAL : 45 hours**

**TEXT BOOKS:**


1. Padiyar, K. R., “HVDC power transmission system”, New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age International (P) Ltd., New Delhi, 1990.

**REFERENCE BOOKS:**


1. Kundur P., “Power System Stability and Control”, McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, “High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1960.
3. Arrillaga, J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.
4. S. Kamakshaiah, V. Kamaraju, ‘HVDC Transmission’, Tata McGraw Hill Education Private Limited, 2011.


**Web Links:**

1. https://www.electrical4u.com/high-voltage-direct-current-transmission/
2. https://circuitglobe.com/hvdc-high-voltage-direct-current.html

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand and explain the benefits, types and application of HVDC Transmission system. | K 2 |
| CO2: | Analyze the configuration and characteristics of HVDC converter. | K 4 |
| CO3: | Examine the Converter control characteristics, Firing angle control and extinction angle control schemes. | K 4 |
| CO4: | Identify the requirements in HVDC for reactive power and harmonics control | K 3 |
| CO5: | Analyze the power flow control in AC and DC system | K 4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | 1 | 1 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| PEC-20 | ELECTRICAL ENERGY CONSERVATION AND AUDITING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of energy conservation and energy auditing.
- To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding energy conservation and energy auditing.

**UNIT I BASICS OF ENERGY AND ITS VARIOUS FORMS 9 hours**

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.

**UNIT II ENERGY MANAGEMENT & AUDIT 9 hours**

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.

**UNIT III ENERGY EFFICIENCY IN ELECTRICAL SYSTEMS 9 hours**

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.

**UNIT IV ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS 9 hours**

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.

**UNIT V ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS 9 hours**

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.,industrial and electrical systems.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
T2: Wadhwa, C.L. 'Generation, Distribution and Utilization of Electrical Energy', New Age International Pvt. Ltd, 2003

**REFERENCE BOOKS:**

R1: Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online).
R2: Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).

**WEB LINKS:**

1. https://www.alternative-energy-tutorials.com/green-energy/energy-saving-tips.html
2. https://www.coursera.org/lecture/electric-power-systems/generation-transmission-distribution-substations-transformers-x97Oo

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain about the energy management and auditing process. | K5 |
| CO2: | Explain about the basic concepts of economic analysis and load management | K5 |
| CO3: | Explain the effective load management system | K5 |
| CO4: | Able to improve the efficiency in compressed air system | K5 |
| CO5: | Explain the design concepts in the field of lighting systems, light sources | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | - | 3 | - | - | - | - | - | - | 3 | - |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| PEC-21 | INDUSTRIAL ELECTRICAL SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- Impart knowledge on effective utilization of Electrical Drives, Electrical Traction and Electro Mechanical process
- Introduce various methods of effectively and efficiently utilizing Electrical Energy for different and desired applications

**UNIT I ELECTRICAL SYSTEM COMPONENTS 9 hours**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, Protection components- Fuse, MCB, MCCB, ELCB, Symbols for wiring components, Single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

**UNIT II RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS 9 hours**

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

**UNIT III ILLUMINATION SYSTEMS 9 hours**

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

**UNIT IV INDUSTRIAL ELECTRICAL SYSTEMS 9 hours**

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

**UNIT V INDUSTRIAL ELECTRICAL SYSTEM AUTOMATION 9 hours**

Study of basic PLC, Role of automation, Advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.

T2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.

**REFERENCE BOOKS:**

R1. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.

R2. . H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008

**WEB LINKS:**

1**.** IS Standards : https://bis.gov.in

2. https://nptel.ac.in/courses/108107112

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand various components of industrial electrical systems. | K 2 |
| CO2: | To explain electrical wiring systems for residential, commercial and industrial consumers through symbols, drawings and SLD | K 2 |
| CO3: | Justify the need of industrial electrical system components and industrial automation | K4 |
| CO4: | Evaluate the size, rating and cost of electrical installations for residential and commercial applications | K5 |
| CO5: | Design appropriate electrical system with protective equipments for industrial applications | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **2** | **2** | **-** | **1** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **3** |
| **CO2** | **2** | **2** | **1** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **2** |
| **CO3** | **3** | **-** | **-** | **2** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **3** |
| **CO4** | **2** | **2** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **1** | **-** | **2** | **2** |
| **CO5** | **2** | **3** | **2** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **2** |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| PEC-22 | BIOMEDICAL INSTRUMENTATION | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To impart knowledge of the principle of operation and design of biomedical instruments.
- To render a broad and modern account of biomedical instruments.

**UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9 hours**

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors

**UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9 hours**

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

**UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9 hours**

Electrodes – Limb electrodes –floating electrodes – pregelled disposability electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

**UNIT IV IMAGING MODALITIES AND ANALYSIS 9 hours**

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

**UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9 hours**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007
T2: Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi,2nd edition, 2003

**REFERENCE BOOKS:**

R1. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
R2. . M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.

**WEB LINKS:**

1**.** https://onlinecourses.nptel.ac.in/noc22_md01/preview

2. https://www.journals.elsevier.com/biomedical-journal

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the bioelectric potentials,the electrode theory, different types of electrodes and transducers. | K 2 |
| CO2: | Explain pulmonary measurements, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, artificial kidney machine. | K 4 |
| CO3: | Explain the working and concepts of ECG,EMG,EEG, plethysmography, impedance cardiology, cardiac arrhythmia’s, pace makers, defibrillators | K2 |
| CO4: | Analyze Clinical Flame photometer ,spectrophotometer ,Colorimeter,chromatography, Blood Gas Analyz, Blood pH Measurement, Blood Cell Counters | K4 |
| CO5: | Explain Medical imaging, Xrays, laser applications, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy. | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **-** |
| **CO2** | **3** | **-** | **-** | **-** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **-** |
| **CO3** | **-** | **2** | **-** | **-** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **1** |
| **CO4** | **3** | **-** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **2** |
| **CO5** | **3** | **-** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **-** |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | ✓ |

| PEC-23 | RESTRUCTURED POWER SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- This course will provide the student with an overview of the restructuring and different restructuring models.
- Explain the students to stranded costs, market operations, and transmission pricing and congestion management.

**UNIT I POWER SYSTEM RESTRUCTURING 9 hours**

Typical Structure of a deregulated electricity system ,Comparison with Vertically integrated electric utility, Motivaton for restructuring of power system-Different entities-Benefits from a competitive environment. Restructuring Models-poolco, bilateral, hybrid models-ISO, Role of ISO, Power exchange-Market Clearing Price-Single Auction and Double Auction Power Pool.

**UNIT II TRANSMISSION AND CONGESTION PRICING 9 hours**

Transmission Pricing, Transmission cost allocation methods: Postage stamp rate method, contract path method, MW Mile method with examples, Congestion Pricing, Congestion pricing methods, Transmission rights.

**UNIT III TRANSMISSION AND CONGESTION PRICING 9 hours**

Transmission Pricing, Transmission cost allocation methods: Postage stamp rate method, contract path method, MW Mile method with examples, Congestion Pricing, Congestion pricing methods, Transmission rights.

**UNIT IV CONGESTION MANAGEMENT AND AVAILABLE TRANSFER CAPABILITY 9 hours**

Management of Inter-zonal and intra- zonal congestion, solution procedure, Formulation of Inter-zonal congestion sub problem with examples, Formulation of Intra-zonal congestion sub problem with examples, Definitions, OASIS, Methods of ATC Determination.

**UNIT V ANCILLARY SERVICE MANAGEMENT 9hours**

Classification of Ancillary services as per NERC – Load generation balancing related services services – Voltage control and reactive power support devices – Black start capability service- NERC standards CPS1 and CPS2 –Case studies.

**TOTAL : -- 45hours**

**TEXT BOOKS:**


T1: Mohammad Shahidepour Mueaffaq Alomoush, Marcel Dekker, “Restructured Electrical power systems Operation, Trading and Volatility ", CRC Press; 1st edition, 2001.

T2: Kankar Bhattacharya, Math H.J. Boolen, Jaap E. Daadler, " Operation of restructured power systems ", Kluwer Academic publishers, 2012.


**REFERENCE BOOKS:**


R1: Loi Lei Lai ,John, " Power System Restructuring and deregulation Trading, Performance and information Technology ", John Wiley &Sons Ltd ,England ,2001.

R2: Marija Illic, Francisco Galiana and Lester fink, “Power System Restructuring Engineering and Economics ", Kluwer Academic publishers, USA 2013.
R3: P.Venkatesh, B.V.Manikantan, S.Charles raja, “Electrical Power systems Analysis, security and deregulation ", PHI Learning private limited, New Delhi 2012.

**WEB LINKS:**

1. https://nptel.ac.in/courses/108101005/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the need of restructuring of power system, different entities in deregulated environment, different market place mechanism and reasons and objectives of deregulation of various power system across all. | K2 |
| CO2: | Analyze the various market models, levels of competition exist among these models and features of electricity as a commodity. | K4 |
| CO3: | Analyze the different types of Transmission cost allocation methods | K4 |
| CO4: | Analyze the Congestion Management methods and able to calculate ATC using different mechanisms. | K4 |
| CO5: | Analyze about various ancillary services and markets for these services in National and International scenario. | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | ✓ | | |

| PEC-24 | SCADA AND DCS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- This course focus on basic concepts of implementation of digital controllers for industrial process, components of SCADA and DCS, architecture of DCS.

**UNIT I INTRODUCTION TO DIGITAL CONTROLLERS 9hours**

Introduction - Computer in process control - Data loggers, Data acquisition systems (DAS) – Data storage with time stampings - Direct Digital Control (DDC), Supervisory Digital Control (SCADA) - Controller software -Man machine interface- Management Information System.

**UNIT II COMPUTER CONTROLLED SYSTEMS AND COMPONENTS OF SCADA 9hours**

Basic building blocks of Computer controlled systems – SCADA – Data Acquisition System – Supervisory Control – Direct digital Control. SCADA: - Hardware and software, Remote terminal UNITs, Master Station and Communication architectures.

**UNIT III DISTRIBUTED CONTROL SYSTEM 9hours**

DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities.

**UNIT IV INTERFACES IN DCS 9hours**

Operator interfaces - Low level and high level operator interfaces – Displays - Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS.

**UNIT V APPLICATIONS OF SCADA & DCS IN INDUSTRIES 9hours**

Applications of SCADA & DCS in Thermal power plant, Cement manufacturing Industries, Sugar Industries, paper manufacturing Industries and Water Treatment plant.

**TOTAL : -- 45hours**

**TEXT BOOKS:**


T1: Krishna kant, “Computer based industrial control”, PHI, second edition, 2010.
T2: Michael P. Lukas, “Distributed Control System”, Van Nostrand Reinhold Co., Canada, 1995.
T3: David Bailey & Edwin Wright, “Practical SCADA for Industry”, Elsevier 2003.


**REFERENCE BOOKS:**


R1: Krishna Kant, “Digital control systems”, ISTE learning materials centre, First edition 2001.
R2: Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: “DNP3, 60870.5 and Related Systems”, Newnes, 1st Edition, 2004.


**WEB LINKS:**

1. https://www.elprocus.com/distributed-control-system-features-and-element

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | To understand the basics of digital controllers | K2 |
| CO2: | To understand the concepts of computer controlled systems | K2 |
| CO3: | To understand the architecture of distributed control system | K2 |
| CO4: | To know the basics of operator interfaces in DCS | K2 |
| CO5: | To understand the applications of SCADA and DCS in industries | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 1 | 1 | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | ✓ | | |

# OPEN ELECTIVE COURSES

| OEC – 01 | ELECTRICAL MACHINES-III | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To introduce the concepts of ideal synchronous machines and poly-phase induction machines
- Applications which will be utilized in the electrical machines with its performance and theory of operation.

**UNIT I THEORY OF IDEAL SYNCHRONOUS MACHINES 9 hours**

The ideal synchronous machine, synchronous machine inductances, transformation to direct and quadrature axis variables, basic machine relation id dq0 variables, steady state analysis using dq0, transient analysis, three-phase short circuit, transient power angle characteristics, effect of additional rotor circuits.

**UNIT II THEORY OF IDEAL POLY-PHASE INDUCTION MACHINES 9 hours**

The ideal induction machine, transformation to dq variables, basic machine relation in dq variables, steady state analysis using dq0, electrical transients in induction machine, single phasing of three-phase induction motor, power invariance.

**UNIT III FRACTIONAL HORSE POWER MOTOR 9 hours**

Qualitative examination, starting and running performance of single phase induction motor, revolving field theory of single-phase induction motor, AC tachometer, unbalanced operation of symmetrical two-phase machine, the symmetrical component concept, twophase control motors.

**UNIT IV AC COMMUTATOR MOTORS 9 hours**

Rotational EMFs in commutator windings, action of commutator as frequency converter, effect of EMF injection in secondary circuit of three-phase slip-ring induction motor, secondary (slip) power, constant HP and constant torque drives, Kramer and Scherbius system of speed control, single-phase series motors, universal motors, phasor diagrams, methods of improving commutation.

**UNIT V SPECIAL MOTORS 9 hours**

Hystersis motor, reluctance motor, stepper motor, Synchros and linear induction motor, Permanent magnet brushless DC motor.

**TOTAL : 45 hours**

**TEXT BOOKS:**


1. “Electrical machines”, Fitzerald and Kingseley, 2nd edition, McGrawHill.
2. “Performance and design of AC commutator machines”, E. O. Taylor.


**REFERENCE BOOKS:**


1. “Generalized theory of electrical machines”, Bimbhra, Khanna Pbs.
2. “Power system stability”, Kimbark, vol-3, Wiely
3. “General theory of electrical machines”, Adkins.


**WEB LINKS:**

1. https://pythonprogramming.net/
2. https://www.geeksforgeeks.org/python-programming-language/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain the theory of ideal synchronous machines and, basic machine relation | K2 |
| CO2: | Analyze and apply the concept of steady state analysis and electrical transients in polyphase machines. | K2 |
| CO3: | Examine the starting and running performance of single phase induction motor and revolving field theory. | K3 |
| CO4: | Make use of various speed control system for AC motors. | K3 |
| CO5: | Evaluate the basic operation and performance of special machines and can select special machines for different purpose. | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | 3 | 2 | 1 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | 3 | 2 | 1 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| OEC-02 | ELECTRICAL MATERIALS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system.

**UNIT I ELEMENTARY MATERIALS SCIENCE CONCEPTS 9 hours**

Bonding and types of solids, Crystalline state and their defects, Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect.

**UNIT II DIELECTRIC PROPERTIES OF INSULATORS IN STATIC AND ALTERNATING FIELD 9 hours**

Dielectric constant of mono-atomic gases, poly-atomic molecules and solids, Internal field in solids and liquids, Properties of Ferro-Electric materials, Polarization, Piezoelectricity, Frequency dependence of Electronic and Ionic Polarizability, Complex dielectric constant of non-dipolar solids, dielectric losses

**UNIT III MAGNETIC PROPERTIES AND SUPERCONDUCTIVITY 9 hours**

Magnetization of matter, Magnetic Material Classification, Ferromagnetic Origin, Curie-Weiss Law, Soft and Hard Magnetic Materials, Superconductivity and its origin, Zero resistance and Meissner Effect, critical current density.

**UNIT IV CONDUCTIVITY OF METALS 9 hours**

Ohm's law and relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.

**UNIT V SEMICONDUCTOR MATERIALS 9 hours**

Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, Trends in materials used in Electrical Equipment.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.

T2: Electrical Properties of Materials, 8th Edition by Solymar, L, Oxford University PressNew Delhi.


**REFERENCE BOOKS:**


R1: Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S. Chand & Company Ltd-New Delhi.

R2: Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi


**WEB LINKS:**

1. https://www.electrical4u.com/dielectric-properties-of-insulation/
2. https://irds.ieee.org/topics/semiconductor-materials

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the use of bonding and crystallinity in the concept of electrical materials. | K2 |
| CO2: | Make use of the dielectric properties of insulators in static and alternating fields in the related system. | K3 |
| CO3: | Apply the magnetic properties and superconductivity in the electrical system. | K3 |
| CO4: | Explain the behavior of conductivity of metals. | K5 |
| CO5: | Understand the facts of semiconductor materials by means of carrier density and band gap. | K3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| OEC -03 | FUNDAMENTALS OF NANOSCIENCE | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To introduce the concept and develop skill on Nano science and Nanotechnology.
- To learn about basis of nanomaterial science, preparation method, types and application.

**UNIT I INTRODUCTION** **9 hours**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION** **9 hours**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III NANOMATERIALS** **9 hours**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

**UNIT IV CHARACTERIZATION TECHNIQUES** **9 hours**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation.

**UNIT V APPLICATIONS** **9 hours**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1.A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

T2.N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

**REFERENCE BOOKS:**


R1: G Timp, “Nanotechnology”, AIP press/Springer, 1999.

R2: AkhleshLakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.


**WEB LINKS:**

1. https://edubuzz360.com/ge8073-fundamentals-of-nano-science/
2. http://www.lkouniv.ac.in/site/writereaddata/siteContent/20200412080803947 4anupam_tripathi_engg_Nanotechnology.pdf

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the fundamentals of Nano science | K 2 |
| CO2: | Demonstrate the preparation of nanomaterials | K 2 |
| CO3: | Understand about the science of nanomaterials | K 2 |
| CO4: | Develop knowledge in characteristic nanomaterial | K 3 |
| CO5: | Identify the right nanomaterial against the applications. | K 3 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO2** | - | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO3** | - | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO4** | - | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | - | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** ✓ | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| OEC -04 | MICRO ELECTRO MECHANICAL SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the applications of MEMS to disciplines beyond Electrical and mechanical engineering

**UNIT I INTRODUCTION** **9 hours**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

**UNIT II SENSORS AND ACTUATORS-I** **9 hours**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

**UNIT III SENSORS AND ACTUATORS-II** **9 hours**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

**UNIT IV MICROMACHINING** **9 hours**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

**UNIT V POLYMER AND OPTICAL MEMS** **9 hours**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.

T2: Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

**REFERENCE BOOKS:**


R1: NadimMaluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.

R2: Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.


**WEB LINKS:**

1. https://link.springer.com/referencework/10.1007/978-981-10-5945-2
2. https://nptel.ac.in/courses/117105082

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | To understand working principles of currently available micro sensors, actuators, and motors, valves, pumps, and fluidics used in Microsystems. | K2 |
| CO2: | To apply scaling laws that are used extensively in the conceptual design of micro devices and systems. Students will be able to differentiate between the positive and negative consequences of scaling down certain physical quantities that are pertinent to Microsystems | K5 |
| CO3: | To choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process. | K3 |
| CO4: | To use materials for common micro components and devices | K3 |
| CO5: | To consider recent advancements in the field of MEMS and devices. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 1 | 3 | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 2 | 2 | 1 | - | 2 | - | - | - | - | - | 1 | - | 2 | 2 |
| **CO3** | 3 | 1 | - | 2 | 1 | - | - | 1 | - | - | - | - | 3 | 3 |
| **CO4** | 3 | 2 | - | 2 | - | - | - | - | - | - | 1 | - | 2 | 2 |
| **CO5** | 2 | 3 | 2 | - | 2 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | ✓ |

| OEC – 05 | ELECTRIC VEHICLE MECHANICS AND CONTROL | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To provide knowledge of Electric Vehicle Mechanics and control mechanism
- Understand about working principle of electronics and sensor less control in electric vehicles.

**UNIT I ELECTRIC VEHICLE ARCHITECTURE 9 hours**

History of evolution of Electric Vehicles - Series parallel architecture of Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

**UNIT II MECHANICS OF ELECTRIC VEHICLES 9 hours**

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of EV's - motor torque and power rating and battery capacity.

UNIT III **CONTROL OF DC AND AC MOTOR DRIVES 9 hours**

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.

**UNIT IV ENERGY STORAGE SYSTEMS 9 hours**

Battery: Principle of operation, types, models, SOC of battery, Traction Batteries and their capacity for standard drive cycles. Alternate sources: Fuel cells, Ultra capacitors, Fly wheels.

**UNIT V HYBRID VEHICLE CONTROL STRATEGY 9 hours**

HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode.

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Iqbal Husain, “Electric and Hybrid Electric Vehicles”, CRC Press, 2011.

T2: Wei Liu, “Hybrid Electric Vehicle System Modeling and Control”, Second Edition, WILEY, 2017.


**REFERENCE BOOKS:**


R1: James Larminie and John Lowry, “Electric Vehicle Technology Explained”, Second Edition 2012.

R2: Christopher D Rahn, Chao-Yang Wang, “Battery Systems Engineering”, Wiley, 2013.


**WEB LINKS:**

1. https://nptel.ac.in/courses/108106170
2. https://www.mdpi.com/journal/wevj

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | To identify and describe the history and evolvement of electric & hybrid electric vehicles to emphasize on the need and importance of EV/HEV for sustainable future | K 2 |
| CO2: | To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performance and control. | K6 |
| CO3: | To compare and evaluate various energy sources and energy storage components for EV and HEV applications. | K3 |
| CO4: | To model, analyze and design EV/HEV drive train with energy management strategies. | K5 |
| CO5: | To recognize the need to adapt and engage in operations EV/HEV with the absolute technological change in the transportation system for sustainable future. | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 2 | 2 | 1 | - | 3 | - | - | - | - | - | - | - | 2 | 2 |
| **CO3** | 3 | - | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 1 | 1 | - | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **CO5** | 2 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 2 | 3 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | | | ✓ | | ✓ |

| OEC – 06 | OPTIMIZATION TECHNIQUES | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- Operation research models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function).
- The problem formulation by using linear, dynamic programming, game theory and queuing models.
- The stochastic models for discrete and continuous variables to control inventory and simulation of manufacturing models for the production decision making
- Formulation of mathematical models for quantitative analysis of managerial problems in industry.

**UNIT I LINEAR PROGRAMMING 9 hours**

Formulation-Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems

**UNIT II UNCONSTRAINED ONE DIMENSIONAL OPTIMIZATION TECHNIQUES 9 hours**

Necessary and sufficient conditions –Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

**UNIT III UNCONSTRAINED DIMENSIONAL OPTIMIZATION TECHNIQUES 9 hours**

Direct search methods –Random search –pattern search and Rosen brooch's hill claiming method-Descent methods-Steepest descent, conjugate gradient, quasi –Newton method.

**UNIT IV CONSTRAINED OPTIMIZATION TECHNIQUES 9 hours**

Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.

**UNIT V DYNAMIC PROGRAMMING 9 hours**

Principle of optimality- recursive equation approach-application to shortest route, cargo-loading, allocation and production schedule problems.

**TOTAL : --45 hours**

**TEXT BOOKS:**


1. Rao, S.S.,'Optimization: Theory and Application' Wiley Eastern Press, 1978.
2. Taha, H.A., Operations Research –An Introduction, Prentice Hall of India.


**REFERENCE BOOKS:**


1. Fox, R.L.,'Optimization methods for Engineering Design', Addition Welsey, 1971


**WEB LINKS:**

1. https://www.researchgate.net/publication/270091578_Foundation_of_Linear_Programming
2. http://ieeexplore.ieee.org/abstract/document/7546296/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Formulate optimization problems. | K6 |
| CO2: | Solve various constrained and unconstrained problem in single variable. | K3 |
| CO3: | Solve various constrained and unconstrained problem in multi variable. | K3 |
| CO4: | Apply constrained optimization methods. | K3 |
| CO5: | Discuss applications of optimization techniques. | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| OEC - 07 | PRINCIPLES OF MANAGEMENT & PROFESSIONAL ETHICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To enable the students to study the evolution of Management, its functions and principles of management and alsoto learn the application of the principles to work in an organization.

**UNIT I OVERVIEW OF MANAGEMENT 9 hours**

Definition - Management - Role of managers - Evolution of Management thought – Organization and the environmental factors – Trends and Challenges of Management in Global Scenario.

**UNIT II PLANNING & ORGANIZING 9 hours**

Nature and purpose of planning and Organizing - Planning process - Types of plans – Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions. - Organization structure - Formal and informal groups I organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal.

**UNIT III DIRECTING & CONTROLLING 9 hours**

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication – Organization Culture - Elements and types of culture - Managing cultural diversity. Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

**UNIT IV ENGINEERING ETHICS & HUMAN VALUES 9 hours**

Definition - Societies for engineers – Code of Ethics – Ethical Issues involved in cross border research - Ethical and Unethical practices – case studies – situational decision making - Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT V SAFETY RESPONSIBILITIES AND RIGHTS 9 hours**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination – Global issues - Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
T2: Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.
T3: Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

**REFERENCE BOOKS:**

R1: Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
R2: Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
R3: Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.
R4: Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
R5: John RBoatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003

**WEB LINKS:**

1. https://education.stateuniversity.com/pages/cw1ev9e9ib/An-Introduction-to-the-Principles-of-Management.html
2. https://ncert.nic.in/textbook/pdf/lebs102.pdf

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the management roles and skills and evolution of the management. | K 2 |
| CO2: | Analyze the planning and organizing system of the management | K 4 |
| CO3: | Understand the directing and controlling system of the management | K 2 |
| CO4: | Develop engineering ethics in society and improve human values | K 6 |
| CO5: | Understand the safety responsibilities, apply ethics in society and discuss the ethical issues related to engineering | K 2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO2** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO3** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO4** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO5** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/** | **Open book** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | **Presentation** | **test** |
| | | | ✓ | | |

| **OEC - 08** | **PROJECT MANAGEMENT** | **3** | **0** | **0** | **3** |
|---|---|---|---|---|---|

**Course Objectives**

- To understand the fundamentals of the Project Management.
- To present and defend both orally and in written the scheduling and execution of a Project.

**UNIT I OVERVIEW OF PROJECT MANAGEMENT 9 hours**

Basic concepts. Life Cycle of a Project. The Steps in managing a Project. International Standards (PMI, IPMA). Different types of projects: industrial, telecommunication, research and more. The role of the Project Manager. Terms of the Project Contract.

**UNIT II PLANNING THE PROJECT PLANNING 9 hours**

Developing a Mission, Vision, Goals and Objectives of the Project. Owners and Stakeholder. The Work Breakdown Structure (WBS) to plan a project.

**UNIT III TIME AND COST MANAGEMENT 9 hours**

Estimation of Time, Costs and Resources. Scheduling Project Work. Critical Path Method (CPM). Assignment Resources to Tasks. Resource balancing. Analysis and reports using Software tools (Microsoft Project).

**UNIT IV THE PROJECT RISK PLAN 9 hours**

Defining Project Risks.Process to establish the project risk plan. Contingency Reserves. Coordination points. Risk Matrix Analysis. Project Control and Evaluation. The Change Control Process. Project Control using Earned Value Analysis.

**UNIT V PROJECT AS AN INDEPENDENT ACTIVITY IN THE COMPANY AND QUALITY STANDARDS 9 hours**

Project Performance. Project Integration into the Finance Planning of the Company. Post-project Value. Multi-project Value. Quality Standards Components and objectives of a Quality Management System. ISO 21500:2013. UNE 157001. UNE 166001 & 166002. Project Quality Plan. Verification, Control and Audit of Industrial Projects. RD 1432 for R&D&IT Projects

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: J. Heagney.: “Fundamentals of project Management” (2011)

T2: HoraldKerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002.


**REFERENCE BOOKS:**


R1: H. Kerzner. Project Management: a Systems Approach to Planning, Scheduling and Controlling. John Wiley & Sons, 2006

R2: M.P. Spinner, Project management : principles and practices, Prentice-Hall International, [1997]ISO.UNE 21500:2013

**WEB LINKS:**

1. https://www.investopedia.com/terms/p/project-management.asp
2. https://www.teamgantt.com/project-management-guide/what-is-project-management

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Apply the knowledge and competences to manage an industrial Project and also a Research and development one. | K3 |
| CO2: | Explain the key items and elements of the Project management. | K5 |
| CO3: | Identify the main process groups in Project management. | K3 |
| CO4: | Understand and analyze the basic tools to manage the time, cost, risk and quality in a Project. | K2 |
| CO5: | Categorize, control and audit industrial projects. | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 | 2 | 3 |
| **CO2** | - | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 | 2 | 3 |
| **CO3** | - | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 | 2 | 3 |
| **CO4** | - | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 | 2 | 3 |
| **CO5** | - | 2 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | ✓ | ✓ | | |

| OEC - 09 | ORGANIZATIONAL BEHAVIOUR | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To help the students to develop cognizance of the importance of human behaviour.
- To provide the students to analyse specific strategic human resources demands for future action.

**UNIT I FOCUS AND PURPOSE** **9 hours**

Definition, need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models.

**UNIT II INDIVIDUAL BEHAVIOUR** **9 hours**

Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification.

Misbehaviour – Types – Management Intervention. Emotions - Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement- Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception- Impression Management. Motivation – importance – Types – Effects on work behavior

**UNIT III GROUP BEHAVIOUR** **9 hours**

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

**UNIT IV LEADERSHIP AND POWER** **9 hours**

Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

**UNIT V DYNAMICS OF ORGANIZATIONAL BEHAVIOUR** **9 hours**

Organizational culture and climate – Factors affecting organizational climate – Importance.

Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change.

Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life.

Organizational development – Characteristics – objectives –. Organizational effectiveness

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.

T2: Fred Luthans, Organisational Behavior, McGraw Hill, 11th Edition, 2001.

**REFERENCE BOOKS:**

R1: UdaiPareek, Understanding Organisational Behaviour, 2nd Edition, Oxford Higher Education, 2004.

R2: Mc Shane & Von Glinov, Organisational Behaviour, 4th Edition, Tata Mc Graw Hill, 2007.

**WEB LINKS:**

1. https://nptel.ac.in/courses/110106145
2. https://onlinelibrary.wiley.com/journal/10991379

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Demonstrate the applicability of the concept of organizational behavior to understand the behavior of people in the organization. | K2 |
| CO2: | Demonstrate the applicability of analyzing the complexities associated with management of individual behavior in the organization. | K2 |
| CO3: | Analyze the complexities associated with management of the group behavior in the organization. | K4 |
| CO4: | Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization. | K2 |
| CO5: | Analyze the complexities associated with organizational change and stress | K4 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | - | - | 1 | - | - | - | 2 | - | 3 | - | - | - | - |
| **CO2** | 2 | - | - | 2 | - | - | - | 1 | - | 1 | - | - | - | - |
| **CO3** | - | - | 2 | - | 2 | - | - | 1 | - | 2 | - | - | - | - |
| **CO4** | 1 | 1 | - | 2 | - | - | - | 2 | - | 2 | - | - | - | - |
| **CO5** | - | - | 1 | - | - | - | - | 1 | - | 3 | - | - | - | - |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | | ✓ | | ✓ |

| OEC - 10 | ROBOTICS AND AUTOMATION | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To impart knowledge on various drive system, sensors and machine vision system
- To understand the programming and specific industrial applications

**UNIT I FOUNDATION FOR BEGINNERS 9 hours**

Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator

**UNIT II BUILDING BLOCKS OF A ROBOT 9 hours**

Types of electric motors - DC, Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self driving cars

**UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS 9 hours**

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector -common types and design case study.

**UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 9 hours**

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot

**UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9 hours**

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro &Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002

T2: Roland Siegwart, Illah Reza Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2011

**REFERENCE BOOKS:**


R1: K.S. Fu, R.C. Gonzalez and C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.

R2: Wesley E Snyder R, Industrial Robots, Computer Interfacing and Control, Prentice Hall International Edition, 1988.


**WEB LINKS:**

1. https://www.mdpi.com/journal/robotics
2. https://nptel.ac.in/courses/112105249

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Summarize knowledge of basic concepts of robotic systems | K2 |
| CO2: | Analyze the functions of sensors and machine vision system in the robot | K4 |
| CO3: | Categorize the drives, manipulators and grippers | K2 |
| CO4: | Develop the qualitative knowledge of navigation and control of robot | K6 |
| CO5: | Evaluate the recent trends and applications of robotics in various field | K5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | - | - | - | - | - | - | - | 1 | - | - | 3 | 3 |
| **CO2** | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 2 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | 1 | 3 | 1 | - | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO5** | 2 | 2 | 3 | 3 | 2 | - | 1 | | 1 | - | 2 | - | 2 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | ✓ | ✓ | ✓ | | |

| OEC-11 | MICROCONTROLLER BASED SYSTEM DESIGN | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To impart knowledge on the architecture of PIC microcontroller its interrupts, timers and the peripheral devices used for data communication and transfer.
- To study about the architecture of ARM processor and its organization

**UNIT I INTRODUCTION TO PIC MICROCONTROLLER 9 hours**

Introduction to PIC Microcontroller - PIC 16C6x and PIC16C7x Architecture- PIC16cxx - Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.

**UNIT II INTERRUPTS AND TIMER 9 hours**

PIC micro controller Interrupts- External Interrupts-Interrupt Programming- Loop time subroutine - Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variable strings.

**UNIT III PERIPHERALS AND INTERFACING 9 hours**

$I^2C$ Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC and Sensor Interfacing - Stepper Motor, DC Motor speed Control using PWM

**UNIT IV INTRODUCTION TO ARM PROCESSOR 9 hours**

ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

**UNIT V ARM ORGANIZATION 9 hours**

3-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution-ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.

T2: Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

**REFERENCE BOOKS:**

R1: Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

**WEB LINKS:**

1. https://microcontrollerslab.com/pic-microcontroller-architecture/
2. https://www.geeksforgeeks.org/pipelining-in-arm/

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Explain the architecture and pipelining concept of PIC Microcontroller | K2 |
| CO2: | Identify various Interrupts and Timers available in PIC microcontroller. | K2 |
| CO3: | Develop a microcontrollers based system using various peripherals and interfacing them | K3 |
| CO4: | Understand the concepts of ARM Processor and its memory hierarchy | K2 |
| CO5: | Summarise the pipelining concepts and execution of instructions | K2 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO4** | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | 2 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 |

**ASSESSMENT METHODS:**

| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| OEC-12 | TOTAL QUALITY MANAGEMENT | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- The course aims to provide an understanding of the process of managing quality, to provide a valuable perspective for future business managers and managing services.

**UNIT I INTRODUCTION** **9 hours**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

**UNIT II TQM PRINCIPLES** **9 hours**

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal 106 - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I** **9 hours**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II** **9 hours**

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY SYSTEMS** **9 hours**

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.

**TOTAL : 45 hours**

**TEXT BOOKS:**

T1: Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint,2006.

**REFERENCE BOOKS:**


R1: James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First IndianEdition, Cengage Learning, 2012.

R2: Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

R3: Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd.,2006.Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004


**WEB LINKS:**

1. https://www.educba.com/total-quality-management-notes/
2. https://www.academia.edu/37213047/TOTAL_QUALITY_MANAGEMENT_notes

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Compare the contributions made by Deming, Juran and Crosby to implement TQM concept | K 2 |
| CO2: | Conclude the role of the management and leadership in an organization | K 5 |
| CO3: | Classify various quality improvement tools and techniques to improve the quality of a product. | K 4 |
| CO4: | Value the importance of six sigma concepts and TPM concepts for the growth of an organization. | K 5 |
| CO5: | Explain the need for ISO 9001-2008 and ISO 14000 Quality System in an organization ethical issues related to engineering | K 5 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO2** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO3** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO4** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| **CO5** | - | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | ✓ | | |

| OEC-13 | PLC AND DISTRIBUTED CONTROL SYSTEMS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To give an introductory knowledge about PLC and the programming languages and provide adequate knowledge about of application of PLC.
- To provide basic knowledge in the architecture and local control unit of distributed control system and computer controlled systems.

**UNIT I PROGRAMMABLE LOGIC CONTROL 9 hours**

Evolution of PLCs — Sequential and programmable controllers — Architecture GE Fanuc- ABB-Siemens Higher end — Programming of PLC — relay logic — Ladder logic — Functionalblocks programming.

**UNIT II COMMUNICATION IN PLCS 9 hours**

Requirement of communication networks for PLC — connecting PLC to computer — Use ofEmbedded PC as PLC — comparative study of Industrial PLCs - PLC application in IndustrialAutomation.

**UNIT III DISTRIBUTED CONTROL SYSTEMS 9 hours**

Evolution — Different architectures — Local control unit — Operator interface — Display‘s — Engineering interface. Case study - DCS - Study of two popular DCS available in market —Factors to be considered in selecting DCS.

**UNIT IV HART AND FIELD BUS 9 hours**

Introduction — Evolution of signal standard — HART Communication protocol — Communication modes — HART networks — HART commands — HART field controller implementation — HART and OSI model — Field bus — Introduction profibus, Mod bus – Foundation field bus — General field bus architecture — basic requirements of field bus standard — Field bus topology — Interoperability CAN & LIN bus .

**UNIT V AS – INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET 9 hours**

AS interface- Introduction, Physical layer, Data link layer and Operating characteristics. Devicenet: - Introduction, Physical layer, Data link layer and Application layer. Industrial Ethernet: - Introduction, 10Mbps Ethernet and 100Mbps Ethernet - Introduction to OLE for process control (OPC).

**TOTAL : 45 hours**

**TEXT BOOKS:**


T1: John.W. Webb, Ronald A Reis, “Programmable Logic Controllers - Principles and Applications”, Prentice Hall Inc., New Jersey, 2003

T2: B.G. Liptak, “Instrument Engineers Hand, Process control and Optimization”, CRC press-Radnor, Pennsylvania,2006.

T3: M.Chidambaram, “Computer Control of Process,” Narosa Publishing, New Delhi, 2003


**REFERENCE BOOKS:**


R1: A.S.Tanenbaum, Computer Networks, Third Edition, Prentice Hall of India, 1996.

R2: Michael P.Lucas, Distributed Control System, Van Nastrand Reinhold Company, New York,1986.

**WEB LINKS:**

1. https://nptel.ac.in/courses/108105062
2. https://onlinecourses.nptel.ac.in/noc20_me39/preview

**COURSE OUTCOMES**

| | | |
|---|---|---|
| CO1: | Understand the architecture and the ladder logic diagram of PLC | K2 |
| CO2: | Develop PLC programme for industrial application. | K3 |
| CO3: | Choose the Distributed control system according to the application requirement | K3 |
| CO4: | Analyse the protocols and architecture of HART and field bus. | K4 |
| CO5: | Design various interfaces to digital control system. | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 3 | - | - | 1 | - | - | - | - | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | - | - | 1 | - | - | - | - | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 3 | - | - | 1 | - | - | - | - | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 3 | - | - | 1 | - | - | - | - | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 3 | - | - | 1 | - | - | - | - | 3 | 2 |

**ASSESSMENT METHODS:**

| CAT 1 | CAT 2 | Model Exam | End Semester Exams | Assignments | Case Studies |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

| OEC-14 | ENGINEERING ECONOMICS | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To analyses the voltage distribution in insulator strings and cables and methods to improve the same. To understand the operation of the different distribution schemes.
- To learn the techniques of incorporating inflation factor in economic decision making

**UNIT I INTRODUCTION TO MANAGERIAL ECONOMICS AND DEMAND ANALYSIS** **9 hours**

Definition of Managerial Economics - Nature and scope of Managerial Economics - Managerial Economics and other disciplines. Objectives of the firm - Factors influencing Managerial decisions, Demand Analysis – Defining demand, Types of demand and Determinants of demand, Elasticity of Demand and Supply.

**UNIT II PRODUCTION AND COST ANALYSIS** **9 hours**

Production Analysis – Production function, Returns to a factor, Returns to scale, ISO quants and least cost combination of inputs. Cost Analysis – Cost concepts, Determinants of cost, Short-run cost-output Relationship, Long-run cost output relationship, Economies and Diseconomies of scale and Estimating cost-Output Relationship.

**UNIT III PRICING** **9 hours**

Determinants of Price – Pricing under different objectives – Pricing under different market structures – Price discrimination – Pricing of Joint products – Pricing methods in practice.

**UNIT IV MACRO ECONOMICS – I** **9 hours**

National Income – Definition and Measurement – GDP, GNP, NDP, Personal Income – Business Cycles – Two and Four phases – Inflation – Causes and Effects of inflation.

**UNIT V MACRO ECONOMICS - II** **9 hours**

MRTP – FERA – International Trade – Balance of Trade – Balance of payments – Terms of Trade – Fiscal Policy – Foreign Exchange.

**TOTAL : 45 hours**

**Text Books:**

T1: Nag A, “Macro Economics for Management Students” MacMillan India Ltd., New Delhi, 2005

**T2:** Yogesh Maheshwari, “Managerial Economics”, Third edition, PHI 2012.

**Reference Books:**

R1: Mote V L, Samuel Paul and G.S.Gupta, “ Managerial Economics – concepts and cases”,McGraw Hill Education (India), 2011.

R2: Paneerselvam R, “Engineering Economics”, PHI, 2013.
R3: Ramachandra Aryasri A and Ramana Murthy V V, “Engineering Economics and Financial Accounting”, McGraw Hill Education (India), New Delhi, 2004.

**Web Links:**

**https://inzeko.ktu.lt/**

**https://www.hzu.edu.in/engineering/engineering%20economy.pdf**

**COURSE OUTCOMES**

| | | |
|---|---|---|
| **CO1:** | Understand principles of micro economics and demand forecasting. | K2 |
| **CO2:** | Understanding and knowledge in production and detailed cost analysis. | K2 |
| **CO3:** | Explain the methodologies and principles of pricing. | K5 |
| **CO4:** | Classify the Macro Economics of various parameters of Gross National Product. | K4 |
| **CO5:** | Create Awareness in business dynamics in macro economics. | K6 |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 2 | 3 |
| **CO2** | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 3 |
| **CO3** | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 3 |
| **CO4** | 0 | 2 | 3 | 2 | 3 | 2 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 3 |
| **CO5** | 0 | 2 | 2 | 2 | 3 | 2 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 3 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| ✓ | ✓ | | ✓ | | |

| OEC-15 | ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**Course Objectives**

- To imparts the knowledge of basic concepts of artificial intelligence and expert systems
- To introduce students to the basic concepts and techniques of Machine Learning

**UNIT I INTRODUCTION TO AI** **9 hours**

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

**UNIT II PROBLEM SOLVING METHODS** **9 hours**

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems -Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games.

**UNIT III KNOWLEDGE REPRESENTATION** **9 hours**

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories - Reasoning with Default Information

**UNIT IV MACHINE LEARNING BASICS** **9 hours**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

**UNIT V LINEAR MODELS** **9 hours**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multilayer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

**TOTAL : -- 45 hours**

**Text Books:**


T4: Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013.

T5: Bratko, —Prolog: Programming for Artificial Intelligence‖, Fourth edition, AddisonWesley Educational Publishers Inc., 2011.


**Reference Books:**


R4: S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition 2009.

R5: M. Tim Jones, —Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008


**Web Links:**

2. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3. https://nptel.ac.in/courses/106102220

**COURSE OUTCOMES**

| | | |
|---|---|---|
| **CO1:** | **Learn and develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents** | **K5** |
| **CO2:** | **Understand about fundamental areas of Local Search Algorithms, Adversarial Searching and Neural Networks.** | **K2** |
| **CO3:** | **Understand knowledge of the world using logic and infer new facts from that Knowledge.** | **K2** |
| **CO4:** | **Understand different techniques related to Machine Learning.** | **K2** |
| **CO5:** | **Construct algorithms to learn linear models** | **K3** |

**MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 |
| **CO2** | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 |
| **CO3** | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 |
| **CO5** | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 |

**ASSESSMENT METHODS:**

| | | | | | |
|---|---|---|---|---|---|
| **CAT 1** | **CAT 2** | **Model Exam** | **End Semester Exams** | **Assignments** | **Case Studies** |
| ✓ | ✓ | ✓ | ✓ | ✓ | |
| **Quiz** | **MCQ** | **Projects** | **Seminars** | **Demonstration/ Presentation** | **Open book test** |
| | | | | | |

**ANNEXURE-II**

**SEMESTER I**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| BSC | 22CBEE11 | Chemistry | 2018-2019 | | | Interdisciplinary | Employability |
| BSC | 22CBEE12 | Mathematics – I (Calculus and Differential Equations) | 2018-2019 | | | Interdisciplinary | Employability |
| ESC | 22CBEE13 | Programming for Problem solving | 2018-2019 | | | Interdisciplinary | Employability |
| ESC | 22CBEE13 | Basics of civil and Mechanical Engineering | 2022-2023 | | | Interdisciplinary | Employability |
| ESC | 22PBEE13 | Workshop/Manufacturing Practices | 2018-2019 | | | Interdisciplinary | Employability |
| BSC | 22PBEE11 | Chemistry Laboratory | 2018-2019 | | | Interdisciplinary | Employability |
| ESC | 22PBEE12 | Programming for problem solving Laboratory | 2018-2019 | | | Interdisciplinary | Employability |
| MC | | Student Induction Program | 2022-2023 | | | | Skill development |
| MC | | Universal Human Values-Understanding harmony | 2022-2023 | | | Interdisciplinary | Skill development |

**SEMESTER II**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| HSC | 22CBEE21 | English | 2018-2019 | | | Interdisciplinary | Employability |
| BSC | 22CBEE22 | Physics ( Waves and Optics and introduction to quantum mechanics) | 2018-2019 | | | Interdisciplinary | Employability |
| BSC | 22CBEE23 | Mathematics II (Linear Algebra, Transform, Calculus and Numerical Methods) | 2018-2019 | | | Interdisciplinary | Employability |
| ESC | 22CBEE24 | Basic Electrical and Electronics Engineering | 2018-2019 | 2022-2023 | 40% | Interdisciplinary | Employability |
| ESC | 22CBEE25 | Engineering Graphics and Design- Blended | 2018-2019 | 2022-2023 | 60% | Interdisciplinary | Employability |
| HSC | 22PBEE23 | English Laboratory | 2018-2019 | | | Interdisciplinary | Employability |
| BSC | 22PBEE21 | Physics Laboratory | 2018-2019 | 2022-2023 | 70% | Interdisciplinary | Employability |
| ESC | 22PBEE22 | Basic Electrical and Electronics Engineering Laboratory | 2018-2019 | | | Interdisciplinary | Employability |
| MC | 22GLCI21 | Constitution of India | 2022-2023 | | | Interdisciplinary | Skill development |

**SEMESTER III**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| BSC | 22CBEE31 | Mathematics III (Fourier series and transforms) | 2018-2019 | | | Interdisciplinary | Employability |
| ESC | 22CBEE33 | Engineering Mechanics | 2018-2019 | | | Interdisciplinary | Employability |
| PCC | 22CBEE35 | Analog Electronics | 2018-2019 | | | Interdisciplinary | Employability |
| PCC | 22CBEE34 | Electric Circuit Analysis | 2018-2019 | | | Interdisciplinary | Employability |
| PCC | 22CBEE36 | Electrical Machines-I | 2018-2019 | 2022-2023 | 69% | | Employability |
| PCC | 22CBEE32 | Electromagnetic Theory- Blended | 2018-2019 | | | | Employability |
| PCC | 22PBEE32 | Electric Circuits Laboratory | 2018-2019 | | | Interdisciplinary | Employability |
| PCC | 22PBEE31 | Electrical Machines-I Laboratory | 2018-2019 | | | | Employability |
| HSC | 22SUPD31 | Personality Development I | 2018-2019 | | | Interdisciplinary | Skill development |
| MC | 22BESY31 | Basic life skills | 2018-2019 | | | Interdisciplinary | Skill development |

**SEMESTER IV**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| BSC | 22CBEE41 | Mathematics IV (Probability and Statistics) | 2018-2019 | | | Interdisciplinary | Employability |
| PCC | 22CBEE42 | Measurement and Instrumentation | 2018-2019 | 2022-2023 | 60% | Interdisciplinary | Employability |
| PCC | 22CBEE43 | Digital Electronics | 2018-2019 | 2022-2023 | 40% | Interdisciplinary | Employability |
| PCC | 22CBEE44 | Electrical Machines-II | 2018-2019 | | | | Employability |
| PCC | 22CBEE45 | Linear Integrated Circuits- Blended | 2018-2019 | 2022-2023 | 32% | Interdisciplinary | Employability |
| PCC | 22PBEE41 | Analog and Digital Electronics Laboratory | 2018-2019 | | | Interdisciplinary | Employability |
| PCC | 22PBEE42 | Electrical Machines-II Laboratory | 2018-2019 | | | | Employability |
| HSC | 22SUPD41 | Personality Development II | 2018-2019 | | | Interdisciplinary | Skill development |
| BSC | 22CBEE46 | Environmental Science and Engineering | 2018-2019 | | | Interdisciplinary | Skill development |
| MC | 22BESY41 | Gender Institution and Society | 2022-2023 | | | Interdisciplinary | Skill development |

**SEMESTER V**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| PCC | 22CBEE51 | Power Electronics | 2018-2019 | 2022-2023 | 36% | | Employability |
| PCC | 22CBEE52 | Control Systems | 2018-2019 | 2022-2023 | 42% | | Employability |
| PEC | 22CBEE5A | Professional Elective – I(Electrical Machine Design) | 2018-2019 | | | | Employability |
| OEC | 22CBEE5B | Open Elective – I(Fundamentals of nano science) | 2018-2019 | 2022-2023 | 40% | Interdisciplinary | Employability |
| PCC | 22CBEE53 | Transmission and Distribution - Blended | 2018-2019 | | | | Employability |
| PCC | 22PBEE51 | Measurements and Control System Laboratory | 2018-2019 | | | Interdisciplinary | Employability |
| PCC | 22PBEE52 | Power Electronics laboratory | 2018-2019 | | | | Employability |
| HSC | 22SUPD51 | Personality Development III | 2018-2019 | | | Interdisciplinary | Skill development |
| PCC | | Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra /Mathworks) - Minimum 4 weeks | 2022-2023 | | | | Skill development |

**SEMESTER VI**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| PCC | 22CBEE61 | Power System Analysis | 2018-2019 | | | | Employability |
| PEC | 22CBEE6A | Professional Elective – II(Power System protection and switch gear) | 2018-2019 | | | | Employability |
| PEC | 22CBEE6B | Professional Elective – III(Computer Aided Power system Analysis-Blended) | 2018-2019 | | | | Employability |
| OEC | 22CBEE6C | Open Elective – II(Principles of management and professional ethics) | 2018-2019 | | | Interdisciplinary | Skill development |
| PCC | 22CBEE62 | Solid State Drives | 2018-2019 | | | | Employability |
| PCC | 22PBEE61 | Electrical Drives Lab | 2018-2019 | | | | Employability |
| PCC | 22PBEE62 | Power Systems Laboratory | 2018-2019 | | | | Employability |
| HSC | 22SUPD61 | Personality Development - IV | 2018-2019 | | | Interdisciplinary | Skill development |
| PCC | 22IBEE61 | Summer Internship (4 weeks) | 2018-2019 | | | | Skill development |

**SEMESTER VII**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| OEC | 22EBEE7A | Open Elective – III (Microcontroller based System Design) | 2018-2019 | 2022-2023 | 40% | Interdisciplinary | Employability |
| OEC | 22EBEE7B | Open Elective – IV(Robotics and Automation) | 2018-2019 | 2022-2023 | 40% | Interdisciplinary | Employability |
| PEC | 22EBEE7D | Professional Elective– IV(Power System Operation and Control) | 2018-2019 | | | | Employability |
| PCC | 22CBEE71 | Special Electrical Machines | 2018-2019 | | | | Employability |
| PCC | 22EBEE7F | Microprocessor Microcontroller | 2018-2019 | 2022-2023 | 48% | Interdisciplinary | Employability |
| PCC | 22PBEE71 | Power System Protection lab | 2022-2023 | | | | Employability |
| PCC | 22PBEE72 | Microprocessor Microcontroller Lab | 2018-2019 | | | Interdisciplinary | Employability |
| Project | 22RBEE71 | Project Phase I | 2018-2019 | | | | Skill development |

**Semester VIII**

| Category | Code | Course | Year of Introduction | Year of Revision | % of Revision | Activities/Content with direct on Interdisciplinary | Activities/Content with direct on Employability/ Competency/ Entrepreneurship / Skill development / |
|---|---|---|---|---|---|---|---|
| PEC | 22EBEE8A | Professional Elective– V (Electrical Energy Conservation and Auditing) | 2018-2019 | 2022-2023 | 40% | | Employability |
| OEC | 22EBEE8B | Open Elective – V((Electric Vehicle Mechanics and Control) | 2018-2019 | 2022-2023 | 40% | Interdisciplinary | Employability |
| OEC | 22EBEE8C | Open Elective – VI(Total Quality Management ) | 2018-2019 | | | Interdisciplinary | Skill development |
| Project | 22RBEE82 | Project Phase II | 2018-2019 | | | | Skill development |

## ANNEXURE III

## LIST OF COURSES INTEGRATE CROSS CUTTING ISSUES

| S. NO | Name of the Program | Course Code | Name of the course | Gender | Environment and Sustainability | Human Values | Health Determinants | Right to Health | Emerging Demographic changes | Professional Ethics |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Electrical and Electronics Engineering | 22CBEE11 | Chemistry | | ✓ | | | | | |
| 2 | Electrical and Electronics Engineering | 22CBEE12 | Mathematics – I (Calculus and Differential Equations) | | | | | | ✓ | |
| 3 | Electrical and Electronics Engineering | 22CBEE13 | Programming for Problem solving | | | | | | ✓ | |
| 4 | Electrical and Electronics Engineering | 22CBEE14 | Basic Civil and Mechanical Engineering | | | | | | ✓ | |
| 5 | Electrical and Electronics Engineering | 22PBEE11 | Chemistry Laboratory | | ✓ | | | | | |
| 6 | Electrical and Electronics Engineering | 22PBEE12 | Programming for problem solving Laboratory | | | | | | ✓ | |
| 7 | Electrical and Electronics Engineering | 22PBEE13 | Manufacturing Practices | | | | | | ✓ | |
| 8 | Electrical and Electronics Engineering | 22CBEE15 | Universal Human Values : Understanding Harmony | | | ✓ | | | | |
| 9 | Electrical and Electronics Engineering | 18CBEE21 | English | | | | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|
| 10 | Electrical and Electronics Engineering | 22CBEE22 | Physics<br>( Waves and Optics and introduction to quantum mechanics) | | | | | | ✓ | |
| 11 | Electrical and Electronics Engineering | 22CBEE23 | Mathematics-II<br>(LinearAlgebra ,Transform,<br>Calculusand Numerical Methods) | | | | | | ✓ | |
| 12 | Electrical and Electronics Engineering | 22CBEE24 | Basic Electrical and Electronics Engineering | | | | | | ✓ | |
| 13 | Electrical and Electronics Engineering | 22CBEE25 | Engineering Graphics and Design | | | | | | ✓ | |
| 14 | Electrical and Electronics Engineering | 22PBEE21 | Physics Laboratory | | | | | | ✓ | |
| 15 | Electrical and Electronics Engineering | 22PBEE22 | Electrical Engineering Laboratory | | | | | | ✓ | |
| 16 | Electrical and Electronics Engineering | 22PBEE23 | English Laboratory | | | | | | ✓ | |
| 17 | Electrical and Electronics Engineering | 22GLCI21 | Constitution of India | | | ✓ | | | | ✓ |
| 18 | Electrical and Electronics Engineering | 22CBEE31 | Mathematics III(Fourier series and transforms) | | | | | | ✓ | |
| 19 | Electrical and Electronics Engineering | 22CBEE32 | Electromagnetic Theory | | | | | | ✓ | |
| 20 | Electrical and Electronics Engineering | 22CBEE33 | Engineering Mechanics | | | | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|
| 21 | Electrical and Electronics Engineering | 22CBEE34 | Electrical Circuit Analysis | | | | | | ✓ | |
| 22 | Electrical and Electronics Engineering | 22CBEE35 | Analog Electronics | | | | | | ✓ | |
| 23 | Electrical and Electronics Engineering | 22CBEE36 | Electrical Machines-I | | | | | | ✓ | |
| 24 | Electrical and Electronics Engineering | | Electrical Machines- I Laboratory | | | | | | ✓ | |
| 25 | Electrical and Electronics Engineering | 22PBEE32 | Electric Circuits Laboratory | | | | | | ✓ | |
| 26 | Electrical and Electronics Engineering | 22SUPD31 | Personality Development-I | | | ✓ | | | | |
| 27 | Electrical and Electronics Engineering | 22BESY31 | Basic Life Skills | | | ✓ | | | | |
| 28 | Electrical and Electronics Engineering | 22CBEE41 | Mathematics - IV (Probability and statistics) | | | | | | ✓ | |
| 29 | Electrical and Electronics Engineering | 22CBEE42 | Measurements and Instrumentation | | | | | | ✓ | |
| 30 | Electrical and Electronics Engineering | 22CBEE43 | Digital Electronics | | | | | | ✓ | |
| 31 | Electrical and Electronics Engineering | 22CBEE44 | Electrical Machines – II | | | | | | ✓ | |
| 32 | Electrical and Electronics Engineering | 22CBEE45 | Linear Integrated Circuits | | | | | | ✓ | |
| 3 | Electrical and Electronics | 22CBEE46 | Environmental Science and | | ✓ | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Engineering | | Engineering | | | | | | | |
| 34 | Electrical and Electronics Engineering | 22SUPD41 | Personality Development II | | | ✓ | | | | |
| 35 | Electrical and Electronics Engineering | 22PBEE41 | Analog and Digital Electronics Laboratory | | | | | | ✓ | |
| | Electrical and Electronics Engineering | | | | | | | | ✓ | |
| 36 | Electrical and Electronics Engineering | 22PBEE42 | Electrical Machines – II Laboratory | | | | | | ✓ | |
| 37 | Electrical and Electronics Engineering | 22CBEE51 | Power Electronics | | | | | | ✓ | |
| 38 | Electrical and Electronics Engineering | 22CBEE52 | Control Systems | | | | | | ✓ | |
| 39 | Electrical and Electronics Engineering | 22CBEE5A | Professional Elective – I(Electrical Machine Design) | | | | | | ✓ | |
| 40 | Electrical and Electronics Engineering | 22CBEE5B | Open Elective – I(Fundamentals of nano science) | | | | | | ✓ | |
| 41 | Electrical and Electronics Engineering | 22CBEE53 | Transmission and Distribution | | | | | | ✓ | |
| 42 | Electrical and Electronics Engineering | 22PBEE51 | Measurements and Control System Laboratory | | | | | | ✓ | |
| 43 | Electrical and Electronics Engineering | 22PBEE52 | Power Electronics laboratory | | | | | | ✓ | |
| 4 | Electrical and Electronics | 22SUPD51 | Personality Development | | | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Engineering | | III | | | | | | | |
| 45 | Electrical and Electronics Engineering | | Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/Mathworks) - Minimum 4 weeks | | ✓ | | | | ✓ | |
| 46 | Electrical and Electronics Engineering | 22CBEE61 | Power System Analysis | | | | | | ✓ | |
| 47 | Electrical and Electronics Engineering | 22CBEE6A | Professional Elective – II(Power System Protection and Switch Gear) | | | | | | ✓ | |
| 48 | Electrical and Electronics Engineering | 22CBEE6B | Professional Elective – III(Computer Aided Power system Analysis- Blended) | | | | | | ✓ | |
| 49 | Electrical and Electronics Engineering | 22EBEE6C | Open Elective – II(Principles of management and professional ethics) | | | ✓ | | | | ✓ |
| 50 | Electrical and Electronics Engineering | 22CBEE62 | Solid State Drives | | | | | | ✓ | |
| 51 | Electrical and Electronics Engineering | 22PBEE61 | Electrical Drives Lab | | | | | | ✓ | |
| 52 | Electrical and Electronics Engineering | 22PBEE62 | Power Systems Laboratory | | | | | | ✓ | |
| 53 | Electrical and Electronics | 22SUPD61 | Personality Development - | | | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| | Engineering | | IV | | | | | | | |
| 54 | Electrical and Electronics Engineering | 22IBEE61 | Summer Internship (4 weeks) | | | | | | | |
| 55 | Electrical and Electronics Engineering | 22EBEE7A | Open Elective – III(Microcontroller based System Design) | | | | | | ✓ | |
| 56 | Electrical and Electronics Engineering | 22EBEE7B | Open Elective – IV(Robotics and Automation) | | | | | | ✓ | |
| 57 | Electrical and Electronics Engineering | 22EBEE7D | Professional Elective– IV(Power System Operation and Control) | | | | | | ✓ | |
| 58 | Electrical and Electronics Engineering | 22CBEE71 | Special Electrical Machines | | | | | | ✓ | |
| 59 | Electrical and Electronics Engineering | 22EBEE7F | Microprocessor Microcontroller | | | | | | ✓ | |
| 60 | Electrical and Electronics Engineering | 22PBEE71 | Power System Protection lab | | | | | | ✓ | |
| 61 | Electrical and Electronics Engineering | 22PBEE72 | Microprocessor Microcontroller Lab | | | | | | ✓ | |
| 62 | Electrical and Electronics Engineering | 22RBEE71 | Project Phase I | | ✓ | | | | ✓ | |
| 63 | Electrical and Electronics Engineering | 22EBEE8A | Professional Elective– V(Electrical Energy Conservation and Auditing) | | ✓ | | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|
| 64 | Electrical and Electronics Engineering | 22EBEE8B | Open Elective – V(Electric Vehicle Mechanics and Control) | | ✓ | | | | ✓ | |
| 65 | Electrical and Electronics Engineering | 22EBEE8C | Open Elective – VI(Total Quality Management ) | | | ✓ | | | | |
| 66 | Electrical and Electronics Engineering | 22RBEE82 | Project Phase II | | | ✓ | | | | |