## SCHEME OF COURSE WORK

**Course Details:**

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| **Course Title** | **: MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS (ELECTIVE-I)** | | |
| **Course Code** | **: 13EE2106** | **L P C** | **: 4 0 3** |
| **Program:** | **: M.Tech.** | | |
| **Specialization:** | **: Power System Control & Automation** | | |
| **Semester** | **: I** | | |
| **Prerequisites** | **: Power Electronics, Electrical Machines** | | |
| **Courses to which it is a prerequisite** | **: Research** | | |

**Course Outcomes (COs):**

After completion of the course student acquire knowledge in

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| CO1 | Derive a mathematical model of Power Electronic Devices and computer simulation techniques widely used for Power electronic Converters |
| CO2 | Derive a mathematical model and Simulation of AC-DC and DC-DC Converters |
| CO3 | Derive a mathematical model and Simulation of DC motor drive systems |
| CO4 | Derive a mathematical model and Simulation of Induction Drive Systems |
| CO5 | Derive a mathematical model and Simulation of Synchronous motor drive systems |

**Program Outcomes (POs):**

A graduate of Power System Control & Automation will be able to

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| 1 | Acquire in-depth knowledge in the area of power system control and automation. |
| 2 | Analyze the models with respect to any kind of problem on hand and try to solve related to power system control and automation. |
| 3 | Develop the capability of problem solving and original thinking to arrive at feasible and optimal solutions considering societal and environmental factors. |
| 4 | Interpret and demonstrate sufficient knowledge base, to apply the techniques and tools either individually or in groups to solve power system problems. |
| 5 | Select state-of-the-art tools for modeling, simulation and analysis of problems related to power systems. |
| 6 | Recognize positively any collaborative and multidisciplinary research to achieve common goals. |
| 7 | Demonstrate knowledge and understanding of power system engineering and management principles and apply the same for efficiently carrying out projects with due consideration to economical and financial factors. |
| 8 | Communicate confidently, make effective presentations and write good reports to engineering community and society. |
| 9 | Recognize the need for life-long learning and have the ability to do it independently. |
| 10 | Understand Social responsibilities and follow ethical practices to contribute to the community for sustainable development. |
| 11 | Predict and self examine critically the outcomes of actions, reflect on to make corrective measures and move forward positively. |

**Course Outcome** Versus **Program Outcomes:**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
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| **CO-1** | M | M | M | S | S | | M | | | | |
| **CO-2** | M | M | M | S | S | | M | | | | |
| **CO-3** | M | M | M | S | S | | M | | | | |
| **CO-4** | M | M | M | S | S | | M | | | | |
| **CO-5** | M | M | M | S | S | | M | | | | |

*S* - Strongly correlated, *M* - *Moderately* correlated, *Blank* - *No correlation*

| **Assessment Methods:** | Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam |
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**Teaching-Learning and Evaluation**

| Week | TOPIC / CONTENTS | Course Outcomes | Sample questions | TEACHING-LEARNING STRATEGY | Assessment Method & Schedule |
|---|---|---|---|---|---|
| 1 | Overview and modeling of Power Electronic (PE) devices: Diodes, Thyristors, IGBTs, MOSFET, | CO-1 | Demonstrate the Model for MOSFET.<br><br>Demonstrate the Model for IGBT | ▫ Lecture<br>▫ Discussion | Mid-Test 1 (Week 9)<br>Seminar (Week 2) |
| 2 | Comparison of switching characteristics<br>of various devices<br>Transient and Steady state behaviour of PE devices | CO-1 | Compare the switching characteristics of various devices | ▫ Lecture<br>▫ Discussion | Mid-Test 1 (Week 9)<br>Seminar (Week 2) |
| 3 | Challenges in Computer Simulation Solution techniques for time domain simulation | CO-1 | What are the challenges in computer simulation solution techniques for time domain simulation | ▫ Lecture<br>▫ Discussion | Mid-Test 1 (Week 9)<br>Seminar (Week 3) |
| 4 | widely used circuits and / or system oriented simulators. Choice of a simulator | CO-1 | What are widely used simulators.<br><br>Describe the choice of a simulator. | ▫ Lecture<br>▫ Discussion | Mid-Test 1 (Week 9)<br>Seminar (Week 4) |
| 5 | Modeling of controlled and uncontrolled ac/ dc converters; single- phase & 3- phase ac/dc converters; other topologies for ripple current minimization and power factor improvement | CO-2 | Model the single phase AC-DC converter.<br><br>Explain how the power factor is improved? | ▫ Lecture<br>▫ Discussion | Mid-Test 1 (Week 9)<br>Seminar (Week 5) |
| 6 | Modeling & Simulation of dc/dc converters such as Buck, Boost, Buck-Boost | CO-2 | Explain how simulation of DC/DC converter is performed. | ▫ Lecture<br>▫ Demonstration | Mid-Test 1 (Week 9)<br>Seminar (Week 6) |
| 7 | Modeling & Simulation of Cuk and Full bridge dc/dc Converters. | CO-2 | Explain how simulation of Cuk converter is performed. | ▫ Lecture<br>▫ Demonstration | Mid-Test 1 (Week 9)<br>Seminar (Week 7) |
| 8 | Equivalent circuits for DC motors, DC | CO-3 | Draw the equivalent | ▫ Lecture | Mid-Test 1 |

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| | motors with a separately excited field winding, | | circuits for separately excited DC motors and obtain its transfer function. | ▫ Discussion | (Week 9) Seminar (Week 8) |
| **9** | **Mid-Test 1** | | | | |
| 10 | DC servo drives and their control, Adjustable speed dc Drives, | CO-3 | With the help of block diagram explain the speed control of DC servo motor. | ▫ Lecture<br>▫ Discussion<br>▫ Problem solving | Mid-Test 2 (Week 18) Seminar (Week 10) |
| 11 | Effect of discontinuous current, Field weakening effects | CO-3 | What is the effect of Discontinuous current for the converter fed DC motor drive | ▫ Lecture<br>▫ Discussion | Mid-Test 2 (Week 18) Seminar (Week 11) |
| 12 | Induction motor characteristics at rated frequency and rated voltage | CO-4 | Draw the Induction motor Torque-slip characteristics | ▫ Lecture<br>▫ Discussion | Mid-Test 2 (Week 18) Seminar (Week 12) |
| 13 | simulation of variable frequency voltage source square wave / PWM drives | CO-4 | Explain how the simulation of V/F control of Induction motor is obtained for a given simulator. | ▫ Lecture<br>▫ Demonstration | Mid-Test 2 (Week 18) Seminar (Week 13) |
| 14 | CSI drive simulation | CO-4 | Explain how the simulation of CSI fed Induction motor drive is obtained for a given simulator. | ▫ Lecture<br>▫ Demonstration | Mid-Test 2 (Week 18) Seminar (Week 14) |
| 15 | Principles of synchronous motor operation; | CO-5 | Explain the principle of Synchronous motor with a neat sketch. | ▫ Lecture<br>▫ Discussion | Mid-Test 2 (Week 18) Seminar (Week 15) |
| 16 | Brushless dc motor drive operation, synchronous motor servo drive simulation, | CO-5 | Explain the operation of Brushless dc motor drive with a neat sketch.<br><br>Explain how simulation of synchronous motor servo drive is obtained for a chosen simulator. | ▫ Lecture<br>▫ Demonstration | Mid-Test 2 (Week 18) Seminar (Week 16) |
| 17 | Load commutated synchronous motor drive. | CO-5 | Explain the operation of load commutated synchronous motor drive. | ▫ Lecture<br>▫ Demonstration | Mid-Test 2 (Week 18) Seminar (Week 17) |
| **18** | **Mid-Test 2** | | | | |
| **19/20** | **END EXAM** | | | | |