|  |  |  |  |
| --- | --- | --- | --- |
| EE-260 Electrical Machines | | | |
| Course Code: | EE-260 | **Semester:** | Fall 2022 |
| Credit Hours: | 3+1 | **Prerequisite Codes:** |  |
| Instructor: | Neelma Naz | **Class:** | BEE-12CD |
| Office: | A-213 | **Telephone:** | 051-90852139 |
| Lecture Days: | Mon, Tues, Wed | **E-mail:** | neelma.naz@seecs.edu.pk |
| Class Room: | CR-10,1 | **Consulting Hours:** | Tuesday: 15:00-17:00 hrs |
| Lab Engineer: | Engr. Mughees Ahmad | **Lab Engineer Email:** | mughees.ahmed@seecs.edu.pk |
| Knowledge Group: | EPC | **Updates on LMS:** | After Every Lecture |

|  |  |
| --- | --- |
| Course Description: | |
|  | The course gives the introduction to Electromechanical Systems, provides undergraduate students with both a basic and practical understanding of subject. The main objectives of this course are: (1) to analyze transformer circuits and describe their practical application in single phase and three phase systems, (2) to describe the principle of operation of AC and DC machines and (3) to analyze the effect of machine parameters on the performance of a given AC or DC machine in terms of speed, torque, power and efficiency. This course covers magnetic circuits, single phase transformer and equivalent circuit, autotransformer, basic concepts of electromechanical energy conversion, and DC and AC machines modeling and steady state analysis. The course will enable the students to understand the theory and build strong concepts of electric machines and transformer by practically implementing their knowledge in Electro-mechanical Lab. At the successful completion, the course should develop understanding of magnetic circuits, single phase transformer and equivalent circuit, autotransformer, basic concepts of electromechanical energy conversion, DC and AC machines modeling and, steady state analysis. |

|  |
| --- |
| Course Learning Outcomes: |
| |  |  |  |  | | --- | --- | --- | --- | | **CLO** | **Description**  After the completion of the course the students will be able to: | **BT Level** | **PLOs** | | 1. | **Describe** fundamental concepts, theories and laws of magnetics & magnetically coupled circuits. | C2 | 1 | | 2. | **Analyze** the characteristics and operation of transformers and derive their equivalent circuits. | C4 | 2 | | 3. | **Analyze** the characteristics and operation of synchronous machines and derive their three phase equivalent circuits. | C4 | 2 | | 4. | **Analyze** the characteristics and **derive** the equivalent circuits of three phase induction motors, DC machines and single-phase machines. | C4 | 2 | | 5. | **Analyze** and **interpret** experimental data acquired during conduct of electrical machinesexperiments | P3 | 4 | | 6. | **Implement & Test** different electric machines using state of the art LabVolt tools and Test Equipment | P4 | 5 | | 7. | **Exhibit** good professional and ethical behavior while **adhering** to lab safety rules. | A3 | 8 | | 8. | **Function** effectively both individually and as a member of a team | A3 | 9 | |

|  |
| --- |
| Mapping of CLOs to Program Learning Outcomes |
| |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **PLOs/CLOs** | **CLO1** | **CLO2** | **CLO3** | **CLO4** | **CLO5** | **CLO6** | **CLO7** | **CLO8** | | PLO 1 (Engineering Knowledge) | √ |  |  |  |  |  |  |  | | PLO 2 (Problem Analysis) |  | √ | √ | √ |  |  |  |  | | PLO 3 (Design/Development of Solutions) |  |  |  |  |  |  |  |  | | PLO 4 (Investigation) |  |  |  |  | √ |  |  |  | | PLO 5 (Modern tool usage) |  |  |  |  |  | √ |  |  | | PLO 6 (The Engineer and Society) |  |  |  |  |  |  |  |  | | PLO 7 (Environment and Sustainability) |  |  |  |  |  |  |  |  | | PLO 8 (Ethics) |  |  |  |  |  |  | √ |  | | PLO 9 (Individual and Team Work) |  |  |  |  |  |  |  | √ | | PLO 10 (Communication) |  |  |  |  |  |  |  |  | | PLO 11 (Project Management) |  |  |  |  |  |  |  |  | | PLO 12 (Lifelong Learning) |  |  |  |  |  |  |  |  | |

|  |
| --- |
| Assessment Modules, Weightages, and Mapping to CLOs |
| |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Assessments/CLOs** | **CLO1** | **CLO2** | **CLO3** | **CLO4** | **CLO5** | **CLO6** | **CLO7** | **CLO8** | | Quizzes: 14% of the theory part | √ | √ | √ | √ |  |  |  |  | | Assignments: 6% of the theory part | √ | √ | √ | √ |  |  |  |  | | OHTs: 30% of the theory part | √ | √ | √ | √ |  |  |  |  | | Labs:25% of the course |  |  |  |  | √ | √ | √ | √ | | End Semester Exam:50% of theory part | √ | √ | √ | √ |  |  |  |  | |

|  |  |
| --- | --- |
| Books: | |
| Text Book: | 1. Chapman, S. J., Electric Machinery Fundamentals, 4th edition, McGraw Hill, 2005. |
| Reference Books: | 1. B. S. Guru, H. R. Hiziroglu, Electric Machinery and Transformers, 3rd Edition, Oxford University Press, 2001s. |

|  |  |
| --- | --- |
| Main Topics to be Covered: | |
| The course spans over a number of different topics as under: | |
| 1. Introduction to electro-magnetic theory | 4. Induction Motor |
| 2. Transformers | 5. DC Machines |
| 3. Synchronous Generator | Special Motors |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Lecture Breakdown: | | | | |
| Week No. | **Lecture**  **No.** | **Topics** | **Sections** | **Remarks** |
| 1 | 1 | Introduction to Electro-Mechanical Systems | - |  |
| 1 | 2 | Fundamentals of Machinery | 1.1 - 1.3 |  |
| 1 | 3 | Magnetic Field and Faraday's Law | 1.4 - 1.5 |  |
| 2 | 4 | Linear DC Machine | 1.6 - 1.10 |  |
| 2 | 5 | Introduction to Transformers | 2.1 - 2.3 |  |
| 2 | 6 | Real Single-Phase Transformer | 2.4 |  |
| 3 | 7 | Transformer Circuit | 2.5 - 2.6 |  |
| 3 | 8 | Transformer Efficiency | 2.7 - 2.8 |  |
| 3 | 9 | Autotransformer | 2.9 |  |
| 4 | 10 | Three-Phase Transformer | 2.10 |  |
| 4 | 11 | A Simple Loop in A Uniform Magnetic Field | 4.1 |  |
| 4 | 12 | The Rotating Magnetic Field | 4.2 |  |
| 5 | 13 | Induced Voltage in AC Machines -1 | 4.3 |  |
| 5 | 14 | Induced Voltage in AC Machines-2 | 4.4 |  |
| 5 | 15 | OHT-1 Preparation | Revision |  |
| 6 |  | OHT - 1 Week | OHT–1 |  |
| 7 | 16 | OHT-1 Showing | OHT-1 Solution |  |
| 7 | 17 | Torque and Insulation in AC Machines | 4.5 - 4.6 |  |
| 7 | 18 | AC Machines Losses | 4.7 - 4.8 |  |
| 8 | 19 | Introduction to Synchronous Generators | 5.1 |  |
| 8 | 20 | Brushless Exciter Mechanism | 5.2 |  |
| 8 | 21 | Equivalent Circuit of Synchronous Generators | 5.4 - 5.6 |  |
| 9 | 22 | Model Parameters of Synchronous Generators | 5.7 |  |
| 9 | 23 | Load Effects on Synchronous Generators | 5.8 |  |
| 9 | 24 | Parallel Operations of AC Generators - 1 | 5.9 |  |
| 10 | 25 | Parallel Operations of AC Generators - 2 | 5.9 |  |
| 10 | 26 | Parallel Operations of AC Generators - 3 | 5.9 |  |
| 10 | 27 | Introduction to Induction Motor | 7.1-7.2 |  |
| 11 | 28 | EQ. Circuit of Induction Motor | 7.3 |  |
| 11 | 29 | Torque & Power in Induction Motor | 7.4 |  |
| 11 | 30 | OHT - 2 Preparation | Revision |  |
| 12 |  | OHT-2 Week |  |  |
| 13 | 31 | OHT-2 Showing | OHT-2 Solution |  |
| 13 | 32 | Induction Motor Torque Speed Characteristics | 7.5 |  |
| 13 | 33 | Determining Circuit Model Parameters | 7.11 |  |
| 14 | 34 | Introduction to DC Machines | 8.1-8.3 |  |
| 14 | 35 | Introduction to DC Motors | 9.1 - 9.3 |  |
| 14 | 36 | Separately Excited and Shunt DC Motors | 9.4 |  |
| 15 | 37 | Series & Compound DC Motors, and PMDC Motors | 9.5 - 9.7 |  |
| 15 | 38 | DC Generators | 9.11 - 9.13 |  |
| 15 | 39 | Introduction & Types of DC Generators | 9.14 - 9.17 |  |
| 16 | 40 | Universal Motor and Single-Phase Ind. Motors | 10.1 - 10.2 |  |
| 16 | 41 | Characteristics of Single-Phase Ind. Motors | 10.3 - 10.4 |  |
| 16 | 42 | Overview of Various Special Purpose Motors | 10.5 - 10.7 |  |
| 17 | 43 | ESE - Preparation | Revision |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Lab Experiments: | | | |
| Week | **Lab** | **Topic** |  |
| 1 | Lab 1 | Introduction to three phase power system |  |
| 2 | Lab 2 | Analysis of three phase power system |  |
| 3 | Lab 3 | Examples of Faraday's Laws |  |
| 4 | Lab 4 | Eddy Currents and Laminated Cores |  |
| 5 | Lab 5 | Hysteresis Loop and Core Losses |  |
| 6 | Lab 6 | Single Phase Transformers |  |
| 7 | Lab 7 | Auto-transformer |  |
| 8 | Lab 8 | Introduction to Machines |  |
| 9 | Lab 9 | Three Phase Alternator Characteristics |  |
| 10 | Lab 10 | Generator Synchronization |  |
| 11 | Lab 11 | Three Phase Squirrel Cage Induction Motor |  |
| 12 | Lab 12 | Shunt and Series Dc Motor Characteristics |  |
| 13 | Lab 13 | Shunt and Series Dc Motor Characteristics (Part two) |  |

|  |  |
| --- | --- |
| Tools / Software Requirement: | |
|  | MATLAB/SIMULINK is required for the practical work. The system administration has installed all the software in the lab allocated for this purpose. |

|  |  |
| --- | --- |
| Grading Policy: | |
| Quiz Policy: | The quizzes will be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor’s discretion. |
| Assignment Policy: | In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No ‘best-of’ policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams. |
| Lab Conduct: | The labs will be conducted for three hours every week. A lab handout will be given in advance for study and analysis The lab handouts will also be placed on LMS. The students are to submit their results by giving a lab report at the end of lab for evaluation. One lab report per group will be required. However, students will also be evaluated by oral viva during the lab. |
| Plagiarism: | SEECS maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people’s work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action. |

­­­