# 36.Course Specification of Electrical Machines (2)

| I.Course Identification and General Information: | | | | | | |
|---|---|---|---|---|---|---|
| 1. | Course Title: | Electrical Machines (2). | | | | |
| .2 | Course Code & Number: | MT209. | | | | |
| .3 | Credit hours: | C.H | | | | TOTAL CR. HRS. |
| | | Th. | Seminar | Pr | Tu. | |
| | | 2 | - | 2 | 2 | 4 |
| .4 | Study level/ semester at which this course is offered: | Third Year-Second Semester. | | | | |
| .5 | Pre –requisite (if any): | Electrical Circuits (2). | | | | |
| 6. | Co –requisite (if any): | None. | | | | |
| 7. | Program (s) in which the course is offered: | Mechatronics Engineering Program. | | | | |
| .8 | Language of teaching the course: | English Language. | | | | |
| .9 | Location of teaching the course: | Mechatronics Engineering Department. | | | | |
| 10. | Prepared By: | Assoc. Prof. Dr. Radwan Mohammed AL Bouthigy. | | | | |
| 11. | Date of Approval: | | | | | |

## II.Course Description:

This course is designed to provide principal concepts of electrical machines as a major Mechatronics system component. This course covers construction, classification, performance characteristics, analysis, parallel operation, testing and applications of: three-phase synchronous AC machines ,special purpose motor and asynchronous AC machines as well as, starting and speed control of the different types of motors.

| III.Course Intended learning outcomes (CILOs) of the course | | Referenced PILOs |
|---|---|---|
| **a1.** | Identify the operation principles, construction, performance characteristics, application areas, merits and demerits of synchronous and asynchronous machines. | A1, A3. |
| **a2.** | Express the equivalent circuit, the analytic model, parallel operation, regulation and speed control of synchronous machines. | A6, A8 |

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|---|---|---|---|---|
| Assoc. Prof. Dr. Abdul-Malik Momin | Assoc. Prof. Dr. Mohammad Algorafi | Prof. Dr. Mohammed AL-Bukhaiti | Assoc. Prof. Dr. Huda Al-Emad | Prof. Dr. Al-Qassim Mohammed Abbas |

| | | |
|---|---|---|
| **b1.** | Analyze the operation conditions, modeling and design principles of AC synchronous and induction machines using mathematical models and computer simulation. | B1,B2,B3 |
| **b2.** | Explore the various requirements and operation conditions of synchronous generator and motors from the related manufacturer data sheets, codes and standards. | B1,B2,B3 |
| **c1.** | Apply methods of regulation and speed control to adjust and/or modify the performance and the output characteristic of general type of rotating electrical machines. | C1,C2 |
| **c2.** | Conduct experiment to obtain the parameters and load characteristics of various AC motors and generators under different loading conditions. | C1,C2 |
| **d1.** | Co-operate in teams to conduct experiments, analyze results, and develop technically sound reports of outcomes. | D1,D3,D6 |
| **d2.** | Review transferable skills of problem solving and design. | D1,D3,D6 |

**(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:**

| Course Intended Learning Outcomes | Teaching Strategies | Assessment Strategies |
|---|---|---|
| **a1.** Identify the operation principles, performance construction, characteristics, application areas, merits and demerits of synchronous and asynchronous machines. | Lectures, Tutorial, Interactive Class Discussions, Laboratory Experiments, Self-Study. | Assignments, Written Exams, Quizzes. |
| **a2.** Express the equivalent circuit, the analytic model, parallel operation, regulation and speed control of synchronous machines. | Lectures, Tutorial, Interactive Class Discussions, Laboratory Experiments, Self-study. | Assignments, Written Exams, Quizzes. |

**(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:**

| Course Intended Learning Outcomes | Teaching Strategies | Assessment Strategies |
|---|---|---|
| **b1.** Analyze the operation conditions, modeling and design principles of AC synchronous and induction machines using mathematical models and computer simulation. | Lectures, Interactive Class Discussions, Laboratory Experiments, Self and Cooperative Learning. | Assignments, Quizzes, Written Exams, Homework, Lab. Reports. |

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|---|---|---|---|---|
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| | | |
|---|---|---|
| **b2.** Explore the various requirements and operation conditions of synchronous generator and motors from the related manufacturer data sheets, codes and standards. | Lectures, Interactive Class Discussions, Laboratory Experiments, Self and Cooperative Learning. | Assignments, Quizzes, Written Exams, Homework, Lab. Reports. |

| © **Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:** | | |
|---|---|---|
| Course Intended Learning Outcomes | Teaching Strategies | Assessment Strategies |
| **c1.** Apply methods of regulation and speed control to adjust and/or modify the performance and the output of characteristic of general type rotating electrical machines. | Lectures, Interactive Class Discussion Exercises, Series of laboratory Experiment, Self-Study, Assignments. | Quizzes, Laboratory Assignments and Reports, Homework, Mid-Term and Final exams. |
| **c2.** Conduct experiment to obtain the parameters and load characteristics of various AC motors and generators under different loading conditions | Lectures, Interactive Class Discussion Exercises, Series of Laboratory Experiment, Self-Study Assignments | Quizzes, Laboratory Assignments and Reports, Homework, Mid-Term and Final Exams. |

| (D) **Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:** | | |
|---|---|---|
| Course Intended Learning Outcomes | Teaching Strategies | Assessment Strategies |
| **d1.** Co-operate in teams to conduct experiments, analyze results, and develop technically sound reports of outcomes.. | Lectures, Interactive Class Discussion, Self-Study Assignments. | Laboratory Reports, Assignments, Quizzes, Written Exams, Lab. Exams, Homework. |
| **d2.** Review transferable skills of problem solving and design.. | Lectures, Interactive Class Discussion, Self-study Assignments. | Laboratory Reports, Assignments, Quizzes, Written Exams, Lab. Exams, Homework. |

## IV.Course Content:

### A – Theoretical Aspect:

| Order | Units/Topics List | Learning Outcomes | Sub Topics List | Number of Weeks | Contact Hours |
|---|---|---|---|---|---|
| 1. | Three-Phase Synchronous Generators. | a1, a2, b1, b2, c1, c2, d1, d2. | • Construction, Operation principles and application areas.<br>• Performance characteristics and equivalent circuits.<br>• Mathematical and MATLAB model.<br>• Voltage and Power regulations.<br>• Parallel operation of synchronous generators. | 3 | 6 |
| 2. | Three-Phase Synchronous Motors. | a1, a2, b1, b2, c1, c2, d1, d2. | • Construction, Performance characteristics, equivalent circuits and application areas.<br>• Mathematical modeling and MATLAB representation.<br>• Speed control. | 2 | 4 |
| 3. | Single-Phase Induction Motors. | a1, a2, b1, b2, c1, c2, d1, d2. | • Construction and Operation principles.<br>• Performance characteristics, equivalent circuits and application areas.<br>• Modeling of single-phase induction motors. | 3 | 6 |
| 4. | Mid-Term Exam. | a1, a2, b1, b2. | • The First 3 Chapters. | 1 | 2 |
| 5. | Three-Phase Induction motors. | a1, a2, b1, b2, c1, c2, d1, d2. | • Construction, Operation principles and application areas.<br>• Performance characteristics and equivalent circuits.<br>• Speed control and starting methods<br>• Mathematical and MATLAB modeling. | 4 | 8 |
| 6. | Special Purpose Machines. | a1, a2, b1, b2, | • Construction, Operation principles and application | 2 | 4 |

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|---|---|---|---|---|---|
| | | c1, c2, d1, d2. | areas of stepper and servo motors. | | |
| 7. | Final Exam. | a1, a2, b1, b2 | • All Chapters. | 1 | 2 |
| **Number of Weeks /and Units Per Semester** | | | | **16** | **32** |

## B- Tutorials Aspect:

| Order | Tutorial Skills List | Number of Weeks | Contact Hours | CILOs |
|---|---|---|---|---|
| 1 | Three-phase Synchronous generators.<br>• Equivalent circuits<br>• Performance characteristics<br>• Phasor diagram<br>• Power and torque<br>• Determining model parameters.<br>• Effect of load changes | 2 | 4 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 2 | Three-phase Synchronous generators.<br>• Mathematical and MATLAB model.<br>• Voltage and Power regulations.<br>• Parallel operation of synchronous generators. | 2 | 4 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 3 | Three-phase Synchronous motors.<br>• Equivalent circuits<br>• Performance characteristics<br>• Effect of load changes<br>• Effect of field current changes<br>• Power factor correction<br>• Starting of motor | 3 | 6 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 4 | Single-phase Induction motors.<br>• Equivalent circuits.<br>• Performance characteristics<br>• Starting and speed control. | 1 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 5 | Three--phase Induction motors.<br>• Concept of rotor slip | 2 | 4 | a1,a2,b1,b2,,c1,c2,d1,d2. |

| | | | | |
|---|---|---|---|---|
| | • Equivalent circuits<br>• Power and torque | | | |
| 6 | Three phase Induction motors.<br>• Performance characteristics.<br>• Determining model parameters.<br>• Starting control methods.<br>• Speed control methods. | 3 | 6 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 7 | Stepper and servo motors<br>• Equivalent circuits<br>• Speed control | 1 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** | |

**C - Practical Aspect:**

| Order | Tasks/ Experiments | Number of Weeks | Contact Hours | Learning Outcomes |
|---|---|---|---|---|
| 1. | • Safety regulations and requirements in electrical laboratories.<br>• Introduction to main laboratory devices and instrumentations.<br>• Introduction to main measurement devices.<br>• Reporting format. | 1 | 2 | a1,a2,b1,b2, c1,c2,d1,d2. |
| 2. | • External characteristics of three phase synchronous generator<br>• Voltage regulation of three phase synchronous generator<br>• Synchronous generator characteristics | 2 | 4 | a1,a2,b1,b2, c1,c2,d1,d2. |
| 3. | • Parallel operation and synchronism of synchronous generator.<br>• Computer modeling of parallel operation and synchronism. | 1 | 2 | a1,a2,b1,b2, c1,c2,d1,d2. |
| 4. | • Load characteristics of Synchronous motor<br>• Synchronous motor characteristics<br>• V – curve of Synchronous motor<br>• Computer modeling of three-phase synchronous motors. | 2 | 4 | a1,a2,b1,b2, c1,c2,d1,d2. |
| 5. | • Starting and reversing of Three-phase Induction motors | 5 | 10 | a1,a2,b1,b2, c1,c2,d1,d2. |

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|---|---|---|---|---|
| | • Performance characteristics of Three-phase Induction motors (no load, locked rotor, DC test and load test)<br>• Measurement of torque – speed of Three-phase Induction motors<br>• Speed control of Three-phase Induction motors<br>• Effect of rotor resistance for behavior of three phase induction motor<br>• Computer modeling of three-phase induction motors. | | | |
| 6. | • Single-phase Induction motors starting.<br>• Single-phase Induction motors characteristics.<br>• Computer modeling of single-phase induction motors. | 1 | 2 | a1,a2,b1,b2, c1,c2,d1,d2. |
| 7. | • Speed control Stepper and servo motors | 1 | 2 | a1,a2,b1,b2, c1,c2,d1,d2. |
| 8. | Laboratory exam | 1 | 2 | a1,a2,b1, b2,c1,c2. |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** | |

## V.Teaching strategies of the course:

- Lectures.
- Interactive Class Discussion.
- Tutorial Classes and Exercises.
- Series of Laboratory Experiment.
- Self-Study of Computer Aided Design Software Like Modelica and/MATLAB.

## VI.Assignments:

| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
|---|---|---|---|---|
| 1. | Design and implementation of Synchronous generator circuits using MATLAB tools. | a1,a2,b1,b2,d2. | 3th | 2 |
| 2. | Design and implementation of Synchronous motor circuits using MATLAB tools. | a1,a2,b1,b2,c1. | 4th | 2 |

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|---|---|---|---|---|
| 3. | Design and implementation of three induction motor circuits using MATLAB tools. | a1,a2,b1,b2,c1. | 6th | 2 |
| 4. | Design and implementation of stepper motor circuits using MATLAB tools. | a1,a2,b1,b2,c1. | 8th | 2 |
| 5. | Lab-reports. | a1,a2,b1,b2. | Weekly | 2 |
| **Total** | | | | **10** |

## VII.Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment | Aligned Course Learning Outcomes |
|---|---|---|---|---|---|
| 1. | Quizzes. | 4th,7th,10th, and 13th | 20 | 10% | a1,a2,b1,b2. |
| 2. | Assignments & Homework, Tasks & Presentation. | Weekly | 20 | 10% | a1,a2,b1,b2,d2. |
| 3. | Mid-Term Exam. | 9th | 20 | 10% | a1,a2,b1,b2. |
| 4. | Final Exam Practical. | 15th | 20 | 10% | a1,a2,b1,b2,c1,c2,d2. |
| 5. | Final Exam Theoretical. | 16th | 120 | 60% | a1,a2,b1,b2 |
| **Total** | | | **200** | **100%** | |

## VIII.Learning Resources:

- Written in the following order: ( Author - Year of publication – Title – Edition – Place of publication – Publisher).

**1- Required Textbook(s) ( maximum two ).**

1- Chapman S. J. (2005), Electric Machinery Fundamentals,4 th Edition, McGraw-Hill.
2- Fitzgerald A. E. (2003), Electric Machinery, 6th Edition, McGraw-Hill.

**2- Essential References.**

1. D.F. Warne (2000), Newnes Electrical Engineer's Handbook, 1st Edition, Biddles Ltd-www. biddlesxo. Uk.
2. Nasar S. A. (1998), Electric Machines and Electromechanics, 2nd Edition, Schaum's outlines series- McGraw-Hill.
3. Bandyopadhyay M.N, (2009), ELECTRICAL MACHINES: THEORY AND PRACTICE, 1st Edition, Prentice-Hall of India Pvt Ltd.
4. Bimbhra P.S.,(1995), Electric Machinery , 7th Edition Khanna Publishers.

**3- Electronic Materials and Web Sites *etc*.**

1. Modelica Association (2000). ModelicaTM - A Unified Object-Oriented Language for Physical Systems Modeling. Tutorial Version 1.4 (ModelicaTutorial14.pdf). Available from: https://modelica.org/documents/
2. MapleSim Video Tutorial: Modelica Video lectures available form: http://www.youtube.com/watch?v=reehU1dzeDc.
3. Simulink-Matlab tutorial for beginners Video lectures available form:
4. http://www.youtube.com/results?search_query=simulink+tutorial+for+beginners&oq=simulink&gs_l=youtube.1.9.0l10.337429.342148.0.351270.8.8.0.0.0.0.738.2481.3j3-2j2j0j1.8.0...0.0...1ac.1.11.youtube.iIK7kMX6hfo

## IX.Course Policies:

| | |
|---|---|
| **1.** | **Class Attendance:** The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and considered as an exam failure. If the student is absent due to illness, he/she should bring the approved statement from university Clinic. |
| **2.** | **Tardy:** For late in attending the class, the student will be initially notified. If he comes late in attending class again, he will consider as absent. |
| **3.** | **Exam Attendance/Punctuality:** The student should attend the exam on time. He is Permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in exam. |
| **4.** | **Assignments & Projects:** In general, one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment. |
| **5.** | **Cheating**: For cheating in exam, the student considered as failure. Case the cheating repeated three times during study the student will disengage from the Faculty |
| **6.** | **Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Affair Council of the university. |
| **7.** | **Other Policies:**<br>- The mobile phone is not allowed to be used during class lecture. It must be closed, otherwise the student will ask to leave the lecture room<br>- The mobile phone is not allowed to be taken with in class during the examination.<br>- Lecture notes and assignments may be given directly to students using soft or hard copy. |

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|---|---|
| Reviewed By | Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat.<br>President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi.<br>Head of Mechatronics Engineering Department: Assoc. Prof. Dr. Abdul-Malik Momin. |
| | Deputy Rector for Academic Affairs Assoc. Prof. Dr. Ibrahim AlMutaa.<br>Assoc. Prof. Dr. Ahmed Mujahed.<br>Asst. Prof. Dr. Munaser Alsubari. |

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# Template for Course Plan of Electrical Machines (2)

| I.Information about Faculty Member Responsible for the Course: | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Name of Faculty Member** | Assoc. Prof. Dr. Radwan AL-Bouthigy | **Office Hours** | | | | | |
| **Location& Telephone No.** | 775284933 | **SAT** | **SUN** | **MON** | **TUE** | **WED** | **THU** |
| **E-mail** | Radwan006@yahoo.com | | | | | | |

| II.Course Identification and General Information: | | | | | | |
|---|---|---|---|---|---|---|
| 1. | Course Title: | Electrical Machines (2) | | | | |
| 2. | Course Code & Number: | MT209. | | | | |
| 3. | Credit hours: | **C.H** | | | | **Total Cr.Hrs.** |
| | | **Th.** | **Tr.** | **Pr.** | **Tu.** | |
| | | 2 | - | 2 | 2 | 4 |
| 4. | Study level/ semester at which this course is offered: | Third Year-Second Semester. | | | | |
| 5. | Pre –requisite (if any): | Electrical Circuits (2). | | | | |
| 6. | Co –requisite (if any): | None. | | | | |
| 7. | Program (s) in which the course is offered: | Mechatronics Engineering Program. | | | | |
| 8. | Language of teaching the course: | English Language. | | | | |
| 9. | Location of teaching the course: | Mechatronics Engineering Department. | | | | |
| 10. | Prepared By: | Assoc. Prof. Dr. Radwan Mohammed AL Bouthigy. | | | | |
| 11. | Date of Approval: | | | | | |

## III.Course Description:

This course is designed to provide principal concepts of electrical machines as a major Mechatronics system component. This course covers construction, classification, performance characteristics, analysis, parallel operation, testing and applications of: three-phase synchronous AC machines ,special purpose motor and asynchronous AC machines as well as, starting and speed control of the different types of motors.

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|---|---|---|---|---|
| Assoc. Prof. Dr. Abdul-Malik Momin | Assoc. Prof. Dr. Mohammad Algorafi | Prof. Dr. Mohammed AL-Bukhaiti | Assoc. Prof. Dr. Huda Al-Emad | Prof. Dr. Al-Qassim Mohammed Abbas |

| IV.Course Intended learning outcomes (CILOs) of the course | | Referenced PILO |
|---|---|---|
| **a1.** | Identify the operation principles, construction, performance characteristics, application areas, merits and demerits of synchronous and asynchronous machines. | A1, A3. |
| **a2.** | Express the equivalent circuit, the analytic model, parallel operation, regulation and speed control of synchronous machines. | A6, A8 |
| **b1.** | Analyze the operation conditions, modeling and design principles of AC synchronous and induction machines using mathematical models and computer simulation. | B1,B2,B3 |
| **b2.** | Explore the various requirements and operation conditions of synchronous generator and motors from the related manufacturer data sheets, codes and standards. | B1,B2,B3 |
| **c1.** | Apply methods of regulation and speed control to adjust and/or modify the performance and the output characteristic of general type of rotating electrical machines. | C1,C2 |
| **c2.** | Conduct experiment to obtain the parameters and load characteristics of various AC motors and generators under different loading conditions. | C1,C2 |
| **d1.** | Co-operate in teams to conduct experiments, analyze results, and develop technically sound reports of outcomes. | D1,D3,D6 |
| **d2.** | Review transferable skills of problem solving and design. | D1,D3,D6 |

## V.Course Content:

### A – Theoretical Aspect:

| Order | Units/Topics List | Sub Topics List | Number of Weeks | Contact Hours |
|---|---|---|---|---|
| 1. | Three-Phase Synchronous Generators. | • Construction, Operation principles and application areas.<br>• Performance characteristics and equivalent circuits.<br>• Mathematical and MATLAB model.<br>• Voltage and Power regulations.<br>• Parallel operation of synchronous generators. | 1,2,3 | 6 |
| 2. | Three-Phase Synchronous Motors. | • Construction, Performance characteristics, equivalent circuits and application areas.<br>• Mathematical modeling and MATLAB representation. | 4,5 | 4 |

| | | | | |
|---|---|---|---|---|
| | | • Speed control. | | |
| 3. | Single-Phase Induction Motors. | • Construction and Operation principles.<br>• Performance characteristics, equivalent circuits and application areas.<br>• Modeling of single-phase induction motors. | 6,7,8 | 6 |
| 4. | Mid-Term Exam. | • The First 3 Chapters. | 9 | 2 |
| 5. | Three-Phase Induction Motors. | • Construction, Operation principles and application areas.<br>• Performance characteristics and equivalent circuits.<br>• Speed control and starting methods<br>• Mathematical and MATLAB modeling. | 10,11,12,13 | 8 |
| 6. | Special Purpose Machines. | • Construction, Operation principles and application areas of stepper and servo motors. | 14,15 | 4 |
| 7. | Final Exam | • All Chapters. | 16 | 2 |
| **Number of Weeks /and Units Per Semester** | | | **16** | **32** |

## C- Tutorials Aspect:

| Order | Tutorial Skills List | Number of Weeks | Contact Hours | Learning Outcomes |
|---|---|---|---|---|
| 1. | Synchronous Three-phase generators.<br>• Equivalent circuits<br>• Performance characteristics<br>• Phasor diagram<br>• Power and torque<br>• Determining model parameters.<br>• Effect of load changes | 1,2 | 4 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 2. | Synchronous Three-phase generators.<br>• Mathematical and MATLAB model.<br>• Voltage and Power regulations.<br>• Parallel operation of synchronous generators. | 3,4 | 4 | a1,a2,b1,b2,c1,c2,d1,d2. |

| | | | | |
|---|---|---|---|---|
| 3. | Three-phase Synchronous motors.<br>• Equivalent circuits<br>• Performance characteristics<br>• Effect of load changes<br>• Effect of field current changes<br>• Power factor correction<br>• Starting of motor | 5,6,7 | 6 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 4. | Single-phase Induction motors.<br>• Equivalent circuits.<br>• Performance characteristics<br>• Starting and speed control. | 8 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 5. | Three--phase Induction motors.<br>• Concept of rotor slip<br>• Equivalent circuits<br>• Power and torque | 9,10 | 4 | a1,a2,b1,b2,,c1,c2,d1,d2. |
| 6. | Three phase Induction motors.<br>• Performance characteristics.<br>• Determining model parameters.<br>• Starting control methods.<br>• Speed control methods. | 11,12,13 | 6 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 7. | Stepper and servo motors<br>• Equivalent circuits<br>• Speed control | 14 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** | |

**C - Practical Aspect:**

| Order | Tasks/ Experiments | Number of Weeks | Contact Hours | Learning Outcomes |
|---|---|---|---|---|
| 1. | • Safety regulations and requirements in electrical laboratories.<br>• Introduction to main laboratory devices and instrumentations. | 1 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |

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|---|---|---|---|---|
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| | | | | |
|---|---|---|---|---|
| | • Introduction to main measurement devices.<br>• Reporting format. | | | |
| 2. | • External characteristics of three phase synchronous generator.<br>• Voltage regulation of three phase synchronous generator.<br>• Synchronous generator characteristics. | 2,3 | 4 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 3. | • Parallel operation and synchronism of synchronous generator.<br>• Computer modeling of parallel operation and synchronism. | 4 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 4. | • Load characteristics of Synchronous motor.<br>• Synchronous motor characteristics.<br>• V – curve of Synchronous motor.<br>• Computer modeling of three-phase synchronous motors. | 5,6 | 4 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 5. | • Starting and reversing of Three-phase Induction motors.<br>• Performance characteristics of Three-phase Induction motors (no load, locked rotor, DC test and load test).<br>• Measurement of torque – speed of Three-phase Induction motors.<br>• Speed control of Three-phase Induction motors.<br>• Effect of rotor resistance for behavior of three phase induction motor.<br>• Computer modeling of three-phase induction motors. | 7,8,9,10, 11 | 10 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 6. | • Single-phase Induction motors starting. | 12 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |

| | | | | |
|---|---|---|---|---|
| | • Single-phase Induction motors characteristics.<br>• Computer modeling of single-phase induction motors. | | | |
| 7. | • Speed control Stepper and servo motors. | 13 | 2 | a1,a2,b1,b2,c1,c2,d1,d2. |
| 8. | Laboratory exam. | 14 | 2 | a1,a2,b1,b2,c1,c2. |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** | |

## VI.Teaching strategies of the course:

- Lectures.
- Interactive Class Discussion.
- Tutorial Classes and Exercises.
- Series of Laboratory Experiment.
- Self-Study of Computer Aided Design Software Like Modelica and/MATLAB.

## VII.Assignments:

| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
|---|---|---|---|---|
| 1. | Design and implementation of Synchronous generator circuits using MATLAB tools. | a1,a2,b1,b2,d2. | 3th | 2 |
| 2. | Design and implementation of Synchronous motor circuits using MATLAB tools. | a1,a2,b1,b2,c1. | 4th | 2 |
| 3. | Design and implementation of three induction motor circuits using MATLAB tools. | a1,a2,b1,b2,c1. | 6th | 2 |
| 4. | Design and implementation of stepper motor circuits using MATLAB tools. | a1,a2,b1,b2,c1. | 8th | 2 |
| 5. | Lab. reports. | a1,a2,b1,b2. | Weekly | 2 |
| **Total** | | | | **10** |

## VIII.Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment | Aligned Course Learning Outcomes |
|---|---|---|---|---|---|
| 1. | Quizzes. | 4th,7th,10th, and 13th | 20 | 10% | a1,a2,b1,b2. |
| 2. | Assignments & Homework, Tasks & Presentation. | Weekly | 20 | 10% | a1,a2,b1,b2,d2. |
| 3. | Mid-Term Exam. | 9th | 20 | 10% | a1,a2,b1,b2. |
| 4. | Final Exam Practical. | 15th | 20 | 10% | a1,a2,b1,b2,c1,c2,d2. |
| 5. | Final Exam Theoretical. | 16th | 120 | 60% | a1,a2,b1,b2 |
| **Total** | | | **200** | **100%** | |

## IX.Learning Resources:

- Written in the following order: ( Author - Year of publication – Title – Edition – Place of publication – Publisher).

**1- Required Textbook(s) ( maximum two ).**

1. Chapman S. J. (2005), Electric Machinery Fundamentals,4 th Edition, McGraw-Hill.
2. Fitzgerald A. E. (2003), Electric Machinery, 6 th Edition, McGraw-Hill.

**2- Essential References.**

1. D.F. Warne (2000), Newnes Electrical Engineer's Handbook, 1st Edition, Biddles Ltd-www. biddlesxo. Uk.
2. Nasar S. A. (1998), Electric Machines and Electromechanics, 2nd Edition, Schaum's outlines series- McGraw-Hill.
3. Bandyopadhyay M.N, (2009), ELECTRICAL MACHINES: THEORY AND PRACTICE, 1st Edition, Prentice-Hall of India Pvt Ltd.
4. Bimbhra P.S.,(1995), Electric Machinery , 7th Edition Khanna Publishers.

**3- Electronic Materials and Web Sites *etc*.**

1. Modelica Association (2000). ModelicaTM - A Unified Object-Oriented Language for Physical Systems Modeling. Tutorial Version 1.4 (ModelicaTutorial14.pdf). Available from: https://modelica.org/documents/
2. MapleSim Video Tutorial: Modelica Video lectures available form: http://www.youtube.com/watch?v=reehU1dzeDc.
3. Simulink-Matlab tutorial for beginners Video lectures available form:
4. http://www.youtube.com/results?search_query=simulink+tutorial+for+beginners&oq=simulink&gs_l=youtube.1.9.0l10.337429.342148.0.351270.8.8.0.0.0.0.738.2481.3j3-2j2j0j1.8.0...0.0...1ac.1.11.youtube.iIK7kMX6hfo

| X.Course Policies: | |
|---|---|
| **1.** | **Class Attendance:** The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and considered as an exam failure. If the student is absent due to illness, he/she should bring the approved statement from university Clinic. |
| **2.** | **Tardy:** For late in attending the class, the student will be initially notified. If he comes late in attending class again, he will consider as absent. |
| **3.** | **Exam Attendance/Punctuality:** The student should attend the exam on time. He is Permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in exam. |
| **4.** | **Assignments & Projects:** In general, one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment. |
| **5.** | **Cheating**: For cheating in exam, the student considered as failure. Case the cheating repeated three times during study the student will disengage from the Faculty |
| **6.** | **Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Affair Council of the university. |
| **7.** | **Other Policies:**<br>- The mobile phone is not allowed to be used during class lecture. It must be closed, otherwise the student will ask to leave the lecture room<br>- The mobile phone is not allowed to be taken with in class during the examination.<br>- Lecture notes and assignments may be given directly to students using soft or hard copy. |