**Philadelphia University**
**Faculty of Engineering**
**Department of Electrical**
**First semester, 2014/2015**

**Course Syllabus**

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| **Course Title: Electrical Machine (2)** | **Course code: 610589** |
| **Course Level: 3** | **Course prerequisite:**<br>**Electrical Machine (1) 610381, Electromagnetic Field** |
| **Credit hours: 3/week** | |

**Academic Staff Specifics**

| Name | Rank | Office Number and Location | Office Hours | Email address |
|---|---|---|---|---|
| Dr Zuhair Shebeeb | Associate Prof. | E 715 | 10 – 12:30<br>Mon , Wed | zshabeeb@philadelphia.edu.jo |

**Course module description:**

- To introduce the students with fundamental concepts and principles of operation of various types of electrical machines.
- To lead the students to be familiar with basic experimental and modeling skills for handling problems associated with electrical machines.
- To give the students an appreciation of design and operational problems in the electrical power industry.

**Course module objectives:**

Knowledge of electrical machines construction, operation
Calculation of parameters equivalent circuit.
Know performance of electrical machines
Have an idea about starting braking and speed control of motors

## Course/ module components

1. Electric Machinery , A.Fitzgerald, C.Kingsley & C.Kusko, McGraw-Hill.
2. Electric machine analysis and design applying MATLAB, Jimmie j.Cathy,McGAW-HILL,2001
3. Electric Machines ,Theory ,Operation ,Application ,Adjustment, & Control ", Charles I . Hubert , Maxwell Macmillan ,2002
4. An Introduction to Electrical Machine & Transformer,George McPherson and Robert D. Laramore, John Wiley.

## Support Materials:

- **Study guide (s) (if applicable)**
- **Homeworks and laboratory guide (s) if (applicable).**

**Teaching methods:**

- Lectures (3 hr per week) are used to describe and develop the concepts listed above.
- Supervisions are used to solve problems set by various exercises.
- Eight laboratories in the 3-d year laboratory program develop themes described in this module. The eight experiments illustrate practical aspects of operation of transformers, dc, induction and synchronous machines, respectively. Measurement techniques are emphasized as well as comparison with theoretical predictions.

**Learning outcomes:**

- Knowledge and understanding

  Having successfully completed the module, the students will be able to demonstrate knowledge and understanding of:

  - Theory of electromechanical energy conversion
  - Concepts of fundamental torque equation and rotating and oscillating fields
  - Principles of operation of electrical generators and motors
  - Fundamental characteristics of various types of machines
  - The concept of the equivalent circuit
  - Construction and design issues associated with electrical machines
  - Simple testing of electromechanical devices

- Cognitive skills (thinking and analysis).

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- Communication skills (personal and academic).

  Having successfully completed the module, the students will be able to:

  - Appreciate the complexity of design of electromechanical devices
  - Identify different types of electrical machines
  - Derive equations describing operation of machines
  - Formulate relevant equivalent circuits
  - Compare and contrast the operation of different types of machines
  - Analyze simple problems related to operation of electrical machines

- Practical and subject specific skills (Transferable Skills).

  Having successfully completed the module, the students will be able to:

  - Tackle problems of analysis of performance
  - Explain the shape of characteristics of actual machines
  - Apply equivalent circuits to performance prediction
  - Interpret results and correlate them with theoretical predictions
  - Perform simple tests on machines
  - Work in as groups to conduct an experiment.

- Write a technical repot including with results and conclusions .

**Assessment instruments**

- Short reports and/ or presentations, and/ or short research projects
- Quizzes.
- Home works
- Final examination: 40 marks

| **Allocation of Marks** | |
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| **Assessment Instruments** | **Mark** |
| First Exam | **20%** |
| Second Exam | **20%** |
| Reports, research projects, Quizzes, Home works, Projects | **20%** |
| Final Exam | **40%** |
| **Total** | **100%** |

**Documentation and academic honesty**

- Documentation style (with illustrative examples)

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- Protection by copyright
- Avoiding plagiarism.

**Course/module academic calendar**

| week | Basic and support material to be covered | Homework/reports and their due dates |
|---|---|---|
| **(1)** | **- Review of Basic Electromagnetic Formulas & Magnetic Circuits<br>- Induced emf in AC Machines .** | |
| **(2)** | **- 3-phase induction motors , introduction, construction , types & operation.<br>- Rotating Magnetic Field Theory** | |
| **(3)** | **- Slip & rotor speed , rotor induced voltage & frequency. Equivalent circuit .** | **Home work 1** |
| **(4)** | **- Determination of equivalent cct. parameters , IM performance & characteristics** | |
| **(5)** | **- Power flow in IM , effects of rotor resistance** | |
| **(6)** | **Speed control of IM , Starting and braking methods of IM .** | **Home work 2** |
| **(7)<br>First Examination** | **-3-Phase Synchronous Machines , Construction & Principle of operations, Types , generated voltage.** | |
| **(8)** | **- 3-phase Synchronous generators , introduction, equivalent circuit model ,** | |

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| | **pharos diagrams , voltage regulation, Synchronous generator on infinite bus,** | |
| **(9)** | **- Power flow , losses and efficiency . Synchronous impedance & reactance .** | |
| **(10)** | **- 3-Phase Synchronous motors, equivalent circuit model , determination of synchronous reactance , pharos diagram** | |
| **(11)**<br>**Second Examination** | **Power flow , power & torque characteristics , V – Curves , PF control** | **Home work 3** |
| **(12)** | **- Synchronous condenser , Salient pole synchronous machines, determination of $X_d$ & $X_q$ .** | |
| **(13)** | **- speed control of synchronous motor , starting & braking methods .** | |
| **(14)** | **-Single phase induction motors , construction , double revolving field theory , equivalent circuit , determination of equivalent circuit parameters** | **Home work 4** |
| **(15)** | **- Starting methods and types of single phase IM, single phase series (universal) motor , braking of single phase IM .** | |
| **(16)**<br>**Final Examination** | **- Speed control of single phase IM.**<br>**- Single phase Synchronous motor , Reluctance motors , Hysteresis motors** | |

**Expected workload:**

**On average students need to spend 2 hours of study and preparation for each 50-minute lecture/tutorial.**

**Attendance policy:**

**Absence from lectures and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse acceptable to and approved by the Dean of the relevant college/faculty shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.**

**Module references**

**Books**

1. Dino Zorbas, *Electric Machines, Principles, Applications, and Control Schematics,* Publisher: West Publishing Company, 1989

2. Electric Machinery , A.Fitzgerald, C.Kingsley & C.Kusko, McGraw-Hill.
3. Electric machine analysis and design applying MATLAB, Jimmie j.Cathy,McGAW-HILL,2001
4. Electric Machines ,Theory ,Operation ,Application ,Adjustment, & Control ", Charles I . Hubert , Maxwell Macmillan ,2002
5. An Introduction to Electrical Machine & Transformer,George McPherson and Robert D. Laramore, John Wiley.

**Journals**

IEEE Transactions on Energy Conversion & Industry Application .
IET Proceedings , Part B & C .

**Websites**

www.wikipedia.org