

**FAKULTI KEJURUTERAAN ELEKTRIK  
UNIVERSITI TEKNOLOGI MALAYSIA  
SEMESTER 1 2014/2015**

**SEE3433: ELECTRICAL MACHINES**

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**Synopsis**

This course introduces students to the fundamentals of electrical machines, which are the synchronous machines, induction machines, DC machines and special machines. Students are introduced to their principle of operations, constructions and some analysis on their steady state performances.

**Course outcomes:**

At the end of the course the students should be able to:

- CO1 Apply fundamental knowledge of mathematics, physics, and circuit to solve problems on the electrical machines.
- CO2 Analyze the steady state performance of the electrical machines
- CO3 Apply the concepts to real world applications
- CO4 Be able to work in a team and communicate effectively

**Program Educational Objectives**

*Graduates of the program:*

- Can achieve competitive positions or entry into program of advanced study in areas of their interest
- Are competent and productive in electrical engineering and related practice
- Shall continue to develop professionally through both practical experience and life-long learning
- Shall communicate and lead effectively
- Practice high standards of ethical conduct and societal responsibilities

**Program Outcomes:**

*Student of an engineering program are expected to have the following outcomes:*

- PO1 Ability to acquire and apply knowledge of mathematics, science and engineering
- PO2 Ability to analyze and interpret data
- PO3 Ability to identify, formulate and solve electrical engineering problems
- PO4 Ability to work with modern instrumentation, software and hardware
- PO5 Ability to design a system, component or process to fulfill certain specifications
- PO6 Ability to communicate effectively
- PO7 Ability to function and be productive in a team
- PO8 Ability to recognize the need for, and to engage in life-long learning
- PO9 Understand the impact of the work of engineers on society
- PO10 Understand ethical and professional responsibility

**Mapping of CO to PO1-PO10, emphasis and assessment method**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1,a									
CO2			1,a							
CO3			2,a							
CO4						3,b,c	3,b			

1 = strong emphasis, 2 = medium emphasis, 3 = low emphasis

a = examinations, tests, quizzes; b = assignment, report; c= presentation, laboratory, seminar; d=thesis

### Evaluation

Test 1	17.5%
Test 2	17.5%
Assignment/Quiz	15.0%
Final exams	50.0%

### Contents

#### **Wk 1-2: Introduction to Electromechanical Energy Conversion**

Review of electromagnetism and electromechanical energy conversion: Ampere's circuit law, Faraday's law, magnetic equivalent circuit.

#### **Wk 3: Fundamentals of rotating machines**

Principles of rotating machines – cylindrical machines. Motional voltage and electromagnetic force. Basic construction of rotating electric machines.

#### **Wk 4 – 7: DC machines**

Construction, commutator action, armature windings, effect of armature reaction, interpoles and compensating windings.

Analysis of steady state performance of separately excited and shunt generators, shunt and series motors

Speed control of DC motors

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*TEST 1, Fourth Meeting*

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#### **Wk 8 – 10: 3-phase Induction machines**

Construction, principles of operation, rotating magnetic field. Derivation of equivalent circuits, no-load and blocked rotor tests

Steady state performance characteristics, power flow, classes of induction machines.

Speed control of induction motor.

#### **Wk 11 – 13: Synchronous machines**

Construction: cylindrical and salient pole, starting of synchronous motors, synchronous generators connection to infinite bus, Derivation of equivalent circuit, Open-circuit and short-circuit tests

Synchronous generator: Analysis of steady state performance, power and torque characteristics

Synchronous motor: analysis of steady state performance, power factor control.

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*TEST 2, Seventh Meeting*

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#### **Wk 14: Single-phase induction motors and special motors**

Revolving field theory, equivalent circuit and steady state performance, starting of single phase induction motor, classification of motors. principles of operations of stepper motors: variable reluctance and permanent magnet.

#### **Textbook:**

P.C. Sen, Principles of Electric Machines and Power Electronics, 2nd Edition, John Wiley and Sons

#### **References:**

1. A.E. Fitzgerald, Charles Kingsly Jr., Stephen D. Umans: Electric Machinery, Sixth Edition, Mc Graw Hill, 2003
2. Stephen J. Chapman, Electric Machinery Fundamentals, 3rd Edition, Mc Graw Hill, 1999.
3. Jimmie J. Cathey, Electric Machines: Analysis and design, Mc Graw Hill, 2001