The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course: **Electrical Machines (I) – 0903371 (3 Cr. – Required Course)**

Instructor: Prof. Sadeq Hamed
Office: E306, Telephone: 06/5355000 ext 22857, Email: hamed@ju.edu.jo
Office Hours: Will be posted soon

Course website: http://elearning.ju.edu.jo/

Catalog description: Magnetic circuits. Single-phase transformers: principles, analysis and performance characteristics. Three-phase transformers: construction, connections and vector groups. Single-phase and three-phase transformer testing. Electromechanical energy conversion. Basic principles of DC mechanics. Principles and classification of DC generators. DC motors: analysis, performance characteristics, starting and speed control. DC machines testing. Rotating field. Synchronous generators: classification, analysis, performance characteristics, synchronization process and parallel operation.

Prerequisites by course:

EE	**0903212**	Electrical Circuits (II)	(pre-requisite)
EE	**0903251**	Electromagnetics (I)	(pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Basic electrical circuit analysis techniques.
- Basic electromagnetic concepts.

Textbook: **Electric Machinery Fundamentals by Stephen J. Chapman, McGraw-Hill Education, 5th edition, 2011.**

References:

1. Principles of Electric Machines and Power Electronics by P. C. Sen , Wiley, 3rd edition, 2013.
2. Fitzgerald & Kingsley's Electric Machinery by Stephen D. Umans, McGraw-Hill Education, 7th edition, 2013.
3. Electrical Machines, Drives and Power Systems by Theodore Wildi, Pearson, 6th edition, 2005.
4. Electrical Transformers and Rotating Machines by Stephen L. Herman, Cengage Learning, 4th edition, 2016.
5. Electric Machines and Drives by Ned Mohan, Wiley, 1st edition, 2012.
6. Analysis of Electric Machinery and Drive Systems by Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, and Steven Pekarek, Wiley-IEEE Press, 3rd edition, 2013.

7. Schaum's Outline of Electric Machines & Electromechanics by Syed A. Nasar, McGraw-Hill Education, 2nd edition, 1997.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is to provide the student with the understanding of basic principles, analysis and performance of single and three-phase power transformers, DC generators and motors, 3-phase rotating fields, and 3-phase synchronous generators. The student is also introduced to electromechanical conversion principles and practical testing procedures of electric machines.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will:	[SO]
1. Understand the basic concepts of electromagnetics and electromechanical conversion.	[1]
2. Be familiar with power transformers operation and performance characteristics.	[1]
3. Be familiar with the connections and groups of three-phase transformers.	[1]
4. Be able to safely connect two or more transformers to operate in parallel.	[1]
5. Know the basic relationships and characteristics of DC generators and motors.	[1]
6. Know the basic relationships and characteristics of AC synchronous generators.	[1]

Course topics:	Hrs
1. Electro-Magnetic Circuits: Review of basic laws and relationships of electro-magnetic structures: Amper's Law, B/H characteristics, inductance, etc. Leakage, fringing and core lamination aspects. Magnetic circuits analysis. Stored Energy and Core losses: Eddy-current and Hysteresis losses.	6
2. Single-Phase and Three-Phase Power Transformers: Construction, classification and applications. Ideal transformers: principle of operation and basic relationships. Equivalent circuit development and analysis. Referring technique. The Per Unit system. Testing and parameters determination. Performance characteristics: input power factor, efficiency and voltage regulation. Parallel operation. Autotransformers, inrush current. Three-phase transformers: construction, connections and vector groups.	13
3. Direct Current (DC) Machines: Construction and principle of operation. Excitation methods and classification. Armature winding methods. EMF. Torque and power relationships. Equivalent circuit development of DC generators and motors. Armature reaction and commutation. Performance characteristics of DC Generators. Starting and speed control of DC motors.	11
4. Principles of AC Machines: Rotating magnetic field and EMF equation. Synchronous speed.	2
5. Synchronous Generators (Alternators): Types, construction and principle of operation. Excitation methods. Development of the equivalent circuit and its parameters. Power and torque relationships. Testing procedures and parameters determination. Performance characteristics under different loading conditions. Parallel operation and synchronization process.	10

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021