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

Course: **Electrical Machines Lab – 0903478 (1 Cr. – Required Course)**

Instructor: Dr. Eyad A. Feilat + Eng. Enaam Al-Khatib
Office: E306, Telephone: 06/5355000 ext 22857, Email: e.feilat@ju.edu.jo
Office Hours: Will be posted soon

Course website: http://engineering.ju.edu.jo/ (Go to Electrical Engineering Department Labs)

Catalog description: Transformer magnetic circuits. Testing of single and three-phase transformers. DC generators. Speed control of DC motors. Testing and operational characteristics of alternators. Testing and operational characteristics of synchronous motors. Testing and operational characteristics of induction motors.

Prerequisites by course: **EE** **0903471** Electrical Machines (II) (pre- or co-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Magnetic circuits, single-phase and three-phase transformers.
- DC generators and motors.
- Concept of three-phase rotating field.
- Three-phase synchronous generators.

Textbook: **Lab Manual which can be obtained from the course Website.**

References:

1. Electric Machinery Fundamentals by Stephen J. Chapman, McGraw-Hill Education, 5th edition, 2011.
2. Principles of Electric Machines and Power Electronics by P. C. Sen , Wiley, 3rd edition, 2013.
3. Fitzgerald & Kingsley's Electric Machinery by Stephen D. Umans, McGraw-Hill Education, 7th edition, 2013.
4. Electrical Machines, Drives and Power Systems by Theodore Wildi, Pearson, 6th edition, 2005.
5. Electrical Transformers and Rotating Machines by Stephen L. Herman, Cengage Learning, 4th edition, 2016.
6. Electric Machines and Drives by Ned Mohan, Wiley, 1st edition, 2012.
7. A Reference Book on Experiments with Basic AC/DC Circuits & Electrical Machines, Independently published, 1st edition, 2018.

8. Experiments for Electrical Machines, Drives, and Power Systems by Stephen P. Tubbs, Independently published, 3rd edition, 1997.

Schedule: 16 Weeks, 10 Lab sessions (3 Hours each) plus exams.

Course goals: The overall objective is to allow students to perform a set of experiments to examine the practical details and characteristics of various electrical machines (AC and DC generators and motors), and single-phase and three-phase transformers. And to understand how to use the test results to calculate the parameters of the tested machine equivalent circuit, and correlate practical and theoretical results.

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

Upon successful completion of this course, a student will: **[SO]**

1. Be able to safely conduct appropriate experimentation to measure fundamental performance characteristics and equivalent circuit parameters for different types of electrical machine and power transformers. **[6]**
2. Be able to analyze and interpret measured data, and use engineering judgment to draw conclusions. **[6]**
3. Know the basics of measuring instruments usually involved in electrical machines and power transformers testing (including voltmeters, ammeters, ohmmeters, wattmeters, power factor meters, torque and speed meters) and be able to properly use such instruments. **[6]**
4. Understand the requirements and pre-requisites for technical reporting, and be able to properly report experimental results. **[3]**
5. Be able to effectively function in a team in a collaborative and inclusive manner, to reach the lab goals and objectives. **[5]**

Course topics:

Hrs

1. Single-Phase Transformers: DC test, no-load test and short-circuit test, equivalent circuit parameters evaluation, load test: resistive, inductive and capacitive loading. Voltage regulation and efficiency curves. **3**
2. Transformer Magnetic Circuits: Polarity test, primary and secondary voltages ratio and phase shift. No-load current waveform construction, Hysteresis loop construction. **3**
3. Three-phase transformers: No-load test of Y-y, Y-Δ, Δ-y and Δ-Δ connected transformers. Short-circuit test of Y-y, Y-d, D-y and D-d connected transformers. Load test of three-phase transformers. **3**
4. Separately-excited and shunt DC generators: Failure of EMF generation in shunt generators. No-load test of separately-excited and shunt generators, Load characteristic of DC shunt generators. **3**
5. Compound Generators: No-load characteristics of shunt and series field windings. Load characteristics of differentially compound generators. Load characteristics of cumulatively compound generators. **3**
6. DC Motors: Starting of DC motors. Torque-speed characteristics of separately-excited & shunt DC motors, speed control of DC motors by armature voltage control, speed control of DC motors by field-weakening control. **3**

7.	Synchronous Generators: DC test, open-circuit test and short-circuit tests. Equivalent circuit parameters evaluation. Load test and load characteristics. Voltage regulation of synchronous generators.	**3**
8.	Synchronous motors: Starting of synchronous motors, Load test and torque-power angle characteristics, V-curve and power factor correction.	**3**
9.	Three-Phase Induction (Asynchronous) Motors: Starting of 3-phase induction motors, DC test, No-load test, Blocked-rotor test, Equivalent circuit parameters evaluation, Torque-Speed characteristics of 3-phase induction motors, Speed control of 3-phase induction motors.	**3**
10.	Single phase induction motor: Reverse the rotation of single phase induction motor, starting current, motor load characteristics with variation of torque.	**3**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lab session. Eating and drinking are not allowed during the lab, 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	15%
First Exam	0%	Projects	0%
Midterm Exam	30%	Lab Reports	15%
Final Exam	40%	Teamwork	0%
		Total	**100%**

Last Revised: March 2021