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

Course: **Electrical Drives – 0943582 (3 Cr. – Elective Course)**

Instructor: Dr. Mohammed Al-Haj
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Office Hours: Will be posted soon

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

Catalog description: Classification of Mechanical loads; motors: classification and selection for drive systems; methods of speed control of DC motors; methods of speed control of AC motors; the need for speed control of electric motors; DC choppers and speed control of DC motors; controlled rectifiers and speed control of DC motors, Inverters and speed control of AC motors; soft starting of electric motors.

Prerequisites by course: **EE** **0943461** Power Electronics (pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Electrical circuit analysis techniques.
- Power electronics and semiconductor fundamentals.
- Fourier series, Fourier transform and signal analysis.

Textbook: **Fundamentals of Electric Drives by Mohamed El-Sharkawi, Cengage Learning, 2nd edition, 2018.**

References:

1. Electric Drives by Ion Boldea and Syed A. Nasar, 3rd edition, CRC Press, 2016.
2. Power Electronics: Circuits, Devices & Applications by Muhammad H. Rashid, Pearson, 4th edition, 2013.
3. Electrical Machines, Drives and Power Systems by Theodore Wildi, 6th edition, Pearson, 2005.
4. Electric Motors and Drives: Fundamentals, Types and Applications by Austin Hughes and William Drury, 4th edition, Newnes, 2013.
5. Analysis of Electric Machinery and Drive Systems by Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff and Steven Pekarek, Wiley-IEEE Press, 3rd Edition, 2013.
6. Advanced Electric Drive Vehicles (Energy, Power Electronics, and Machines) by Ali Emadi (Editor), CRC Press, 1st Edition, 2017.
7. Principles of Electric Machines with Power Electronic Applications by Mohamed E. El-Hawary, Wiley-IEEE Press, 2nd edition, 2002.

8. Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles by John G. Hayes and G. Abas Goodarzi, Wiley, 1st edition, 2018.

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

Course goals: The overall objective is to introduce the student to the concepts and principles of electric drive systems, including variable voltage drive and variable frequency drive. The student will also be able to calculate the required size of motors based on mechanical characteristics of the load, and address issues of electromagnetic compatibility and harmonics.

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

Upon successful completion of this course, a student will:		[SO]
1.	Understand electromechanical energy flow in electric drive systems, and learn methods of matching between electric motors and mechanical loads.	[7]
2.	Be familiar with various converters used in electric drives.	[7]
3.	Be able to design control schemes for various types of DC motors.	[1, 2]
4.	Be able to design control schemes for various types of induction motors.	[1, 2]
5.	Understande various types of braking methods of DC motors.	[1]
6.	Understande various types of braking methods of induction motors.	[1]
7.	Understande dynamics of electric drive systems and be able to calculate traveling time.	[1]

Course topics:		Hrs
1.	Dimensioning of Drives: Linear and rotary motion, work, power, energy, mass, inertia, use of gearbox, load matching, friction, speed and torque of motion sequence, elastic coupling of load. Operating conditions of drive, ambient conditions, standard 3-phase motors, servomotors, motor brakes.	8
2.	Power Electronics Converters: Rectifiers: Half wave, full wave, three-phase half wave, three-phase bridge inverters: half leg, single phase, three-phase.	6
3.	Speed Control of DC motors: shunt or separately excited, armature voltage adjustment, field current control, solid state control.	6
4.	Speed Control of series motors: adding resistance, adjusting terminal voltage, adjusting field current.	5
5.	Speed control of induction motors: rotor voltage injection, slip recovery, adjustment of supply frequency, voltage-frequency control.	6
6.	Braking of DC electric motors: regenerative braking, dynamic braking, counter current braking.	4
7.	Braking of induction motors: regenerative braking, dynamic braking, counter current braking.	4
8.	Dynamics of Electric drive systems: traveling time of loaded and unloaded dc and induction motors.	3

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