The University of Jordan
School of Engineering
Mechatronics Engineering Department
2nd Semester – A.Y. 2017/2018

Course: Advanced Drive Systems–0908422 (3 Cr. – Elective Course)

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Course Website: https://elearning.ju.edu.jo/course/view.php?id=1973
https://www.youtube.com/c/LutfiAlSharif

Catalog Data: Introduction and basic concepts; revision of basic mechanics; speed-torque curves and stability; velocity time profiling; four quadrants operation; AC variable voltage drives and soft-starters; AC variable frequency drives; DC drives; electrical and mechanical braking systems.

Prerequisites by Course: Power Electronics and Drives, 0908421, (Electrical Machines 0908321)

Prerequisites By Topic: The students are expected to have a good grounding in the principles of Electrical circuits theory , electrical machines and power electronics.

Textbook: References:

- Material is mainly contained on the webspace (see above).
- Electrical Machines, Drives and Power Systems", Theodore Wildi, 6th Edition, Pearson Prentice Hall.
- Electric Drives and Electromechanical Systems", Richard Crowder, Newnes, 2006.
- Power Electronics and Motor Control", W. Shepherd, L.N. Hully and D.T.W. Liang, Cambridge University Press, Second Edition, 1995.
- Power electronics", Cyril W. Lander, Third Edition, McGraw Hill, 1993.
- Thyristor Theory and Applications", Clay Laster, TAB, 1986.
- Electric Machinery Fundamentals", Stephen J. Chapman, McGraw Hill International Edition, 1991.
- Dynamics", J.L. Meriam, Engineering Mechanics, Volume 2, Wiley, 1980.
- Electromagnetic Compatibility: Interference Suppression and Simulation", Schaffner.

Schedule & Duration: 16 Weeks, 30 lectures (75 minutes each) plus exams.

Minimum Student Material: Textbook, class handouts, scientific calculator, and an access to a personal computer.

Minimum College Facilities: Classroom with whiteboard and projection display facilities, library, computational facilities with MATLAB and other programs.

Course Objectives: The course aims to introduce the candidate to the concepts and principles of drive systems. Students will understand the principles of electrical drives such as speed-torque curves and four quadrant operation. They will also understand the principle of operation of variable voltage AC drives (soft starters) and variable frequency AC drives (inverters). They will also be able to list and compare the two different types of braking systems, mechanical and electrical.

Course Learning Outcomes and Relation to ABET Student Outcomes:

Upon successful completion of this course, a student should:

1.	You are able to analyse the drives in terms of their speed torque curves and their stability as well as four quadrant operation	(a, c)
2.	You know the modern features of variable frequency drives and variable voltage drives.	(j)
3.	You understand the design of the different types of variable frequency drives, variable voltage drives and dc motor drives.	(c, j)
4.	You have improved your presentation skills, report writing skills, teamwork skills and problem solving skills due to the work on the project in this course.	(g, d, i)
5.	You are able to develop the speed time profile for drive systems	(a, c)
6.	You understand the principle of operation of electrical and mechanical braking systems, and their advantages and disadvantages.	(j)
7	You can use Simulink and SimPowerSystems in order to model drive systems and their mechanical loads.	(k)

Course Topics:

	Topic Description	Hrs
1.	**Introduction to Drive Systems**: The components of a drive system; the need for a drive.	**3**
2.	**Revision of Basic Mechanics Concepts**: Flywheels; The need for flywheels; functions of a flywheel; calculating the inertia of a flywheel; types of friction (viscous and coulomb).	**3**
3.	**Speed Torque Curves and Stability**: Types of load; types of drives; speed-torque characteristics of a load; conditions for stability;	**3**
4.	**Speed-time profiling**: distance, velocity, acceleration and jerk; profiling of a speed time curve.	**6**
5.	**Four Quadrant Operation**: Four quadrant operation applied to cars and to elevators.	**3**
6.	**Variable voltage drives**: Principle of operation; firing sequences; disadvantages; use in soft starters.	**6**
7.	**Variable frequency drives**: Principle of operation; advantages; speed torque curve; capacitors; regenerative units; Features of a modern VF drive; programming; communication; speed profile; errors; Problem with scalar control; analogy to DC motors.	**12**
8.	**DC Drives:** Different types of dc drive systems; calculations.	**3**
9.	**Electrical and Mechanical Braking**: The need for braking; types of electrical braking (regenerative braking; dynamic resistor braking; eddy current braking; plugging), Mechanical braking; comparison of the two types of braking.	**3**

Ground Rules:

Attendance is required. To that end, attendance will be taken every lecture; Absence of more than *7 hours* will result in the expulsion of the student from the course.

Assessments:

Exams, Quizzes, Projects, and Assignments.

Grading policy:

Project	**15 %**
Quizes (5 quizzes)	**15%**
Mid Term Exam (including 5% practical)	**30%**
Computerised Final exam	**15%**
Written Final Exam	**25%**
Total	**100%**