ELK 488E: Electric Drive Systems
CRN: 21056

SPRING 2009

SYLLABUS

Course Instructor:
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Objectives: Electric motors are extensively used in many stages of industrial processes. Since 70% of global electricity generation is consumed by electric motors, it is essential to design efficient electric drives to increase system reliability and to lower operational costs in a plant. Substantial energy savings can be obtained by employing advanced control and semiconductor power converter technologies combined with a suitable selection of electric motor type and rating. This course is intended primarily to provide a fundamental knowledge of modeling, analysis and integration of mechanical and electrical components and to introduce various aspects of design and control techniques in electrical drive applications, such as manufacturing lines, electric transportation, air-conditioning and ventilating, crane and hoist applications, etc.

Course Description: Introduction. Fundamentals of mechanical systems. Modeling and analysis of linear and circular motion. Dynamics of electric drive systems. Characteristics of electric drive components: motors, loads and transmission elements. Operating modes and performance evaluation of electric drives. Various applications of electric drives in industry. Use of power electronic circuits in electric motor drives. Test and verification of the concepts covered in this course will be carried out in group projects assigned to students.

Textbooks: Subrahmanyam, V., *Electric Drives: Concepts and Applications*, MacGraw-Hill, 1994.
Leonard, W., *Control of Electrical Drives*, 2nd Ed., Springer Verlag, New York, 1997.
Mohan, N., *Electric Drives: An Integrative Approach*, 2000.

Course WEB Page: http://www.elk.itu.edu.tr/~ovacik

You can find all information about this course in this web site. The results of exams will be posted in this WEB site.

Grading: Submission of assigned group project and poster presentation are required. Those who do not satisfy this criterion will get a grade of "VF" and will not be allowed to take the final exam.

Grading Criteria:

Method	Quantity	Weight
Midterm Exam	2	30%
Term Project	1	30%
Final	1	40%

Course Hours: The lectures will be held on **Thursdays 9:30-12:30**, **Room: EEB 5207**
Office Hours: The scheduled time to see your instructor is on Thursdays, 14:00-17:00

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WEEKLY LECTURE PLAN	
Week	**Topics**
1	Introduction. An overview of electric drives and their use in industry and daily life.
2	Fundamentals of mechanical systems, Newton's law of mechanics. Kinematics of linear and circular motions, calculation of moment of inertia, work, power and energy.
3	Dynamics of drives and system integration: Dynamic equations of linear and circular motions, graphical and numerical analysis of drive system kinetics.
4	Mathematical modeling of electric drives and its components: Integrating electric motors to mechanical systems, characteristics of electric motors and industrial loads, transmission elements, gears and belt-pulley systems, friction and other power losses.
5	Operation of electric drives: Four quadrant operation, methods used for starting, breaking and speed adjustment of overall drive systems, speed adjustment range, times required for starting, breaking and changing the operation points.
6	Stability of electric drives: Conditions required for stable operation of electric of drives. Steady-state stability analysis. Equal-area criterion of transient stability analysis of synchronous motors.
7	Overall system efficiency: calculation of power losses of electric motors and other drive components.
8	Heating limits of electric motors, thermal model of electric motors for analysis of heating and cooling, and various operation modes of electric motors such as continuous, periodic and intermittent duties.
9	Methods to increase system efficiency, use of energy storage devices: mechanical and magnetic energy storage devices and super capacitors.
10	Criteria for motor selection. Regenerative electrical drive applications.
11	Power semiconductor drives for electric motors: basic concepts of power converters. PWM (pulse-width-modulation) control techniques.
12	Open-loop control of DC (direct-current) motors: motor drives with controlled rectifiers and DC choppers. Regenerative operation of DC motors.
13	Open-loop control of AC motors: Soft starting techniques. Variable-speed operation of induction and synchronous motors, scalar and vector control techniques, slip energy recovery for wound-rotor induction motors.
14	Applications of electrical drive technologies used in industrial and daily-life: Hoists, elevators, winches, presses and crushers, conveyor belts, electric traction systems, fans, pumps and compressors, etc.