

Course Specification Document

Title	Electrical Machines
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Credits	3.5 ECTS
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Aims	This course aims to provide the student with the basic concepts and principles of the operation of electrical machines used in industry, power plants, household and commercial appliances, etc., and to enable him to understand the structure of the main electrical machines and the theoretical foundations for their design. It also aims to equip him with the practical skills necessary to perform various tests on electric motors and study their performance properties under different operating conditions.
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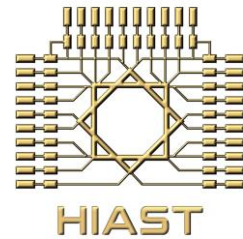
Intended learning outcomes

On successful completion of this course, the student will be able to:

- Understand the structure and operating principle of electrical machines and their applications.
- Obtain and analyze the equivalent electrical circuit for the main types of electrical machines in sinusoidal steady state, and recognize the practical experiments that allow identifying the circuit elements.
- Know the power flow diagram and efficiency calculation for the main types of electrical machines.
- Study the torque/speed characteristics and operating regions for the main types of electrical machines.
- Convert mechanical system requirements into electrical specifications and select the appropriate motor for the mechanical application.
- Analyze and understand the performance characteristics of electric motors under different operating conditions.

Syllabus

- **General introduction/basic principles of electrical machines:** Review of the basic laws of magnetism, classification of electric machines, general structure of electric machines, principles of electromechanical energy conversion.
- **DC machines:** A primitive machine structure that allows understanding the principle of generating electric motive force/electromagnetic torque; the need for a commutator/brushes; and the need to increase the number of magnetic poles, the real structure of the machine; stator and armature winding method; the armature reaction; finding the expression of electrical motive force and electromagnetic torque, the electrical and mechanical model of the machine, power flow diagram, permanent magnet machine; its operation characteristics; machine modes of operation; machine applications, the machines with separately excited; series excited; shunt excited, their operation characteristics, and their applications.



- **Three-phase AC machines/rotating magnetic field generation:** Defining the rotating magnetic field, generating the rotating magnetic field, the theory of the rotating magnetic field, the electromotive force produced by the rotating magnetic field, the winding of the stator coils in AC machines.
- **Induction machines:** The structure, working principle, applications in which the machine is used, construction of the equivalent electrical circuit for the machine in the sinusoidal steady state, power flow diagram and calculation of efficiency, measuring the equivalent electric circuit elements, finding the expression of electromagnetic torque, properties of torque/speed characteristics, starting of the induction motor.
- **Synchronous machines:** The structure, working principle and types of the machine, applications in which the machine is used, starting methods of synchronous motor, the equivalent electrical circuit of the machine in the sinusoidal steady state, the phasor diagram of the machine, the modes of operation of the machine, measuring the elements of the equivalent electric circuit, finding and studying the expression of electromagnetic torque, studying the effect of load changes on motor performance, studying the effect of excitation current changes on motor performance, power curves.