National Mining University

Institute of Electrical Power Engineering
Faculty of Electrical Engineering

Course Description

Faculty of Electrical Engineering

COURSE TITLE	Electric Machines
LEVEL	2nd year of study (2nd semester) and 3rd year of study (1st semester), Undergraduate Compulsory Course
ECTS CREDITS	8.5
DEPARTMENT	Renewable power sources
DESCRIPTION	Power transformers: Construction, Principle of operation, Electromagnetic processes in single-phase and three-phase transformers, Equivalent circuits, Equations, Phasor diagrams, Phasor displacement of three-phase transformers, Determination of parameters, open-circuit and short-circuit tests, Voltage regulation, Secondary voltage adjustment, Transformers parallel operation, Efficiency, Three-winding transformers, Autotransformers, Special types of transformers, Transients in transformers, thermal and dynamic stability. Basics of theory of electric machines: Types of electromagnetic systems of electric machines, Energy conversion , Armature and field windings, Windings magnetomotive force (MMF), Magnetic fields of mutual induction of electric machine, rotating and pulsating fields, Circular and elliptical fields. Windings flux linkage, Voltage induced in windings by rotating field. Fundamental and harmonics of induced voltage, Ways of higher harmonics suppression, Electromagnetic torque, Mechanical, electromagnetic end electrical power of electric machine, Models of electric machines, Use of combined time and spatial complex plane. Three-phase asynchronous machines(AM): Construction and principle of operation of three-phase asynchronous

	machines, AM at locked rotor, Rotor winding referred to the stator side, Modes, equations equivalent circuits and phasor diagrams, use of AM at locked rotor, Processes in AM at revolving rotor, Slip, Equations, Power flow diagram, Electromagnetic power, Efficiency, Equivalent stationary rotor, Equations of AM with equivalent stationary rotor, Equivalent circuits of AM, Characteristics of AM. Circle diagram, Additional torques of AM, Start induction motors and their speed control, AM at asymmetrical conditions. Synchronous machines (SM): Construction of salient and non-salient pole (SM) and their principle of operation, No-load operation of SM, magnetic field, no-load characteristics, Armature MMF and parameters under load, Two-reactions method, Electromagnetic processes in loaded non-salient and salient pole SM, phasor diagrams, Losses and efficiency, Characteristics of separately operating synchronous generator, Parallel operation of synchronous generator with network, synchronizing, generator load control, electromagnetic power, electromagnetic torque, power- and torque- angle curves, V-curve characteristics, Synchronous motors, Synchronous compensators, Switching SM for parallel operation, Transients under load variation, Short circuit of synchronous generators: field killing, three-phase sudden symmetrical short-circuit. DC machines (DCM): Construction and principle of operation, Armature windings, Voltage equation of armature circuit, Armature current, Energy conversion, Equations of armature induced voltage and of electromagnetic torque, Magnetic field at operation under open circuit and load,. Armature reaction, Commutation in DCM, Classes of commutation, methods of improvement and adjustment of commutation, DC generators: classification by methods of excitation, generators circuits, self-excitation of DC generators, characteristics at different excitation, parallel operation, DC motors: methods of excitation, circuits of DC motors, generalized equations of motors characteristics, starting current, Characteristics of DC motors at separate, shunt, series and compound excitation, Start and speed adjustment. Special types of electric machines: Single-phase AC motors, Asynchronous generators, Asynchronous motors with solid rotor, Induction pumps, Linear motors, AC servomotors, Selsyn, Variable transformer, Reluctance synchronous motors, Inductor-type machines, Step motors, Synchronous machines with permanent magnets, Double-fed machines, LC M with permanent magnets, DC servomotors, Unipolar generators, Commutatorless DCM, AC commutator motors, AC-DC commutator motor.

LEARNING OUTCOMES	**Knowledge and Understanding** By the end of the course learning students will be able to: - Explain construction and principle of operation of electric machines and transformers - Understand equations and equivalent circuits of electric machines and transformers - Explain power loss and energy transfer in electric machines and transformers - Understand methods of machines and transformer parameters determination - Explain operating characteristics of electric machines and transformers. **Skills** By the end of the course learning students will be able to: - Perform calculations relating to operation of electric machines and transformers - Determine the correct test conditions to identify equivalent circuit parameters of electric machines and transformers - Determine conditions for experimental obtaining characteristics of rotating machines and transformers.
STUDY TYPE OF THE COURSE	Lectures, laboratory and tutorial
METHOD OF ASSESSMENT	Passing reports on laboratory works Examination
LECTURER	Oleksii Ivanov