OSTIM TECHNICAL UNIVERSITY
FACULTY OF ENGINEERING
ELECTRICAL ELECTRONICS ENGINEERING DEPARTMENT
ELECTRICAL MACHINES
COURSE SYLLABUS FORM
2022-2023

Course Name	Course Code	Period	Hour	Apllication Hour	Lab Hour	Credit	ECTS
Electrical Machines	EEE 304	6	3	0	2	4	4

Prerequisite	-
Language of Instruction	English
Course Status	Compulsory
Course Level	Bachelor
Method of Teaching	Face to face
Learning and Teaching Techniques of the Course	Theoretichal and practical

Course Objective

I. Provide theoretical and practical knowledge of transformers and induction machines.
II. Provide basic knowledge of applicatio ns of these electrical machines in electrical engineering.
III. Gain ability to analyze under different operating conditions.

Learning Outcomes

Bu dersi başarıyla tamamlayabilen öğrenciler;

1.	Gain ability to explain fundamental working principles of transformers and induction machines by using basic electromechanical, electromagnetic and circuit theory.			
2	Provide well understanding of construction of transformers and induction machines.			
3	Distinguish different construction techniques and be able to explain the effects of these techniques on expected machine performance.			
4	Learn equivalent circuit models and operating characteristics of transformers and induction machines, and be able to analyze the power flow between the electrical machines and the power system.			
5	Be able to apply methods regarding operation of transformers and induction machines in practice.			
6	Be able to analyze steady-state behavior of transformers and induction			

	machines operating under different conditions,				
7	Gain knowledge of establishing necessary experimental setups, and be able to interpret experimental measurements.				

Course Outline

Construction of single and three phase transformers, equivalent circuits, operation at no-load and at load, phasor diagrams, short-circuit quantities, voltage regulation, parallel operation, connection group of three phase transformers, magnetization currents, transient phenomena, construction of single and three phase induction machines, introduction to single and three phase windings, winding coefficients, expression of induced e.m.f., rotating field, phasor diagrams, power flow diagrams, efficiency, torque-speed.

Weekly Topics and Releated Preparation Studies

Weeks	Topics	Course Outcomes
1	Rotational motion, Newton's Law, power relationships, magnetic field, magnetic circuit, Ampere's Law, reluctance, flux, flux density, magnetic behavior of materilas, energy losses in magnetic materials: hysteresi s and eddy-current losses, Faraday's Law, Lenz' Law, production of induced force on a wire, induced voltage on a conductor moving in a magnetic field	I
2	Transformers, types and construction, ideal transformer, impedance transformation, real single phase transformer, voltage ratio, magnetization current, current ratio, equivalent circuit.	II, III
3	Determination of equivalent circuit component values: open-circuit and short-circuit tests, per-unit system, phasor diagram	IV, V, VII
4	Transformer efficiency, transformer taps and voltage regulation, autotransformer, threephase transformers	IV, VI
5	wye-wye, wye-delta, delta-wye, delta-delta connections, phasor diagrams, three phase transformation using two transformers, Scott-T connection	IV, VI
6	Inrush current, instrument transformers: voltage and current transformers, determination of polarity of transformer windings. Short circuit ratio, parallel operation	V, VI, VII
7	transformer windings. Short circuit ratio, parallel operation induction motor construction and types,	I, II, III

	rotating magnetic field, speed of magnetic field rotation.	
8	Basic induction motor concepts, development of torque, the concept of rotor slip, electrical frequency on the rotor, equivalent circuit of an induction motor	I, II, III
9	Power and torque in induction motors, losses, efficiency, torque-speed characteristic.	IV
10	Derivation of induced torque equation, maximum torque equation, determining equivalent circuit model parameters: no-load and locked-rotor tests, dc test for stator resistance	IV
11	Variations in torque-speed characteri stics, squirrel-cage rotor designs: deep-bar and doublecage, different types of design classes, starting induction motors: reduced voltage starting, current limiting by series resistance, delta-wye starting.	II, III, V
12	Speed control methods of induction motors: pole changing, changing line frequency. Solid-state motor controllers, induction generators, induction generators operating alone, induction generators in wind power plants	V, VI
13	Single-phase induction motors, double-revolving field theory.	II, V, VI
14	Starting of single-phase induction motors: split phase motors, capacitor-start motors, capacitorstart capacitor-run (permanent-split capacitor) motors, equivalent circuit model of single-phase induction motors with forward and reverse magnetic fields.	II, III, IV, VII

Textbook(s)/References/Materials:
[1] A. E. Fitzgerald, C. Kingsley, S. D. Umans, Electric Machinery, 5 ed., McGraw-Hill, 1990. [2] Sen, P.C., Principles of Electric Machines and Power Electronics, John-Wiley & Sons, 1989. [3] Englemann, R.H., Middendorf, W.H., Handbook of Electric Motors, Marcel Dekker, 1995. [4] Güzelbeyoğlu, N., Elektrik Makinaları I-II, İ.T.Ü Elektrik-Elektronik Fak. Ofset Baskı Atölyesi, 1998. [5] Güzelbeyoğlu, N., Elektrik Makinaları I-II: Teori-Çözümlü Problemler, Birsen Yayınevi, 2005.

Assessment		
Studies	**Number**	**Contribution margin (%)**
Active Participation		

Lab	13	30
Application		
Field Study		
Course-Specific Internship (if any)		
Quizzes / Studio / Critical		
Homework		
Presentation		
Projects		
Report		
Seminar		
Midterm Exams / Midterm Jury	1	30
General Exam / Final Jury	1	40
	Total	
Success Grade Contribution of Semester Studies		
Success Grade Contribution of End of Term		
	Total	

Course Category	
Basic Vocational Courses	X
Specialization/Field Courses	X
Support Courses	
Communication and Management Skills Courses	
Transferable Skills Courses	

Relationship Between Course Learning Outcomes and Program Competencies

No	Learning Outcomes	Contribution Level				
		1	2	3		
1	An ability to apply knowledge of mathematics, science, and engineering to Electrical and Electronics Engineering problems			X		
2	An ability to design and conduct experiments, and to analyze and interpret gathered data		X			
3	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, andsustainability		X			
4	An ability to function on multi-disciplinary teams		X			
5	An ability to identify, formulate, and solve Electrical andElectronics Engineering problems		X			
6	An understanding of professional and ethical responsibility	X				
7	An ability for effective communication	X				
8	An ability to understand and correctly interpret the impact of engineering solutions in a social/global context		X			
9	An ability to engage in life-long learning to follow developments in Electrical and Electronics Engineering		X			
10	A knowledge and understanding of contemporary issues	X				
11	An ability to skillfully use modern engineering tools and techniques necessary for engineering design, analysis and applications		X			
12	A recognition of the need for quality	X				

13	An ability to function individually as well as part of a team	X				

ECTS / Workload Table			
Activities	**Number**	**Duration (Hours)**	**Total Workload**
Course hours (Including the exam week: 16 x total course hours)	13	3	39
Laboratory	13	2	26
Application			
Course-Specific Internship			
Field Study			
Study Time Out of Class	1	39	39
Presentation / Seminar Preparation			
Projects			
Reports			
Homeworks			
Quizzes / Studio Review			
Preparation Time for Midterm Exams / Midterm Jury	1	10	10
Preparation Period for the Final Exam / General Jury	1	10	10
Total Workload			124