Course Number and Title:	EE- 212 Electrical Machines			
Credit Hours:	3+1			
Pre Requisite	Linear Circuits Analysis			
Instructor:	Mehroze Iqbal			
Lab Engineer:	Habib Ur Rahman Habib			
Compulsory/Elective:	Compulsory			
Course Schedule:	Lecture:	3 hours/week		
	Lab:	3 hours/week		
	Office hours:	2 hours/week		
Course Assessment:	Assignments:	2		
	Quizzes:	4		
	Course project:	1		
	Lab work:	14 experiments		
	Exams:	Mid-semester and Final		
Grading Policy:	Quizzes:	10%		
	Assignments:	05%		
	Project:	05%		
	Lab work:	20%		
	Mid-Semester:	20%		
	End-Semester:	40%		
Text Books:	Electric Machinery Fundamentals by Stephan J. Chapman, 4th Ed.			
Reference Book:	Electric Machines by Charles I. Hubert			
Course Objective:	o Develop intuitive concepts regarding fundamental electromagnetic laws governing working of electrical machines including AC transformers, generators and motors o Develop deep insight relating to construction, detailed working and modern day applications of mentioned electrical machines			
Course Learning Outcome	CLO Statement		PLO	Bloom
CLO-1:	Understanding the knowledge about fundamental physical laws governing working of electromagnetic circuits		PLO-1	C1
CLO-2:	Exploring the working of linear machine as generator, motor and transformer by applying basic electromagnetic laws on them		PLO-2	C2
CLO-3:	Converting linear electrical machine into practical machine. Detailed analysis, working, construction and variable loading characteristics of practical DC and AC electrical machines		PLO-2	C3
CLO-4:	Apply acquired knowledge to develop modern day applications out of these practical electrical machines exploiting their unique characteristics		PLO-3	C4
Major Topics covered in the course and level of coverage:	**Introduction:** Basic electromagnetic laws governing electric machinery fundamentals (Amperes law, Faradays Law, Right hand and Left hand rules etc.)			3 hours
	An ideal linear machine: An ideal linear machine as Transformer, generator and motor. Construction, working and analysis of linear machine			3 hours
	DC motors: Practical DC motors, commutation in DC motors, types, construction, working philosophy, variable loading characteristics and applications			6 hours

	DC generators: Practical DC generators, commutation in DC generators, types, construction, working , variable loading characteristics and applications		3 hours
	AC transformers: AC transformers, electromagnetic induction phenomena, construction, working, analysis, loading characteristics and applications		9 hours
	Synchronous generators: Concept of synchronism, rotating field theory in poly phase AC system, detailed working, analysis, loading characteristics and components of synchronous machines along with its applications		6 hours
	Synchronous motors: Detailed working, analysis, loading characteristics and components of synchronous motors along with its applications		6 hours
	Induction machines: Concept of induction and slip, Induction generators and motors. Detailed working, analysis, loading characteristics and components of Induction machines along with their applications		9 hours
	Special purpose motors: Special purpose motors, universal motor, stepper and servo motor, hysteresis motor, brushless motors. Speed control and applications		3 hours
Program learning outcomes and how they are covered by specific course outcomes:	Detailed Contents	CLO	PLO
	Introduction to electrical machines; Basic laws governing working of machines; Transformer, generator and motor action	CLO-1	PLO-1
	Electromagnetic induction and transformer; Linear motor with rotating coil theory; Linear generator with rotating coil theory; General concept of powers in electrical circuits	CLO-1,2	PLO-1,2
	Rotating coil as DC motor and generator; Effect and compensation for computation in DC machine; Construction of DC machine; Power flow in DC machine	CLO-2	PLO-2
	Introduction to DC motor and equivalent circuit; Separately excited motor and shunt motor; Permanent magnet DC motor; Speed control and applications	CLO-3,4	PLO-2,3
	Series motor; Compounded motor; Speed control and applications; Motor starters and efficiency calculations	CLO-3,4	PLO-2,3
	Introduction to DC generator and equivalent circuit; Separately excited generator and shunt generator; Permanent magnet DC generator; Voltage control and applications	CLO-3,4	PLO-2,3
	Series generator; Compounded generator; Voltage control and applications; Efficiency calculations	CLO-3,4	PLO-2,3
	Importance of transformer; Types and construction of transformer; Components of transformer; Ideal transformer; operation and ratios; Equivalent circuit of transformer; Voltage regulation of transformer; Per unit system of measurement and calculations;	CLO-3	PLO-2
	Autotransformer; 3 phase connections for transformer; Per unit system for 3 phase transformers; Instrumentation transformers; Applications of transformers	CLO-3,4	PLO-2,3
	Working philosophy and construction of alternator; Equivalent circuit and internally generated voltages; Phasors diagram of alternator; Power and torque in alternator	CLO-3	PLO-2
	Alternator operating alone; Parallel operation of alternators; Alternator ratings; Applications of synchronous generator	CLO-3,4	PLO-2,3
	Ideology and equivalent circuit of synchronous motor; Effects of loading on synchronous motor; Variable field effects on motor; Synchronous condensers	CLO-3,4	PLO-2,3

	Starting procedure of synchronous motors; Synchronous motors compared to alternators; Synchronous motor speed control and ratings; Applications	CLO-3,4	PLO-2,3
	An introduction and construction of induction motor; Concept of slip in induction motor; Equivalent circuit of induction motor; Power and torque in induction motor	CLO-3	PLO-2
	Torque-Speed characteristics of induction motor; Induction motor design and modern trends ; Starting mechanism of induction motor	CLO-3	PLO-2
	Induction motor Speed control; Determination of induction motor parameters; Induction generator; Applications	CLO-3,4	PLO-2,3
	Universal motors and applications; Single phase induction motors and applications; Hysteresis motor	CLO-3,4	PLO-2,3
	Brushless motors, stepper and servo motors. Their speed control and applications	CLO-3,4	PLO-2,3

Mapping of CLOs with PLOs and Bloom's Taxonomy Cognitive Levels:

PLO	1	2	3	4	5	6	7	8	9	10	11	12
CLO-1	C1											
CLO-2		C2										
CLO-3		C3										
CLO-4			C4									
CLO-5												

Mapping of CLOs with Assessment Methods:

CLOs/Assessment	CLO-1	CLO-2	CLO-3	CLO-4	
Assignments:	√	√	√	√	
Quizzes:	√	√	√	√	
Course project:	√	√	√	√	
Lab work:			√	√	
Mid-Semester:	√	√	√	√	
End-Semester:	√	√	√	√	