

**COURSE CODE: EE0201**

**COURSE TITLE: ELECTRICAL MACHINES I**

**PURPOSE**

To give the students a fair knowledge on the working of various DC machines and Transformers.

**INSTRUCTIONAL OBJECTIVES**

**At the end of the course the students will be able to:**

1. Understand the basics of electromagnetics and concept of rotating machines.
2. Understand the construction, working, characteristics and applications of DC generators.
3. Understand the construction, working, characteristics and applications of DC motors.
4. Understand the construction, working, characteristics and applications of transformers.
5. Understand the testing of DC machines and transformers

**SYLLABUS**

**ELECTRO MAGNETIC INDUCTION & BASIC CONCEPTS IN ROTATING MACHINES**

Introduction to magnetic circuits – Magnetically induced e.m.f and force – AC operation of magnetic circuits – Hysteresis and Eddy current losses. Energy in magnetic systems – Field energy & mechanical force – Single and Multiple excited systems. MMF of distributed windings – Magnetic fields in rotating machines – Generated voltages – Torque.

**DC GENERATORS**

Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Types of excitation – No load and load characteristics of DC generators – commutation – armature reaction – Parallel operation of DC generators.

**DC MOTORS**

Principle of operation of DC motors-Back emf – Torque equation –Types of DC motors-Speed – Torque characteristics of DC motors – Starting of DC motors: 2 point starter, 3 point starter, 4 point starter – Speed control – Losses and efficiency –Applications

**TRANSFORMERS**

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Transformer on No load and Load –Phasor diagram -- equivalent circuit – Regulation - three phase transformer connections-parallel operation of single phase and three phase transformer- Auto transformers

**TESTING OF DC MACHINES & TRANSFORMERS**

Losses and efficiency –Condition for maximum efficiency – Testing of DC machines:Brake test , Swinburne’s test, Retardation test, Hopkinson’s test- Testing of transformer:polarity test,load test, open circuit and short circuit test, Sumpner’s test – All day efficiency

**TEXT BOOKS**

1. Kothari.D.P and Nagrath.I.J. *Electrical Machines*, Tata McGraw Hill Publishing Co.Ltd, New Delhi, 5<sup>th</sup> edition 2002
2. Dr. Murugesh Kumar K. *DC Machines & Transformers*, Vikas Publishing House Pvt Ltd., 2003.

**REFERENCE BOOKS**

1. B.L.Theraja, A.K.Theraja, *Electrical Technology*, Volume II, AC&DC Machines S.chand publications.
2. J.B.Gupta, *Theory and Performance of Electrical Machines*, S.K.Kataria& Sons
3. Albert E Clayton and N N Hancock, *The performance and design of direct current Machines*, Oxford and IBH publishing company Pvt., Ltd., New Delhi 1990.
4. P.S.Bimbhra , *Electrical Machinery*, Khanna Publishers, 2003
5. IL Kosow, *Electrical Machines & Transformers*, Prentice Hall of India

<b>EE 0201 - ELECTRICAL MACHINES – I (R)</b>												
Course designed by		Department of Electrical and Electronics Engineering										
1	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x			x						
2	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)			Professional Subjects(P)			
		x										
3	Broad area (for ‘P’ category)	Electrical Machines		Circuits and Systems		Electronics		Power System		Intelligent Systems		
		x										
4	Course Coordinator	Mr.K.Vijayakumar										

### Detailed Session Plan

#### UNIT 1 ELECTRO MAGNETIC INDUCTION & BASIC CONCEPTS IN ROTATING MACHINES

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Introduction to magnetic circuits – Magnetically induced e.m.f and force – AC operation of magnetic circuits – Hysteresis and Eddy current losses. Energy in magnetic systems – Field energy & mechanical force – Single and Multiple excited systems. MMF of distributed windings – Magnetic fields in rotating machines – Generated voltages – Torque.

Session No.	Topics to be covered	Text book	Page No.	Testing Methods	Instructional Objective	Program Outcome
1	Introduction to magnetic circuits Induced EMF & force	Kothari.D. P and Nagrath.I. J. <i>Electrical Machines</i>	11		Understand the basics of electromagnetic and concept of rotating machines.	. a).An ability to apply knowledge of mathematics, science, and engineering.
2	AC operation of magnetic circuits		34			
3	Hysteresis & Eddy currents		36			
4	Energy in magnetic systems Field energy and mechanical force		156 161			
5	Single & Multiple excited systems MMF of distributed windings		178 225			
6	Magnetic fields in rotating machines		233			
7	Generated voltages Torque		212 188			

#### Unit 2 DC GENERATORS

Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Types of excitation – No load and load characteristics of DC generators – commutation – armature reaction – Parallel operation of DC generators.

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Session No.	Topics to be covered	Text book	Page No.	Testing Methods	Instructional Objective	Program Outcome
8	Constructional features & operation of DC machine	B.L.Theraja, A.K.Theraja, Electrical Technology, Volume II, AC&DC Machines	888		Understand the construction, working, characteristics and applications of DC generators.	b). An ability to design and conduct experiments, as well as to analyze and interpret results. e).An ability to identify, formulate, and solve engineering problems
9	EMF equation & problems		914			
10						
11	Types of Excitation		911			
12	No load & Load characteristics of DC generators		968			
13						

14	Armature reaction		938			
15	commutation		946			
16	Parallel operation of DC generators		953			

**Unit 3 DC MOTORS**

Principle of operation of DC motors-Back emf – Torque equation –Types of DC motors-Speed – Torque characteristics of DC motors – Starting of DC motors: 2 point starter, 3 point starter, 4 point starter – Speed control – Losses and efficiency –Applications

Session No.	Topics to be covered	Text book	Page No.	Testing Methods	Instructional Objective	Program Outcome
18	Principle of operation of DC motors-Back emf	1.B.LTheraja A.K.Theraja, Electrical Technology, Volume II, AC&DC Machines  2.J.B.Gupta Theory & performance of electrical machines	1. 996-998		Understand the construction, working, characteristics and applications of DC motors.	b). An ability to design and conduct experiments, as well as to analyze and interpret results.  e).An ability to identify, formulate, and solve engineering problems
19	Torque equation- Problems		1. 1001			
20						
21	Types of DC motors		2. 296			
22	Speed – Torque characteristics of DC motors		2. 312			
23	Starting of DC motors-types of starters		1. 1073			
24						
25	Speed control		1. 1033			
26	Losses efficiency-applications		1. 1022			

**Unit 4 TRANSFORMERS**

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Transformer on No load and Load –Phasor diagram --equivalent circuit – Regulation - three phase transformer connections-parallel operation of single phase and three phase transformer- Auto transformers

Session No.	Topics to be covered	Text book	Page No.	Testing Methods	Instructional Objective	Program Outcome
26	Principle of operation – Constructional features of single phase and three phase transformers	B.LTherajaA .K.Theraja,E lectrical Technology, Volume II, AC&DC	1116		Understand the construction, working, characteristics and applications of transformers.	b). An ability to design and conduct experiments, as well as to analyze and interpret results.
27			1212			
28	EMF equation- problems		1122			
29	Transformer on No load		1129			

30	and Load –Phasor diagram	Machines				e).An ability to identify, formulate, and solve engineering problems
31	equivalent circuit		1132			
32	Regulation - three phase transformer connections		1156			
33	parallel operation of single phase and three phase transformer		1193 1236			
34	Auto transformers		1186 1			

**Unit 5 TESTING OF DC MACHINES & TRANSFORMERS**

Losses and efficiency –Condition for maximum efficiency – Testing of DC machines:Brake test , Swinburne’s test, Retardation test, Hopkinson’s test- Testing of transformer:polarity test,load test, open circuit and short circuit test, Sumpner’s test – All day efficiency

Session No.	Topics to be covered	Text book	Page No.	Testing Methods	Instructional Objective	Program Outcome
35	Losses and efficiency – Condition for maximum efficiency	1. B.LTherajaA .K.Theraja,Electrical Technology, Volume II, AC&DC Machines  2.Kothari.D .P and Nagrath.I.J. <i>Electrical Machines</i>	1. 1168		Understand the testing of DC machines and transformers	e).An ability to identify, formulate, and solve engineering problems
36	Brake test		1. 1092 1. 1105			
37	Retardation test		1. 1094			
38	Swinburne’s test		1. 1099			
39	Hopkinson’s test		2. 80			
40	Testing of transformer:polarity test,load test,		1. 1146 1. 1150			
41	open circuit and short circuit test-problems					
42	Sumpner’s test		1. 1167			
43	– All day efficiency		1. 1181			