KL UNIVERISTY
FIRST SEMESTER 2010-11
Course Handout
Academic Division

Dated: 07-07-2010

Course No. : **EE C204**
Course Title : **Electrical Machines-I**
Course Structure : **3-1-2**
Course coordinator : **Mr Bhola Jha**
Team of Instructors : **D Seshi Reddy, K. Ranganayakulu, M.Samuel Babu, B.B asavaraja, G. Vinyakumar, E.Veerabhadraiah, B.Hanumanayak, Muralikrishna, V.Rajaphanideep, B.Kiran Babu**

1. Course Description:

Course description per unit is as follows; where each concept of prescribed units takes off from first fundamentals.
Unit I describes the principles of energy conversion and its significance in singly and doubly excited systems. In Unit II, conversion of mechanical energy to electrical energy is emphasized by a device termed as DC generator consisting commutator, brush, armature winding (lap and wave) and field winding. Operating characteristics of the different kinds of generators are analyzed. Unit III explains speed control and performance curves a device termed as DC motor that converts electrical energy to mechanical energy. The various tests (direct and indirect) are discussed to evaluate the efficiency of DC machines. Lucidly, various parameters like phasor diagram, equivalent circuit, regulation and efficiency of a static device i.e. transformer is presented in unit IV. Poly phase connections of 3-phase transformer are illustrated in V. Importance of T-T and V-V connections are highlighted.

2. Scope and Objective of the Course:

This course is designed to meet the industrial applications, transmission and distribution of electrical energy through various stages of transformation of energy.
After going through this course extensively, the student will be able to

1. Understand the importance of fundamental principles.
2. Correlate theoretical, mathematical and operational concepts.
3. Analyze, comprehend and interpret the complex problems.
4. Apply creative thinking towards industrial applications and research.

3. Books:

(i) Textbook:

1. T1. I. J. Nagrath and D. P. Kothari “Electric Machines” TMH.
2. T2. P. S. Bhimbra “Electrical Machinery” Khanna Publishers.

(ii) Reference Book:

1. T3. J.B Gupta “Theory & Performance of Electrical Machines” S.K. Kataria & Sons

4. Syllabus:

UNIT-I

ELECTROMECHANICAL ENERGY CONVERSION: Basic principles of electromechanical energy conversion, Basic aspects and physical phenomena involved in energy conversion, Energy balance.

UNIT-II

DC GENERATORS: Construction, Types of DC generators, EMF equation, lap & wave windings, equalizing connections, armature reaction, commutation, methods of improving commutations, demagnetizing and cross magnetizing MMF, inter-poles, internal and external characteristics of various DC generators, parallel operation, Rosenberg generator.

UNIT-III

DC MOTORS: Principle, back EMF, types of DC motor, torque equation, armature reaction, inter-poles, characteristics of shunt, series & compound motor, DC motor starters, Speed Control of DC Motor: Armature voltage and field current control methods, Ward Leonard method. Braking, losses and efficiency, direct & indirect test, Swinburne's test, Hopkinsion test, field & retardation test.

UNIT-IV

TRANSFORMERS: Construction, types, EMF equation. No load and load conditions. Vector diagrams, OC and SC tests, Equivalent circuits, Sumpner's back-to-back test, losses & efficiency. Voltage regulation, effect of frequency, parallel operation, auto-transformers, separation of losses.

UNIT-V

POLYPHASE TRANSFORMERS: Single unit or bank of single-phase units, poly-phase connections, Open delta and V connections, Phase conversion: 3 to 2 phase conversions, Effect of 3-phase winding connections on harmonics, 3-phase winding transformers, tertiary winding

5.Course Plan:

Lecture No.	Learning objective At the end of session, students will be able to	Topics to be covered	Reference	Page No.
Unit-I				
1	Understand the energy conversion principles	Introduction to electromagnetic systems	T2	160
2	Understand and recall the electromagnetism	Introduction to electromechanical energy conversion systems	T2	160
3	Understand Importance of force and torque in magnetic systems	Force and torque in magnetic systems	T2	164
4	Understand the significance of co energy	Concepts of co energy	T2	165
5	Understand the significance of stored energy for singly excited system	Singly excited system	T2	164
6	Understand significance of stored energy for doubly excited system	Doubly excited system	T2	192

Unit-II				
7	Understand the principle of operation of generator	Introduction to DC generator	T3	123
8	Understand the functions of various parts of generators	Construction and operation	T3	162
9	Understand principle of operation	Construction and operation	T3	162
10	Design the lap winding drawing	Lap winding	T3	178
11	Design the wave winding drawing	Wave winding	T3	187
12	Understand the internal behavior/operation of DC machine	Armature reaction	T3	204
13	Understand the internal behavior/operation of DC machine	Armature reaction	T3	204
14	Understand the internal behavior/operation of DC machine	Commutation and its improvement	T3	211
15	Understand the internal behavior/operation of DC machine	Commutation and its improvement	T3	211
16	Discriminate the various generators	Types of generators	T3	227
17	Evaluate the factors governing the emf generation	EMF build up process and causes for failure to build up	T2	410
18	Discriminate the performances of generators	Characteristics of generators	T2	407
Unit-III				
19	Understand the principle of DC motor	Introduction to motor	T3	291
20	Discriminate the performance of DC motors	Characteristics of motors	T2	429
21	Analyze the various methods of speed control	Speed control of DC motor	T2	454
22	Analyze the various methods of speed control	Speed control of DC motor	T2	454
23	Analyze the starters	Necessity, design and working of starters	T2	444
24	Evaluate the efficiency	Power flow, losses & efficiency and various methods	T2	489
25	Evaluate the losses and efficiency	Brake’s test	T2	495
26	Evaluate the losses and efficiency	Swinburne’s test	T2	496
27	Evaluate the losses and efficiency	Hopkinson’s test	T2	499
28	Evaluate the losses and	Field’s test	T2	502

	efficiency			
29	Evaluate the losses and efficiency	Retardation's test	T3	432
Unit-IV				
30	Understand the principles of operation of transformer	Introduction to transformer	T1	39
31	Understand the functions of various parts of transformer	Construction, operation and classification of transformer	T1	40
32	Understand the functions of various parts of transformer and principle of operation	Construction, operation and classification of transformer	T1	40
33	Understand phasor diagram	Emf equation, phasor diagram on no load and load.	T1	45
34	Analyze the equivalent circuit	Equivalent circuit	T1	52
35	Analyze the parameters affecting performances of transformer	Regulation and efficiency	T1	74
36	Analyze the parameters affecting performances of transformer	Regulation and efficiency	T1	74
37	Evaluate the transformer's performances	OC and SC tests	T1	64
38	Evaluate the transformer's performances	Sumpner's test and all day efficiency	T1	68
39	Differentiate between two winding and auto transformers	Auto transformer	T1	85
40	Understand the various conditions for parallel operation	Parallel operation of transformers	T1	103
Unit-V				
41	Analyze 1- ph and 3-ph transformer	3-ph transformer and bank of transformers	T1	89
42	Understand significance of tap changers	Off load & on load tap changers	T2	100
43	Analyze the balanced and unbalanced systems	Scott and open delta connections	T1	114
44	Distinguish poly phase connections	Star and delta connections and its phasor diagram	T1	89
45	Understand importance of power quality	Harmonics and its suppression by tertiary winding	T1	109

6.Self learning material:

Unit	Topic	Source
I	Energy balance	T2
II	Parallel 0peration of DC generators	T3
II	Rosenberg's generator	R. K Rajput "A Text of Electrical Machine" 2006.
II	Wave winding	T3
III	Ward Leonard speed control	T2
III	Braking	T2
IV	Separation of losses	T2
IV	Effect of frequency	T2
V	Poly phase connections	T3
V	Tertiary winding	T3

7.Evaluation Scheme:

Component	Duration (minutes)	% Weightage	Marks	Date & Time	Venue
Test-1	50 Min	8	10	12-08-2010 9.30 to 10.20 A.M	CSE001,004,005 ,101,102,105, 106,201,204,205 ,301,509, NSH
Test-2	50 Min	8	10	16-09-2010 9.30 to 10.20 A.M	CSE001,004,005 ,101,102,105, 106,201,204,205 ,301,509, NSH
Assignement submission		4	5	Continuous	
Assignment Test	50 Min	4	5	28-10-2010 9.00 to 10.20 A.M	CSE001,004,005 ,101,102,105, 106,201,204,205 ,301,509, NSH
Quiz	30 Min	4	5	28-10-2010 9.00 to 10.20 A.M	CSE001,004,005 ,101,102,105, 106,201,204,205 ,301,509, NSH
Regular Lab Evaluation	Continuous	10	50		
Comprehensive Lab Exam	3 Hrs	8	40		
Comprehensive Exam	3 Hrs	48	60		
Attendance for Theory & Tutorial		4	5	Continuous	
Attendance for Lab		2	10	Continuous	

8. Chamber consultation hour: Informed in the class in first week.

9. Notices: All notices regarding the course will be put in E-learning website.

10.Tutorial: Tutorial will be conducted by the respective in charge faculty. The tutorials are planned to supplement the material taught in the lectures and clear doubts. Student must attend registered section for tutorial in the respective

classroom. Class assignment, class tests and other evaluation components will also be conducted during tutorials. Students must actively participate in the tutorial and come prepared for it.

Course Coordinator