

**Kadi Sarva Vishvavidyalaya, Gandhinagar**  
**Bachelor of Engineering (Electrical Engineering Syllabus)**  
**ELECTRICAL MACHINE - I**  
**B.E. SEM: III**  
**SUBJECT CODE: EE 304**

**A. Course Objective:**

- To present a problem oriented introductory knowledge of Electrical Machines.
- To focus on the study of electro mechanical energy conversion & different parts of electrical machine.
- To address the underlying concepts & methods behind Electrical Engineering machines.
- To identify & formulate solutions to problems relevant to Electrical Machines and find the efficiency of machine.

**B. Teaching / Examination Scheme**

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY	IE	CIA	PR. / VIVO		
CODE	NAME	Hrs	Hrs	Hrs	Hrs	Hrs	Marks	Marks	Marks	Marks	Marks	
EE-304	Electrical Machine-I	4	0	2	6	5	3	70	30	20	30	150

**C. Detailed Syllabus**

1. **Principles of Electromechanical Energy Conversions:** Introduction, Flow of Energy in Electromechanical devices, Energy in Magnetic Systems, Singly Excited System, Determination of Mechanical Force, Mechanical Energy, Torque Equation, Doubly Excited System, energy stored in magnetic field, Electromagnetic Torque, Generated EMF in Machines, Torque in Machines with Cylindrical air-gap, General classifications of Electrical Machines.

2. **DC Machines:**

**DC Generator:**

Parts of generator, Armature Winding, coil pitch, back pitch, front pitch, Resultant pitch, commutator pitch, single layer winding, two layer winding, Multiplex winding, lap & wave winding, dummy coils, Types of generators, Equalizer connections, EMF & Torque Equation, total losses and efficiency, Armature reaction, Demagnetizing and Cross Magnetizing Effects, Compensating winding Commutation, Methods for Improving Commutation, Interpoles, Performance Characteristics of DC generators, Critical speed, Parallel operation,

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**DC Motor:**

Principle of Motor, comparison of generator and motor action, Back Emf, Power & torque, Shaft torque, Performance characteristics of DC Motors, Losses & efficiency, power stages, speed control of DC motors, Electric Braking, Necessity of a starter, Three point & four point starters, Starting of DC motors.

3. **Transformers:** Construction and principle, Types & Classification, operation at no load and on load, vector diagrams, equivalent circuit, losses, efficiency and regulation, determination of regulation and efficiency by direct load test and indirect test methods, Sumpner's test, parallel operation, auto transformer, condition for maximum efficiency, all day efficiency.

Star/star, Star/delta, Delta/delta, Delta/Star, delta/zigzag, terminal marking, Nomenclature, Vector diagram, Phase groups, Parallel operation of 3-phase Transformer, Scott connection, V-V connections, tertiary winding, Testing of transformers, Transients in transformers - voltage regulation - off load and on load tap changers, Introduction of harmonics in Transformer.

**D. Lesson Planning**

SR No.	No. of Hours	% Weightage in Exam	Topic
1	04	<b>10</b>	Introduction, Flow of Energy in Electromechanical devices, Energy in Magnetic Systems, Singly Excited System
2	07		Determination of Mechanical Force, Mechanical Energy, Torque Equation, Doubly Excited System, energy stored in magnetic field, Electromagnetic Torque, Generated EMF in Machines, Torque in Machines with Cylindrical air-gap
4	06	<b>35</b>	DC Machines :Construction, Armature Winding, Equalizer connections, EMF & Torque Equation, Armature reaction, Demagnetizing and Cross Magnetizing Effects,
5	07		Commutation, Methods for Improving Commutation, Inter poles and Compensating winding, Performance Characteristics of dc generators, Parallel operation, Performance
6	06		characteristics of DC Motors, Starting of DC motor, 3 point & 4 point starters, speed control of DC motors, Efficiency and Testing of dc Machines -Brake Test, Swinburne Test, Hopkinson's Test, Field Test, Retardation Test.
6	05		Single Phase Transformer: Construction and principle of single-phase transformer, operation at no load and on

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		<b>30</b>	load, Sumpner's Test, vector diagram, equivalent circuit,
7	07		losses, efficiency and regulation, determination of regulation and efficiency by direct load test and indirect test methods
8	06		parallel operation, auto transformer, condition for maximum efficiency, all day efficiency.
9	05		Three Phase Transformer: Star/star, Star/delta, Delta/delta, delta/zigzag, terminal marking, Nomenclature, Vector diagram, Phase groups, Parallel operation
10	07	<b>25</b>	Scott connection, V-V connections, tertiary winding, Testing of transformers, transients in transformers - voltage regulation - off load and on load tap changers, Introduction of harmonics in Transformer.
TOTAL	60	<b>100%</b>	

**E. Instructional Method & Pedagogy**

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures and laboratory, which may carry five marks in overall evaluation.
- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

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**Suggested List of Experiments**

1. External and Internal characteristic of DC Generator.
2. Load Characteristics of D.C. Motor.
3. Speed Control Methods of DC shunt motors.
4. Speed Control Methods of DC series motors.
5. O.C. / S.C. Test on single Phase Transformer.
6. Polarity & Voltage ratio Test on Single Phase Transformer.
7. Load Test on Single Phase Transformer.
8. Parallel operation of Single Phase Transformer.
9. Sumpner's Test on Single Phase Transformer.
10. Three phase Transformer Connections.(Phase Groups)

**F. Students Learning Outcomes**

- The student can be acquired the basic knowledge of energy conversion principle and electrical machine thus being prepared to pursue any area of engineering spectrum in depth as desired.
- The students will be able to effectively employ electrical systems and lead the exploration of new applications and techniques for their use.

**G. Recommended Study Materials**

- **Text & Reference Books:**
  1. Electrical Machines. by Nagarath & Kothari, TMH Publications
  2. Electrical Technology Vol II. B. L. Theraja, S. Chand Publications
  3. Performance and Design of A.C. machines by M. G. Say
  4. Electrical Machines by P S Bhimbra
  5. Electrical Machines by J. B. Gupta, Kataria Pub
  6. Electrical Machine Design by A.K. Shawhney, Dhanpatrai & Sons.