

**II Year – I SEMESTER**

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3+1	0	3

**ELECTRICAL MACHINES – I****Preamble:**

This is a basic course on rotating electrical machines. This course covers the topics related to principles, performance, applications and design considerations of dc machines.

**Learning objectives:**

- i. Appreciate the principles of electromagnetic energy conversion and understand the construction details of DC machine.
- ii. Understand the principle of operation and performance of DC generators.
- iii. Learn the characteristics and performance of DC generators.
- iv. Learn the characteristics and performance of DC motors.
- v. Learn the speed control and testing methods of DC motors.
- vi. Learn the basic ideas of design of DC machines.

**UNIT-I:****Electromechanical Energy Conversion**

Introduction to S.I Units - principles of electromechanical energy conversion – forces and torque in magnetic field systems – energy balance- singly excited machine- magnetic force - co-energy – multi excited magnetic field system-construction features of conventional and modern DC machines.

**UNIT-II:****D.C. Generators – I**

Principle of operation – E.M.F equation- armature windings – lap and wave windings – armature reaction –cross magnetizing and de-magnetizing AT/pole –commutation process – methods of improving commutation – compensating windings – Interpoles.

**UNIT-III:****D.C. Generators – II**

Methods of excitation- self excited and separately excited-types of generators build-up of emf - open circuit characteristics-critical field resistance-critical speed-causes for failure to self excitation-remedial measures – Internal and

external characteristics of separately excited, shunt, series, compound generators-applications, losses and efficiency.

#### **UNIT-IV:**

##### **D.C. Motors**

Principle of operation – back E.M.F - torque equation –characteristics of shunt, series and compound motors – armature reaction and commutation - losses and efficiency- speed torque characteristics-applications of dc motors.

Starting by 3 point and 4 point starters – protective devices.

#### **UNIT-V:**

##### **Speed Control and Testing of D.C. Machines**

Speed control by armature voltage and field flux control – testing of DC machines - brake test, Swinburne’s method – principle of regenerative or Hopkinson’s method - retardation test -- separation of losses – methods of electrical braking: plugging, dynamic and regenerative.

#### **UNIT-VI:**

##### **Design of D.C. Machines**

Design concept - output equation - choice of specific electric and magnetic loadings – separation of D and L - estimation of number of conductors/ turns - coils - armature slots – conductor dimension – slot dimension - choice of number of poles – length of air gap.

##### **Learning outcomes:**

- i. Able to explain the concepts of electromagnetic energy conversion.
- ii. Able to explain the operation of dc generator, armature reaction and commutation.
- iii. Able to analyze the characteristics and performance of dc generators.
- iv. Able to explain the torque developed and performance of dc motors.
- v. Able to analyze the speed control and testing methods of dc motors.
- vi. Able to propose design aspects of a dc machine.

##### **TEXT BOOKS:**

- 1 Electrical Machines – P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald, Charles kingsley, Stephen D.Umans, TMH

**REFERENCE BOOKS:**

1. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria & Sons.
2. Electrical Machines by R.K. Rajput, Lakshmi publications, 5<sup>th</sup> edition.
3. The Performance and Design of DC machines - Albert E. Clayton.
4. Electrical Machine Design by A.K. Sawhney, Dhanpat Rai & Sons publications.
5. Electric Machines by Mulukutla S.Sarma&Mukesh K.Pathak, CENGAGE Learning.