Course Syllabi: UEE301: Direct Current Machines and Transformers (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE301; Direct Current Machines and Transformers

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Bimbhra, P.S., Electrical Machinery, Khanna Publishers (2008).*
   - *Mukherjee, P.K. and Chakravorty, S., Electrical Machines, DhanpatRai (2004).*
   - *Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill (2004).*
   - *Bimbhra, P.S., Generalized Theory of Electrical Machines, Khanna Publishers (2007).*
   - *Toro, Vincert, Electromechanical Devices for Energy Conversion, Prentice Hall of India (2004).*
   - *Fitzgerald, A.E., Kingsley, C. Jr. and Umans, Stephen, Electric Machinery, McGraw Hill (2002).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   General Concepts of Rotating Electrical Machines: Electromagnetic torque, Reluctance torque, Constructional features of rotating electrical machines, Classifications of rotating electrical machines, Construction of DC machines.

   DC Generators: Classification of DC generator, Armature reaction, Compensating windings, Commutation, Methods of improving commutation, Characteristic of DC generators, Voltage buildup of shunt generators, Voltage regulation, Parallel operation of DC generators, Condition for maximum efficiency, Applications of DC generators.

   DC Motors: Characteristic of DC motors, Speed control of DC motors, Ward–Leonard control (Voltage control), Three-point starter, four-point starter, DC shunt motor starter design, Electric breakings of DC shunt and series motors, Condition for maximum mechanical power, Testing of DC machines: Brake test, Swinburne's test, Hopkinson's test or back to back test, Retardation test or Running test, Field's test, Applications of DC motors.

   Single Phase Transformers: Introduction, Basic principle, Types of transformer, Construction, Equivalent circuit, Open circuit and short circuit, Separation of core losses, Per unit representation, Voltage regulation of a transformer, Losses in a transformer, Efficiency of a transformer, Condition for maximum efficiency, All day efficiency, Polarity test of a single–phase transformer, Sumpner's test, Parallel operation, Auto transformer.

   Three-Phase Transformer: Advantages of three phase transformer, Principle of operation, Construction, Three–phase transformer connections, Open delta or V–V connection, Scott connection or T–T connection, Three–phase to two–phase conversion, Three–phase to six–phase conversion, Three–winding transformer, Parallel operation of transformers.

   Special Purpose Transformers: Instrument transformers (CT and PT), Earthing transformer, Pulse transformer, High frequency transformer, Converter transformer.

   Laboratory Work: DC Machines: Characteristics of generators and motors, Speed control, Efficiency, DC generators in parallel. Transformers: Open and short circuit tests, Parallel

operation, Harmonics in no-load current, Three-phase connections, 3−phase to 2−phase and 6−phase conversions.

5. **Specific goals for the course**

After the completion of the course, the students will be able to:

- Test the transformer and calculate its efficiency and performance in distribution system.
- Compare the performance of auto-transformer with that of two winding transformer.
- Use special purpose transformer for measurement and protection.
- Compute the performance of DC motors and generators in various modes.
- Explain the advantages of increasing load with parallel operation.
- Explain the speed control and starting methods of DC motors for specific purpose(s).

6. **Brief list of topics to be covered**

- General Concepts of Rotating Electrical Machines
- DC Generators
- DC Motors
- Single Phase Transformers
- Three-Phase Transformer
- Special purpose transformers