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:** Credits: 4.5; Hours: 6

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

   - *Bimbhra, P.S., Electrical Machinery, Khanna Publishers (2008) 2nd ed.*
   - *Mukherjee, P.K. and Chakravorty, S., Electrical Machines, DhanpatRai (2004) 2nd ed.*
   - *Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill (2004) 3rd ed.*
   - *Bimbhra, P.S., Generalized Theory of Electrical Machines, Khanna Publishers (2007) 5th ed.*
   - *Toro, Vincert, Electromechanical Devices for Energy Conversion, Prentice Hall of India (2004) 2nd ed.*
   - *Fitzgerald, A.E., Kingsley, C. Jr. and Umans, Stephen, Electric Machinery, McGraw Hill (2002) 6th ed.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

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

   Single phase Transformers: Introduction, Basic principle, Types of Transformer, Construction of single–phase Transformer, Transformer windings, Terminals and leads, Bushings, Tapping, Cooling of transformer, Transformer oil, Conservator and breather, Buchhloz relay, Transformer tank, EMF equation of a Transformer, Step–up and step–down transformer, Transformer on no–load and on load, Magnetic leakage, Transformer with resistance and reactance, Equivalent resistance and reactance, Equivalent circuit, Open circuit or no load test, Short circuit or impedance test, Separation of core losses, Total approximate voltage drop of a transformer, Exact voltage drop, Per unit resistance, Leakage reactance and impedance voltage drop, Voltage regulation of a Transformer, Calculation of voltage regulation, 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 of single–phase Transformers, Load sharing of two transformers, Auto transformer.

   Three–phase Transformer: Advantages of three phase Transformer, Principle of operation, Construction of three phase transformers, 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, Rating of Transformers.

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

   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, Principle of DC generator, Principle of DC motor, Lap winding, Wave winding, Electrical and mechanical degrees.

   DC Generators: Classification of DC generator, Brush drop, EMF equation, Derivation of generated emf, Losses in DC generator, Power stages, Condition for maximum efficiency, Armature reaction, Demagnetising and cross–magnetising conductors, Demagnetising

ampere–turns per pole, Cross–magnetising ampere–turns per pole, Compensating windings, Commutation, Value of reactance voltage, Methods of improving commutation, Equalizer rings, Characteristic of DC generators, Voltage build up of shunt generators, Conditions for build–up of shunt generator, Voltage regulation, Parallel operation of DC generators, Applications of DC generators.

DC Motors: Voltage equation, Back emf, Condition for maximum mechanical power, Armature torque of a motor, Relation of speed with back emf and flux, Characteristic of DC motors, Speed control of DC motors, Ward–Leonard control (Voltage control), Necessity of starter for starting of DC motor, Three point starter, Four point starter, DC shunt motor starter design, Electric breakings of DC shunt and series motors, 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. Uses of DC motors.

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.
- Scrutinize three-phase transformer connections and use special purpose transformer for measurement and protection.
- Select appropriate DC motor for specific purpose and can compute their steady performance.
- Compute the performance with DC generators and can supply increasing load with parallel operation.
- Thoughtfully select the speed control and starting method of DC motor.

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

- Single Phase Transformer
- Three Phase Transformer
- Special Phase Transformer
- DC Generator
- DC Motor