**Course Objective:**  
To impart knowledge on the principle of design of electrical machines like transformers, induction machines and DC machine

1. **Materials used in electrical equipment(5 hours)**
   1. Review of electrical conducting materials
      1. Various characteristics and comparison between conducting materials
      2. Materials of high conductivity and high resistivity
   2. Magnetic materials
      1. Classification ,characteristics and application of magnetic materials
      2. Materials for steady flux (solid core materials ), materials for pulsating fluxes (laminated core materials sheet)
      3. Special purpose alloys ,hot rolled and cold rolled steel sheets, sintered power core
      4. Magnetic materials used in transformers, dc machines and ac machines
   3. Insulating materials
      1. Classification ,characteristics ,application
      2. Insulating materials for transformers, dc machines and ac machines, ceramics

1. **Heating and cooling of electric machine(7 hours)**
   1. Review  of heat transfer: Conduction, convection and radiation
   2. Internal temperature (hot spots and their calculations)
   3. Temperature gradients in iron core
   4. Temperature gradients in conductors placed in slots
   5. Ventilation of electrical machine
      1. Types of enclosure, methods of cooling, schemes of ventilation
      2. Cooling of totally enclosed machines ,cooling circuits ,cooling systems
   6. Temperature rise, heating time constant, final steady temperature rise, cooling time constant
   7. Rating of electric machine based on temperature rise
   8. Calculation of temperature rise in armature, field coils and commutators

1. **Transformer Design (13 hours)**
   1. Review of transformer theory
   2. Types of transformer : Power transformer, distribution transformer, core type and shell type
   3. Design approach
      1. Output equations (single and three phase), Volt per turn
      2. Design of core(square core, stepped and cruciform core)
      3. Choice of flux density
      4. Design of winding and choice of current density
      5. Design of insulation
      6. Design of window and window space factor
      7. Design of yoke
   4. Calculation of operating characteristics from design data
      1. Resistance of winding, leakage reactance of winding in core type transformer, iron loss, copper loss, efficiency, regulation.
   5. Design of cooling system
      1. Temperature rise in plain walled tank, design of tank and tubes

1. **Three phase induction motor design  (10 hours)**
   1. Review of three phase induction motor theory
      1. Construction and principle of  three phase induction motor
      2. Various types of three phase stator winding
   2. Design approach:
      1. Output equation, choice of magnetic and electric loading
      2. Choice of stator winding. stator slots and insulation, stator teeth , stator teeth, stator core and stator stamping dimension
      3. Air gap length, rotor design (squirrel cage and slip ring type)
      4. Leakage inductance, evaluation of equivalent circuit parameters and operating characteristics from design data.
2. **DC Machine Design(9 hours)**
   1. Armature Winding
      1. Lap and wave winding
   2. Design Approach :
      1. Output equation, choice of average gap density, choice of ampere conductors per meter
      2. Choice of no of poles in DC machine, pole proportions
      3. Selection of length of air gap
      4. Choice of armature windings, no of armature conductors, no of coils, no of armature slots, armature conductor selection
      5. Design of commutator , design of brushes, design of compensating winding
      6. Evaluation of operating characteristics from design data

**Practical**

1. A detail design of core type power and distribution transformer
   1. orthographic drawing of transformer including winding, tank and tubes
2. A detail design of three phase induction motor
   1. Drawing of three phase stator winding (Mush winding, Lap winding and Wave winding)
3. A detail design of DC armature winding
   1. Drawing of Lap and wave winding used in DC machine armature

**References**

1. A.K. Sawhney “ A course in Electrical Machine Design”
2. M.G. Say “ Performance and design of AC Machines”
3. M.G. Say “Performance and design of DC Machines”

**Evaluation Scheme:**  
The questions will cover all the chapters in syllabus. The evaluation scheme will be as indicated in the table below.

|  |  |  |
| --- | --- | --- |
| **Chapters** | **Hours** | **Marks Distribution\*** |
| 1 | 5 | 10 |
| 2 | 7 | 12 |
| 3 | 13 | 24 |
| 4 | 10 | 18 |
| 5 | 9 | 16 |
| **Total** | **44** | **80** |

**\*Note: There may be minor deviation in marks distribution**