Power Electronics

**Course Objective:**  
To introduce various power electronics based circuits and their use in power system

1. **Characteristics and specification of power electronics device    (10 hours)**
   1. Power Diode: V-I characteristics, switching characteristics , types of diodes , application
   2. Thyristor:
      1. V-I characteristics, Turn On and Off mechanism, switching characteristics, protection scheme,
      2. Types of thyristors, merits-demerits and application  of thyristors,
      3. Firing Circuits : Microcontroller based firing scheme, Long pulse, short pulse and train pulse generation using pulse transformer
      4. Various commutation technique: Load Commutation and Line commutation
   3. Power Transistor :  V-I Characteristics, switching characteristics, merits-demerits and application of transistor
   4. Power MOSFET – V-I Characteristics, Switching characteristics, merits-demerits and applications of MOSFET
   5. Insulated Gate Bipolar transistor (IGBT): V-I characteristics, switching characteristics, merits-demerits and application of IGBT, comparison with MOSFET
   6. Triac : V-I characteristics of Triac, operating modes of Triac, merits-demerits  of Triac
   7. Diac: V-I characteristics and its merits and demerits

1. **Single phase ac to dc conversion  (6 hours)**
   1. Half wave rectification with power diode using inductive and resistive load
   2. Half wave rectification with thyristor using inductive and resistive load
   3. Full wave rectification with diode and thyristor using resistive and inductive load
   4. Wave form, ripple content .Fourier analysis and filtering scheme
   5. Single phase semi-converter and full converter
   6. Power factor improvement
      1. Extinction angle control
      2. Symmetrical angle control

1. **Three phase AC to DC conversion (4 hours)**
   1. Three phase AC to DC conversion using diode and the Fourier analysis of waveforms
   2. Three phase bridge rectification with diodes and the Fourier analysis of waveforms
   3. Three phase full converter

1. **DC chopper (6 hours)**
   1. Introduction
   2. Step down chopper
   3. Chopper with dc motor as load
   4. Step up chopper
   5. Chopper classification

1. **Inverter (8 hours)**
   1. Introduction
   2. Single phase inverter
   3. Single phase inverter with ac motor load
   4. Three phase inverter
   5. Fourier analysis of three phase inverter
   6. Pulse width modulated inverter
      1. Single pulse modulation
      2. Multiple pulse modulations
      3. Sinusoidal pulse width modulation

1. **AC voltage controller (6 hours)**
   1. Single phase voltage controller with phase control using resistive and inductive load
   2. Single phase voltage controller in electronic load controller (ELC)
   3. Principle of operation of single phase cycloconverter
   4. Step-up and step down single phase cycloconverter
   5. Three phase to single phase cycloconverter

1. **HVDC power transmission (5 hours)**
   1. HVDC station configuration (Filter, Converters, Inverters)
   2. Comparison of HVDC and HVAC transmission
   3. Reversible power flow and  control  in dc line
   4. Series operation of converters
   5. 12-pulse operation of converter

**Practical:**

1. Study of single phase rectification with diode and thyristor
2. Study of three phase rectification with diode and thyristor
3. Study of DC conversion using chopper circuit
4. Study of DC to AC conversion with resistive load
5. Study of AC voltage controller with resistive load

**References:**

1. Muhammad H. Rashid  “Power Electronics” Dhanpat Rai and Sons
2. B.R Gupta and V.Singhal “ Power Electronics” Kataria and Sons

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

|  |  |  |
| --- | --- | --- |
| **Chapters** | **Hours** | **Marks Distribution\*** |
| 1 | 10 | 16 |
| 2 | 6 | 8 |
| 3 | 4 | 8 |
| 4 | 6 | 8 |
| 5 | 8 | 16 |
| 6 | 6 | 16 |
| 7 | 5 | 8 |
| **Total** | **44** | **80** |

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