# APPE3006 POWER ELECTRONICS (3-0-0)

**Module I (06 Hours)**
Power Semiconductor Devices and Uncontrolled Rectifiers:
Introduction, working and characteristics of power diodes – power transistors – power MOSFETs – IGBTs.
Uncontrolled Single-phase Half-wave – Full-wave – Bridge rectifiers, Three-phase Half-wave and Bridge rectifiers, performance parameters, and waveform analysis for R and RLloads.
Thyristors, static I-V characteristics, turn-on methods, Gate characteristics, two transistor model of Thyristor, Ratings of Thyristors, Thyristor protection, Design of Snubber circuits, Series and Parallel operation of Thyristors, Thyristor commutation techniques: Natural and Forced commutation.

**Module II (08 Hours)**
Phase Controlled Rectifiers:
Principle of Phase control, Controlled Single-phase Half-wave rectifier, Full-wave converters, Full-wave Bridge converters, Semiconverter, Full converter, analysis with continuous and discontinuous current conduction, performance parameters, and waveform analysis for R – RL – RLE loads, operation with and without free-wheeling diodes.
Controlled Three-phase Half-wave converter – Full-wave converters, Full-wave Bridge converter, Semiconverter, Full converter, performance parameters and waveform analysis for R – RL – RLE loads, Dual converter, effect of source impedance on performance of converters.

**Module III (04 Hours)**
DC to DC Converters:
Principle of step-down and step-up operation, control strategies, generation of duty cycle, Buck, Boost, Buck-Boost, performance parameters, and waveform analysis.
Types of chopper circuits: first-quadrant, second-quadrant, two-quadrant, four-quadrant choppers, thyristor chopper circuits.

**Module IV (06 Hours)**
DC to AC Converters:
Principle of operation, Single-phase Voltage source Bridge inverter, Three-phase Bridge inverter, 180-degree conduction, 120-degree conduction, performance parameters, and waveform analysis, Introduction to Current Source Inverter.
Voltage control of single-phase inverter, pulse-width modulation, single pulse width modulation, sinusoidal pulse width modulation.
Voltage control of three-phase inverters, sinusoidal PWM.

**Module V (06 Hours)**
AC to AC converters and Drives:
AC voltage controllers: principle of phase control, principle of integral cycle control, singlephase full wave voltage controllers with R and RL loads, performance parameters and waveform analysis.
Cyclo converters: single phase Cyclo converters, performance parameters and waveform analysis.
Introduction of Power Electronics application in Electric Drives.

**Course Outcomes (COs)**

**CO1**: Explain the principles, characteristics, and applications of power semiconductor devices and uncontrolled rectifiers. (Understanding - Level 2)

**CO2:** Analyze and design single-phase and three-phase phase-controlled rectifiers with different load types (R, RL, RLE) and evaluate the performance under various conditions. (Analyzing - Level 4)

**CO3:** Describe the operating principles and control strategies of DC-DC converters and evaluate different chopper configurations and their applications. (Applying/Analyzing - Level 3/4)

**CO4:** Analyze the operational characteristics of DC-AC inverters and apply control techniques to single-phase and three-phase inverter circuits. (Applying - Level 3)

**CO5:** Explain AC-AC conversion techniques, including AC voltage controllers and cyclo-converters, and demonstrate their use in electric drives. (Understanding/Applying - Level 2/3)

**Textbooks:**

1. "Power Electronics" by P.S. Bimbhra, 7th edition, Khanna publishers,2022.
2. "Power Electronics-Devices, Circuits, and Applications" by Muhammad H. Rashid, 4th edition, Pearson publishers, 2014.

**Reference books:**

1. "Power Electronics, Converters, Applications, and Design", by Ned Mohan, T. M. Undeland, W. P. Robbins, 3rd Edition, Wiley publishers, 2022.
2. "Power Electronics", by Daniel W. Hart, Mc Graw Hill publishers, 2011.