**Approval: 5th Senate Meeting**

**Course Title** : Power Electronics
**Course Number** : EE-309
**Credit** : 2.5-0.5-0-3
**Pre-requisites** : IC-160
**Distribution** : Elective
**Semester** **:** Odd/Even

**Course Preamble:** Power electronics deals with the processing and control of 'raw' electrical power from an electrical source such as an AC mains supply, a battery bank, a photovoltaic array, or a wind turbine into a form and quality suitable for a particular electrical load. It is an enabling technology with a very wide range of applications, such as a cell phone charger, a personal computer, a microwave oven, an MRI system, a hybrid electric car, or even the electrical grid. As can be noted, the power levels handled can vary from a few watts to several hundreds of megawatts. In this course, we will study the basic principles behind the power electronic circuits used in most such power processing applications. These circuits include power converters for DC to DC, DC to AC and AC to DC applications.

**Detailed Course Syllabus:**

Introduction (2 hours)

About power electronics; power control through switching; overview of power devices, converters and applications.

DC to DC power converters (8 hours)

Buck, boost and buck-boost converters; continuous and discontinuous modes of operation; operation as single-quadrant, two-quadrant and four-quadrant choppers; basics of transformer isolated half-bridge and full-bridge converters.

Power semiconductor switches (8 hours)

Desirable switch characteristics; overview of available switches; power diodes / thyristors including GTOs; power MOSFETs / IGBTs; emerging power devices.

DC to AC inverters (8 hours)

Background; single phase voltage source inverter; square wave and single pulse PWM (Pulse Width Modulation) operation; selective harmonic elimination; three-phase six-step inverter; simple sine-PWM technique; waveform distortion and harmonics; output filter.

Engineering aspects (6 hours)

Drive circuits for power devices; conduction and switching loss calculations; heat sink for power devices; elementary design of magnetic components; basic snubber circuits.

AC to DC Converters (8 hours)

Uncontrolled rectifiers: Single phase bridge rectifier; centre-tapped rectifier; three phase bridge rectifier. Input side and output side performance; concept of AC input power factor under distorted waveforms. Controlled rectifiers: Some basic concepts regarding AC-DC phase controlled thyristor converters. AC to DC

PWM rectifiers: Operation of a PWM bridge DC-AC inverter as an AC to DC PWM rectifier; application in renewable energy systems.

Laboratory Work:

The laboratory will involve a few experiments related to power converters and control of the same.

**Text-books:**


1. Power Electronics: Converters, Applications and Design, by Mohan, Undeland and Robbins, Wiley India (2007)
2. Power Electronics: Essentials & Applications, by L. Umanand, Wiley India (2009)