Course Name : Switch Mode Power Conversion **Approval: 5th senate meeting**
Course Number : EE-504
Credit : 2.5-0.5-0-3
Prerequisites : EE 309 Power Electronics and Teachers Consent
Students intended for : UG/MS/PhD
Elective or Compulsory : Elective
Semester : Odd/Even

Course Permeable: Most modern equipment and gadgets are powered using advanced switch mode power conversion techniques in which available AC power into high quality DC power suitable for such loads. This course deals with the circuits, components, control and the technology underlying such SMPC techniques. The course starts with an introduction followed by a discussion on several different non-isolated and transformer-isolated power converters. An introduction to power semiconductor devices and also design of magnetic components for such applications will be provided. This will then be followed by analysis and design of switching regulator control. Advanced techniques to improve efficiency and power density, such as use of resonant and soft-transition power converters, will be covered. Lastly, the motivation and methods behind single-phase power-factor correction techniques, which have been developed to improve the power quality of AC-DC power supplies, will be covered.

Course Outline:

1. Introduction (2 hours)
   About Switch Mode Power Conversion; overview of the course; industrial relevance of this topic; SMPC requirements.
2. Basic DC to DC power converters (6 hours)
   Basic DC-DC converters - buck, boost, buck-boost&Cuk converters - and their principles of operation; continuous and discontinuous modes of operation; SEPIC converter.
3. Power semiconductor switches (6 hours)
   Review of power diodes, Schottky didoes, power MOSFETs &IGBTs. Recent developments in power devices for switch mode power supplies. Drive requirements, switching performance and snubberdesign . Selection of devices & basic heat sink design.
4. Transformer-Isolated Converters (6 hours)
   Single-switch and multi-switch transformer-isolated DC-DC converters. Flyback and forward converters; transformer isolated half-bridge, full-bridge converters. Push-pull converters. Voltage-fed and current-fed converters.
5. Magnetic Component Design (4 hours)
   Magnetic core materials and performance; basic inductor and transformer design; practical magnetic design; design aspects to be considered for designing transformers for specific applications – flyback, push-pull, bridge, forward converters.
6. Switching Regulator Control (6 hours)
   Small-signal models for switching regulators. Performance analysis and design of closed-loop system under different control methods, and operating modes. Measurement of small signal transfer functions.

7. Soft-Switched and Resonant DC-DC Power Converters (6 hours)
   Motivation. Hard-switching vs soft-switching. Introduction to resonant power converters and their characteristics. Detailed study of a few soft-transition converters.
8. Single-Phase Power-Factor Correction (6 hours)
   Problems due to harmonics in the current drawn by equipment. Basic concept of active power-factor correction (PFC) techniques. Performance analysis and comparison of different PFC techniques.

Reference Material:

1. N Mohan, T M Undeland and W P Robbins, "Power Electronics: Converters, Applications and Design", Wiley
2. A I Pressman, "Switching Power Supply Design", McGraw-Hill
3. Selected Conference and Journal Articles
4. Texas Instruments 'Power Management' Application Notes including articles from the well known Unit rode Seminar Series.
5. Application Notes from International Rectifiers and other Power Devices and ICs manufacturers.