

| Course Type | Course Code | Name of Course | L | T | P | Credit |
|-------------|-------------|----------------------------|---|---|---|--------|
| DE | NEED508 | Design of Power Converters | 3 | 0 | 0 | 3 |

Course Objective

- Reviewing the operation of various power converters, analyzing their performances, designing the converters and their control aspects, and selecting the rating of the components for various applications are also covered. However, strong fundamental knowledge about power electronic components and their interfacing are the prerequisite for the course.

Learning Outcomes

Upon successful completion of this course, students will develop:

- To analyze the theoretical aspects of different converters and inverters.
- Understand the design aspects and selection of components for different converters.
- Understand the Control aspects of the converters for simulation and implementation.

| Unit No. | Topics to be Covered | Lecture Hours | Learning Outcome |
|----------------------------|--|---------------|---|
| 1 | Design aspects of AC to DC uncontrolled and controlled converters: Performance analysis of Line frequency single-phase and three-phase AC-DC converter under constant current load. Operation of single-phase 12-pulse converter. Harmonic analysis of output voltage and input current of the converters under constant current load, selection of components for the design of rectifiers. Design of filter circuits and industrial applications. | 10L | A comprehensive introduction to the course content will be delivered. Different converters' operations, waveform analysis, and harmonic analysis can be performed. Selection of converter components and their rating can be done. |
| 2 | DC to DC Switch Mode Power Converters and their Design: Introduction, steady-state analysis of buck, boost, buck-boost, Cuk converters, Fly-back and forward converters under the continuous and discontinuous mode of operation, design of the DC-DC converters, and filters, design of PWM techniques, Industrial Applications, etc. | 10L | The operations of different converters under continuous and discontinuous modes and their waveform analysis can be done. The analysis of different converters under various loads and supply voltages can also be performed. Design of converters, filter components, and their performance analysis can be done. |
| 3 | Design of Switch Mode DC-AC Inverters: Analysis of the performance of a single-phase switched mode inverter under PWM and square wave mode, as well as their harmonic analysis. Performance analysis of a three-phase inverter under PWM and square wave modes, their harmonic analysis, selection of components for designing single-phase and three-phase inverter components, and design of grid-side filters, industrial applications. | 10L | The operations and harmonic analysis of different PWM inverters can be done under a wide range of modulation indices. Design of inverters, filter components, and their performance analysis can be done. |
| 4 | Design of Thermal and Magnetic Components: Introduction, thermal model of power devices, selection of heat sinks. Magnetic materials, hysteresis and eddy current losses in core, selection of parameters for the Design of magnetic components for Power Electronic Applications, thermal consideration, design steps of an inductor. | 7L | Design aspects of different magnetic and thermal components can be analyzed. The selection of components for successful design can be made. |
| 5 | Design of Drive Circuit for the Power Semiconductor Switches: Turn-on and Turn-off Characteristics of semiconductor switches, Drive circuits for different power semiconductor switches, design of snubber circuit. | 5L | Able to explain the need and operations of different driver circuits for the switching devices can be done. Able to design the corresponding driver circuit for implementation. |
| Total Contact Hours | | 42L | |

Text Books:

- Power Electronics Converters, Application and Design - Mohan N. Undeland. T & Robbins W John (Wiley), 3 rd edition, 2002
- Power Electronics Essentials & Applications, L. Umanand (J Wiley)

Reference Books:

- High-Power Converters and AC Drives-By Bin Wu, IEEE PRESS
- Pulse Width Modulation-by for Power Converters-By D. Grahame Holmes, Thomas A. Lipo, IEEE PRESS.