| | |
|---|---|
| **COURSE TITLE** | **POWER ELECTRONICS** |
| **COURSE CODE** | **01EE1402** |
| **COURSE CREDITS** | **4** |

**Objective:**

1 To enable students to analyze, design, and implement power electronic circuits for efficient conversion of electrical energy across various industrial and domestic applications.

**Course Outcomes:** After completion of this course, student will be able to:

1 Compare the performance of various power semiconductor devices of Thyristor and Transistor family.

2 Establish the relation between control signal and output of converter.

3 Choose the power electronic converter as per the requirement of application.

4 Determine gate driver circuit for power semiconductor device.

**Pre-requisite of course:**Basic Electronics

**Teaching and Examination Scheme**

| Theory Hours | Tutorial Hours | Practical Hours | ESE | IA | CSE | Viva | Term Work |
|---|---|---|---|---|---|---|---|
| 3 | 0 | 2 | 50 | 30 | 20 | 25 | 25 |

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Solid State Semiconductor Devices**<br>Introduction to construction, working and performance characteristics of Diode, BJT, SCR, MOSFET, IGBT;, switching and conduction losses, Single-quadrant switches, two-quadrant and bidirectional switches;, Gate triggering circuit for semiconductor devices; Ratings and protection of semiconductor devices, Selection of switch for converters | 6 |
| 2 | **Isolated and non-isolated DC-DC converters**<br>Operation and Principle of Basic DC-DC converter topologies like Buck, Boost and Buck-Boost converter,, Various control techniques for output voltage control, Mathematical analysis for these converters for steady state,, Concept of CCM and DCM and factors affecting them,, Concept of switching voltage regulators and advantages, Isolated converters: Forward converter, Flyback converter, Push Pull converter,, Half-bridge converter, Full-bridge DC-DC converter, Introduction to Dual Bridge Converter | 12 |

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| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 3 | **Controlled AC to DC converters**<br>Concept of phase angle control,, Half and Fully controlled single phase and three phase converters with R, RL and RLE load., Single phase and three phase semi-controlled converter,, Performance parameters of converters, Applications | 6 |
| 4 | **Inverters**<br>Classification of Inverters, single phase square wave inverter: Half-bridge and full-bridge topology,, Three phase bridge inverter:180? and 120? conduction mode, , Performance parameters, Voltage and frequency control, Harmonic spectrum of inverter., PWM Inverter: Principle, classification of PWM techniques, Bipolar sinusoidal and Unipolar sinusoidal PWM techniques for single phase inverter, Third harmonic injection, Three phase sine PWM technique,, Current Control of Three phase inverter, Applications | 12 |
| 5 | **AC Voltage Regulator**<br>Concept of On-Off or integral cycle control and Phase control;, Various single phase ac-ac controllers with R and RL load;, Gating requirements; Sequence Control of AC regulators; 3-phase full wave regulator configurations with Y and ? connected loads and their analysis with R load;, AC Voltage controller with PWM control;, Basic principle of matrix converter and cyclo converter. | 6 |
| **Total Hours** | | **42** |

**Suggested List of Experiments:**

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Experiment No. 01**<br>Performance Analysis of Buck Converter under CCM and DCM mode | 2 |
| 2 | **Experiment No. 02**<br>Performance Analysis of Boost Converter under CCM and DCM mode | 2 |
| 3 | **Experiment No. 03**<br>Performance Analysis of Flyback converter | 2 |
| 4 | **Experiment No. 04**<br>Performance Analysis of Full Bridge Resonant DC-DC converter | 2 |
| 5 | **Experiment No. 05**<br>Implementation of gate triggering circuit for SCRs | 2 |
| 6 | **Experiment No. 06**<br>Implementation of IGBT/MOSFET gate drivers | 2 |
| 7 | **Experiment No. 07**<br>Simulation of single phase fully controlled AC-DC converter | 2 |
| 8 | **Experiment No. 08**<br>Simulation of three phase fully controlled AC-DC converter | 2 |

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**Suggested List of Experiments:**

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 9 | **Experiment No. 09**<br>Simulation of single-phase full bridge Voltage Source Inverter with Pulse Width Modulation. | 2 |
| 10 | **Experiment No. 10**<br>Simulation of three-phase Voltage Source Inverter with Pulse Width Modulation | 2 |
| 11 | **Experiment No. 11**<br>Simulation of single-phase AC chopper | 2 |
| **Total Hours** | | **22** |

**Textbook :**

1 Power electronics, M D Singh and K B Khanchandani, TMH, New Delhi, 2nd ed., 2007

2 Power Electronics, P.S. Bimbhra, Khanna Publishers, New Delhi, 2012

3 Power Electronics: Converters, Applications and Design, N. Mohan, T. M. Undeland, W.M. Robbins, Wiley India Edition, 2007

**References:**

1 Power electronics: circuits, devices, and applications", Pearson Education India, 2009. , Power electronics: circuits, devices, and applications", Pearson Education India, 2009. , M. H. Rashid, Pearson Education India, 2009

2 Fundamentals of Power Electronics, Fundamentals of Power Electronics, R. W. Erickson and D. Maksimovic, Springer Science & Business Media, 2007

**Suggested Theory Distribution:**

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

| Distribution of Theory for course delivery | | | | | |
|---|---|---|---|---|---|
| **Remember / Knowledge** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Higher order Thinking / Creative** |
| 20.00 | 30.00 | 25.00 | 15.00 | 10.00 | 0.00 |

**Instructional Method:**

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, case studies etc.

2 The internal evaluation will be done on the basis of continuous evaluation of students in the class-room

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in classroom.

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**Instructional Method:**

4 Students will use supplementary resources such as online videos

**Supplementary Resources:**

1 https://nptel.ac.in/courses/108101126
2 https://nptel.ac.in/courses/108105066
3 https://www.coursera.org/learn/power-electronic
4 https://nptel.ac.in/courses/108108077

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