Nirma University

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**V**
Course Code:	**3EE301CC24**
Course Title:	**Power Electronics and Applications**
Course Type:	**Core**
Year of Introduction:	**2024 –25**

L	T	Practical component				C
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to -

1. interpret the characteristics and select suitable device for an application **(BL3)**
2. evaluate performance parameters of converters **(BL5)**
3. analyse and implement different control techniques for power electronic converters **(BL4)**
4. select appropriate converter topology for an application **(BL4)**

Contents: **Teaching Hours: 45**

Unit-I **Power Semiconductor Devices** **06**

Construction, characteristics and ratings of MOSFET, Insulated Gate Bipolar transistors (IGBTs), SCR, TRIACs, Light Activated SCRs (LASCRs), Unijunction transistor (UJT), Gate turn-off thyristors (GTOs), Silicon carbide (SIC), Gallium nitride devices, Power Integrated circuits (PICs), Intelligent Modules

Unit-II **AC-DC Converters** **09**

Single-phase half wave and full wave controlled rectifiers with R, RL and RLE loads, three-phase half wave and full wave controlled rectifier with R, RL, RLE loads, dual converter with circulating and non-circulating current mode, effect of source inductance in controlled rectifiers

Unit-III **Non-Isolated and Isolated DC-DC Converters** **09**

Importance & requirement of DC power supply, introduction to chopper circuit, non-isolated DC-DC converters: Buck, Boost, Buck-Boost, requirement and importance of isolation in power electronics circuits – advantages, Flyback – Forward – Push Pull, half bridge, full bridge converters

Unit-IV **DC-AC Converters** **07**

Basic concept of VSI and CSI, single-phase inverters with loading conditions, three-phase inverters (120° and 180° mode), single & multiple PWM – sine triangle PWM (bipolar & unipolar), introduction of multi-level inverters

Unit-V **AC-AC Converters** **06**

Principle of phase control – single-phase and three-phase AC voltage controllers with R and RL loads, principle of on-off (ICC) control, basic principle of operation – single-phase to single-phase, multi-phase cycloconverters

Unit-VI **Applications of Power Electronics Converters** **08**

Electrical drives, high voltage DC Transmission, renewable energy-based systems – solar & wind, power quality improvement, electric vehicles, solid state CBS, solid state transformers, energy storage solutions, UPS and battery management

Self-Study:

The self-study components of the Contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work:

This shall consist of at least 10 practical / simulations based on the above Contents.

Suggested Reading:

1. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson Education, New Delhi
2. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, Inc., New York
3. L Umanand, Power Electronics, Essentials & Applications, Wiley India
4. M. S. Jamil Asghar, Power Electronics, Prentice-Hall of India Pvt. Ltd., New Delhi
5. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi
6. G. K. Dubey, S. R. Doradla, A. Joshi, R. M. K. Sinha, Thyristorized Power Controllers, New Age International, Delhi
7. B. Jayant Baliga, Power Semiconductor Devices, Thompson Course Technology, Singapore
8. P. S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi
9. C. W. Lander, Power Electronics, McGraw-Hill, UK
10. P. C. Sen, Modern Power Electronics, S. Chand, New Delhi
11. Mukund R. Patel, Wind and Solar Power Systems, CRC Press, Florida
12. Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall, New Delhi
13. Joseph Vithayathil, Power Electronics, Principles and Applications, Indian Edition, McGraw- Hill
14. Research Papers on IEEE/IET/Science Direct etc.

Suggested List of Experiments (not restricted to the following): (Only for Information)

	Title of Experiment	Hrs.
1.	Perform UJT as a relaxation oscillator and Phase control of SCR by UJT with pedestal and ramp method	02
2.	Demonstrate single phase SCR full-controlled bridge converter with different loads	02
3.	Demonstrate the working of single-phase SCR half-controlled bridge converter with RL load and freewheeling diode	02
4.	Analyse the operation of twelve pulse converter	02
5.	Operation of Boost Rectifier with power factor correction	02
6.	Simulation and analysis of Isolated Topologies of dc to dc converters using PSIM®/MATLAB®	02
7.	Simulation and analysis of single-phase Voltage Source Inverter (VSI) using single pulse and multiple Pulse Width Modulation (PWM) techniques in PSIM®/MATLAB®	02
8.	Simulation and analysis of single-phase full bridge inverter using SPWM (unipolar and bipolar) techniques in PSIM®/MATLAB®	02
9.	Simulation and analysis of three phase inverter for 120˚ and 180˚ mode of operation using PSIM®/MATLAB®	02
10.	Observe the performance of single-phase ac voltage Controller	02
11.	Analyse the operation of Uninterrupted Power Supply (UPS) for single phase operation	02
12.	Simulation and analysis of standalone PV system	02

L = Lecture, T = Tutorial, P = Practical, C = Credit