

NIRMA UNIVERSITY
Institute of Technology
B.Tech. in Electrical Engineering
Semester – IV

L	T	P	C
3	0	0	3

Course Code	2EE405
Course Title	Power Electronic Converters and Applications

Course Learning Outcomes (CLO):

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

1. analyze operation of devices and choose the same suitable for an application
2. evaluate various performance parameters of converters
3. implement and analyze different control techniques for power electronic converters
4. choose and apply converter topology suitable for an application

Syllabus:

Teaching Hours: 45

Unit-0: Introduction to Course

01

Overview of power electronic converters and their applications

Unit-1: Power Semiconductor Devices

08

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), Integrated Gate-Commutated Thyristors (IGCTs), MOS-controlled thyristor (MCT), Silicon carbide (SiC), Gallium nitride devices, Power Integrated circuits (PICs), Intelligent Modules

Unit-2: AC to DC Converters

07

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, Introduction to PWM rectifiers

Unit-3: Non Isolated and Isolated DC-DC Converters

06

Importance & Requirement of DC Power Supply, Non-Isolated DC-DC Converters: Buck, Boost, Buck-Boost, Cuk, SEPIC and Zeta converters, Requirement and Importance of Isolation in Power Electronics Circuits – Advantages, Flyback – Forward – Push Pull, Half bridge, Full bridge converters

Unit-4: DC-AC Converter

07

Basic concept of inverters, three phase inverters (120° and 180° mode), Multilevel inverters- Diode Clamped, Flying Capacitor & Cascaded H-Bridge, Different types of PWM strategies-Multi carrier PWM, Single & Multiple PWM – Sine Triangle PWM (Bipolar & Unipolar), SVPWM

Unit-5: AC-AC Converters

05

Principle of Phase Control – Single Phase AC Voltage Controllers with R and RL loads, Three Phase AC Voltage Controllers with R and RL loads, Principle of On-Off (IC) Control. Basic principle of operation-Single phase to single phase, Three phase to single phase Cycloconverter. Three phase to three phase cycloconverter

Unit-6: Electric Drives **03**
Semi-converter and Fully Controlled converter based dc motor drives, chopper control based dc motor drives, Solar and battery powered drives

Unit-7: Power Electronic control for Utility Systems **05**
High voltage DC Transmission, Power electronic transformer, Static excitation systems, Static VAR compensators, Static circuit breakers, Renewable energy based systems – solar & wind, Power Quality improvement devices – active power filter & active front end converter

Unit-8: E-mobility **03**
Power Electronic converters & their control for Electric vehicles, Control of electric motors for traction

Self-Study:

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

Suggested Readings:

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.
15. Product Literatures

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

w.e.f. academic year 2019-20 and onwards