NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**I**
Course Code:	**6EE102**
Course Title:	**Automotive Power Electronics**
Course Type:	(√ **Core**/ □ Value Added Course / □ Department Elective / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	**2022 – 23**

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. analyze operation of devices and choose the same suitable for EV application. **(BL4)**
2. evaluate various performance parameters of converters. **(BL5)**
3. implement and analyze different control techniques for power electronic converters. **(BL4)**
4. choose and apply converter topology suitable for EV application. **(BL6)**

Syllabus: **Teaching Hours: 45**

Unit-1: Introduction **05**

Role of power electronics in EV, Characteristics and operation of power electronics switches – Diode, BJT, MOSFET and IGBT, Selection parameters for semiconductor switches, losses in semiconductor switches, gate triggering circuits, SiC devices.

Unit-2: AC to DC converters for onboard and offboard charging systems **08**

AC to DC converters – operation and analysis of single-phase uncontrolled and controlled rectifier with different operating conditions of vehicle battery, concept of three-phase rectifier, limitations of conventional rectifier circuits, power factor improved unidirectional and bidirectional ac to dc converters

Unit-3: DC to DC converters **12**

DC to DC converters – operation and analysis of non-isolated and isolated converters for vehicle application, bidirectional converter, resonant converter for EV applications

Unit-4: DC to AC converters for EV motors **08**

DC to AC converters – operation and analysis of single-phase and three-phase inverter for motor control applications, concept and applications of multi-level inverters, bidirectional operation.

Unit-5: Control of power electronic converters **12**

Modelling of power electronic converter, design of controller, sinusoidal pulse width modulation, space vector modulation technique, predictive and sliding mode control, protection of power electronic converters

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.

Laboratory Experiments:
This shall consist of at least 10 experiments / simulations based on the above syllabus.

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. B. Jayant Baliga, Power Semiconductor Devices, Thompson Course Technology, Singapore.
5. P. S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi
6. C. W. Lander, Power Electronics, McGraw-Hill, UK
7. P. C. Sen, Modern Power Electronics, S. Chand, New Delhi
8. Mukund R. Patel, Wind and Solar Power Systems, CRC Press, Florida
9. Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall, New Delhi
10. Joseph Vithayathil, Power Electronics, Principles and Applications, McGraw- Hill
11. Research Papers on IEEE/IET/ScienceDirect etc.
12. Product Literatures

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

1. Analyze gate triggering circuits for SCR, IGBT and MOSFET.
2. To demonstrate single phase SCR full-controlled bridge converter for charger.
3. To demonstrate three phase SCR full-controlled bridge converter with load and its triggering circuit (04 hours).
4. Analyze operation of non-isolated dc to dc converter for on board chargers.
5. Analyze operation of isolated dc to dc converter for vehicles.
6. Analyze operation of single-phase bridge inverter.
7. Simulation based analysis of three-phase bridge inverter for vehicular loading conditions (04 hours).
8. Simulation and analysis of bidirectional operation of three-phase bridge converter.
9. Simulation based analysis of single-phase full bridge inverter using SPWM (unipolar and bipolar) technique in PSIM/MATLAB (04 hours).
10. Simulation and analysis of three phase inverter performance using SVPWM technique in PSIM/MATLAB (04 hours).

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