

Core VIII

Semester-IV Power Electronics and e-Vehicle

Course Outcomes:

- Upon the completion of this course, students will demonstrate the ability to:
- Understand the basic operating principles of power electronic devices like SCR, Diac, Triac, IGBT, and power MOSFET.
- Understand working of Electric Vehicles and recent trends
- Analyse different power converter topology used for electric vehicle application
- Develop the electric propulsion UNIT and its control for application of electric vehicles

Unit- 1

- Power Devices: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity, Introduction to family of thyristors.
- Silicon Controlled Rectifier (SCR): structure, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Factors affecting the characteristics/ratings of SCR, Gate-triggering circuits, Control circuits design and Protection circuits, Snubber circuit.

Unit- 2

- Diac and Triac: Basic structure, working and V-I characteristic of, application of a Diac as a triggering device for a Triac.
- Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc. Application of SCR: SCR as a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads; AC voltage control using SCR and Triac as a switch.
- Power MOSFETs: operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.

Unit- 3

Generation of DC power – Mention of batteries. Single phase, Two phase and Three phase. Transformers. Power transmission and distribution. Domestic electrical wiring – connection from AC line to the meter, sockets, mention of phase neutral and the need of earthing. Mention of electric shock and safety. Mention of power type (ac or dc) and current ratings for home appliances. Mention of tester. Electric motor working principle. Inverter, Uninterrupted Power supply (UPS) – online and off line UPS, SMPS.

Unit-4

E-Vehicles: Electric and Hybrid Electric Vehicles Configuration of Electric Vehicles, Performance of Electric Energy storage for EV and HEV Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and

operation, Types of Fuel Cells, Super Capacitors. Power Electronic Converter for Battery Charging, charging methods for battery, Termination methods, charging from grid.

Suggested References:

- ✓ *Power Electronics, P.C. Sen, TMH*
- ✓ *Power Electronics & Controls, S.K. Dutta*
- ✓ *Power Electronics, M.D. Singh & K.B. Khanchandani, TMH*
- ✓ *Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education*
- ✓ *Power Electronics, Applications and Design, Ned Mohan, Tore.*
- ✓ *Power Electronics, K. HariBabu, Scitech Publication.*
- ✓ *Power Electronics, M.S. Jamil Asghar, PHI.*
- ✓ *A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand*
- ✓ *Electrical Circuits, K.A. Smith and R.E. Alley, Cambridge University Press, 2012.*
- ✓ *A Text Book in Electrical Technology - B L Theraja - S Chand & Co., 2005*
- ✓ *Performance and design of AC machines - M G Say, CBS Publishers and Distributers Pvt Ltd., 3rd Edition, 2002, e-book edition 2017.*
- ✓ *Basic Electrical Engineering - V K Mehta and Rohit Mehta, 6th Edition, S Chand and Company, 2006*
- ✓ *M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, 1st edition, CRC Press, 2004*
- ✓ *Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021*
- ✓ *Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.*
- ✓ *C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001*
- ✓ *Chris Mi, M. AbulMasrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications with Practical Perspectives, Wiley Publication, 2011.*

Practical:

1. Study of I-V characteristics of DIAC
2. Study of I-V characteristics of a TRIAC
3. Study of I-V characteristics of a SCR
4. SCR as a half wave and full wave rectifiers with R and RL loads
5. DC motor control using SCR.
5. DC motor control using TRIAC.
6. AC voltage controller using TRIAC with UJT triggering.
7. Study of parallel and bridge inverter.
8. Design of snubber circuit
9. VI Characteristic of MOSFET and IGBT (Both)
10. Study of chopper circuits
11. Un boxing and assembling of desktop computers.
12. Types of motors and transformers used in household appliances.
13. Understanding voltage, current, frequency etc. of ac mains

14. Up gradation of RAM, hard disk and SSD
15. SMPS: Block diagram and working Inverter
16. Types of motors and transformers used in household appliances.
17. SMPS: Block diagram and working Inverter.
18. Simulation and analysis of electrical systems using MATLAB.