VOC 113: Industrial Electronics

Learning Objectives:-

1) To introduce students with concept of Industrial Electronic system. Why it is needed, What are various parts in it, how they work.

2) Understand classifications of various Power devices and know their construction, working principle, how they are controlled by small power, advantages, disadvantages.

3) Understand how the Power devices are used to make various industrial electronic systems like controlled rectifier, chopper, inverter etc.

Learning Outcomes:-

1) Students will acquire terminologies in Industrial electronic systems.

2) Students will be able to understand which device to be used for what applications.

3) Students will be able to understand how various industrial electronic systems work.

Module- 1: Power Electronic Devices

Introduction – Concept, Applications, Power electronic devices

Silicon Controlled Rectifiers (SCRs) – Static I-V characteristics, Switching on and off of SCR, SCR protection (Snubber circuits, overvoltage protection, overcurrent protection, gate protection), Heating, cooling and mounting

Members of Thyristor Family- LASCR, DIAC, TRIAC, ASCR, RCT; Triggering Devices- UJT, PUT

Module- 2: Turn ON and Turn OFF methods of SCR

Turn ON mechanism of SCR- High Voltage triggering, thermal triggering, Illumination triggering, dv/dt triggering Gate triggering.

Gate trigger circuits - R triggering circuit, RC triggering circuit, UJT triggering circuit (Operation, applications and limitations). Use of Pulse transformer in triggering circuit,

Turn OFF Circuits - Concept of Turn OFF / commutation mechanism of SCR through various methods

Module -3: Phase Controlled Rectifiers

Phase control – Basic concept (Firing Angle α and conduction angle θ)

Phase Control Rectifiers - Single phase half wave controlled rectifier with R, RL load, Effect of freewheeling diode; Single phase centre tapped full wave controlled rectifier with R, RL load; Effect of freewheeling diode; Single phase Bridge type full wave controlled rectifier with R, RL load; Effect of freewheeling diode (operation and waveforms). (Basic three phase half wave uncontrolled and controlled rectifier; Need and Uses of Poly phase rectifier.

Understand need and use of Isolation transformer and Power scope.

Module - 4: Choppers & Inverters

Choppers- Fundamental Concept, basic circuit and its operation using SCR and MOSFET Step Up and Step down Chopper

Inverters- Fundamental Concept, Need of an inverter, Classification of inverters, Important applications of inverter, Working principle of Series, Parallel, bridge inverter, Performance parameters of inverter.

Block diagram and working principle of SMPS and UPS.

Module – 5:

Tutorials, assignments, demonstrations and presentation based on Module I to IV

References:

1. Power Electronics - Dr. P.S. Bhimbra, Khanna Publishers, Fifth Edition, 2014 Reprint, New Delhi
2. Power Electronics - M.D. Singh, K. Khanchandani, Tata Mc. Graw Hill Publishers, Second Edition, 2008 Third Reprint, New Delhi
3. Industrial and Power Electronics - Deodatta Shingare, Electrotech Publication, Second Edition, 2004, Pune
4. Industrial Electronics – Terry Bartlet; Cengage Learning India Edition, Second Indian Reprint, 2006, New Delhi
5. Power Electronics Circuits Devices and Applications - Muhammad H. Rashid; Prentice Hall of India; Third Edition, Seventh Impression, 2009, New Delhi
6. Power Electronics and Its Applications - Alok Jain; Penram International Publishing (India) Pvt. Ltd., Second Edition, 2004, Mumbai