

INTRODUCTION TO POWER ELECTRONICS

Power Electronics is a field which combines Power (electric power), Electronics and Control systems. Power engineering deals with the static and rotating power equipment for the generation, transmission and distribution of electric power.

Electronics deals with the study of solid state semiconductor power devices and circuits for Power conversion to meet the desired control objectives (to control the output voltage and output power). Power electronics may be defined as the subject of applications of solid state power semiconductor devices (Thyristors) for the control and conversion of electric power.

Power electronics deals with the study and design of Thyristorised power controllers for variety of application like Heat control, Light/Illumination control, motor control – AC/DC motor drives used in industries, High voltage power supplies, Vehicle propulsion systems, High voltage direct current (HVDC) transmission.

1.1 BRIEF HISTORY OF POWER ELECTRONICS

The first Power Electronic Device developed was the Mercury Arc Rectifier during the year 1900. Then the other Power devices like metal tank rectifier, grid controlled vacuum tube rectifier, ignitron, phanotron, thyatron and magnetic amplifier, were developed & used gradually for power control applications until 1950. The first SCR (silicon controlled rectifier) or Thyristor was invented and developed by Bell Lab's in 1956 which was the first PNPN triggering transistor.

The second electronic revolution began in the year 1958 with the development of the commercial grade Thyristor by the General Electric Company (GE). Thus the new era of power electronics was born. After that many different types of power semiconductor devices & power conversion techniques have been introduced. The power electronics revolution is giving us the ability to convert, shape and control large amounts of power.

1.2 SOME APPLICATIONS OF POWER ELECTRONICS

Advertising, air conditioning, aircraft power supplies, alarms, appliances – (domestic and industrial), audio amplifiers, battery chargers, blenders, blowers, boilers, burglar alarms, cement

kiln, chemical processing, clothes dryers, computers, conveyors, cranes and hoists, dimmers (light dimmers), displays, electric door openers, electric dryers, electric fans, electric vehicles, electromagnets, electro mechanical electro plating, electronic ignition, electrostatic precipitators, elevators, fans, flashers, food mixers, food warmer trays, fork lift trucks, furnaces, games, garage door openers, gas turbine starting, generator exciters, grinders, hand power tools, heat controls, high frequency lighting, HVDC transmission, induction heating, laser power supplies, latching relays, light flashers, linear induction motor controls, locomotives, machine tools, magnetic recording, magnets, mass transit railway system, mercury arc lamp ballasts, mining, model trains, motor controls, motor drives, movie projectors, nuclear reactor control rod, oil well drilling, oven controls, paper mills, particle accelerators, phonographs, photo copiers, power supplies, printing press, pumps and compressors, radar/sonar power supplies, refrigerators, regulators, RF amplifiers, security systems, servo systems, sewing machines, solar power supplies, solid-state contactors, solid-state relays, static circuit breakers, static relays, steel mills, synchronous motor starting, TV circuits, temperature controls, timers and toys, traffic signal controls, trains, TV deflection circuits, ultrasonic generators, UPS, vacuum cleaners, VAR compensation, vending machines, VLF transmitters, voltage regulators, washing machines, welding equipment.

1.3 POWER ELECTRONIC APPLICATIONS

1.3.1 COMMERCIAL APPLICATIONS

Heating Systems Ventilating, Air Conditioners, Central Refrigeration, Lighting, Computers and Office equipments, Uninterruptible Power Supplies (UPS), Elevators, and Emergency Lamps.

1.3.2 DOMESTIC APPLICATIONS

Cooking Equipments, Lighting, Heating, Air Conditioners, Refrigerators & Freezers, Personal Computers, Entertainment Equipments, UPS.

1.3.3 INDUSTRIAL APPLICATIONS

Pumps, compressors, blowers and fans. Machine tools, arc furnaces, induction furnaces, lighting control circuits, industrial lasers, induction heating, welding equipments.

1.3.4 AEROSPACE APPLICATIONS

Space shuttle power supply systems, satellite power systems, aircraft power systems.

1.3.5 TELECOMMUNICATIONS

Battery chargers, power supplies (DC and UPS), mobile cell phone battery chargers.

1.3.6 TRANSPORTATION

Traction control of electric vehicles, battery chargers for electric vehicles, electric locomotives, street cars, trolley buses, automobile electronics including engine controls.

1.3.7 UTILITY SYSTEMS

High voltage DC transmission (HVDC), static VAR compensation (SVC), Alternative energy sources (wind, photovoltaic), fuel cells, energy storage systems, induced draft fans and boiler feed water pumps.