22EE208 POWER ELECTRONIC DEVICES AND CIRCUITS

Source: https://www.ncl.ac.uk/engineering/research/electrical-electronic-engineering/electrical-power/electronics/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of Electrical and Electronics Engineering, Analog Electronics.

COURSE DESCRIPTION AND OBJECTIVES:

Power electronics involves the study of electronic circuits intended to control the flow of electrical energy. It deals with the processing and control of 'raw' electrical power from an electrical source such as an AC mains supply, a battery bank, a photovoltaic array, or a wind turbine into a form quality suitable for a particular electrical load. It is an enabling technology with a very wide range of applications, such as military/avionic products, industrial products, transportation system, telecom products, medical equipments etc.

MODULE–1

UNIT-1 **15L+0T+10P=25 Hours**

POWER SEMI-CONDUCTOR DEVICES AND SINGLE PHASE CONTROLLED CONVERTERS:

Power Semi-Conductor Devices: Introduction, operation and characteristics of power devices (SCR, MOSFET, IGBT and GTO); Snubber Protection, Triggering and commutation of SCR.

Single Phase Controlled Converters: Study of semi and full bridge converters for R and RL loads; Analysis of load voltage - derivations of form factor and ripple factor; Effect of source impedance. Performance parameters.

UNIT-2 **09L+0T+06P=15 Hours**

THREE PHASE:

Study of semi and full bridge converters for R and RL loads, Load voltage and current waveforms. Performance parameters.

PRACTICES:

- Study of characteristics of SCR, MOSFET & IGBT.
- Gate firing circuits for SCR's.
- Forced commutation circuits (Class A, Class B, Class C, Class D & Class E).
- Single phase fully controlled bridge converter with R and RL loads (MATLAB Simulation & Hardware).
- Single phase half controlled converter with R load (MATLAB Simulation & Hardware).

MODULE–2

UNIT-1 **15L+0T+10P=25 Hours**

CHOPPERS AND AC-AC CONVERTERS:

Choppers: Analysis of step-down (Buck Converter) and step-up (Boost Converter), Control strategies-time ratio and current limit control; Analysis of fly-back, forward converters for SMPS.

AC-AC Converters: Single phase AC voltage regulators with R and RL loads, Sequence control of AC voltage regulators; Single phase to single phase cyclo converter - step up and step down with R and RL loads.

SKILLS:

- ✓ *Understand the switching characteristics of various power semi conductor devices.*
- ✓ *Design the commutation circuits for SCRs based on application.*
- ✓ *Design a SCR based controlled converter for given specifications.*
- ✓ *Design a buck converter for given specifications.*
- ✓ *Design a boost converter for given specifications.*
- ✓ *Design a PWM generator for given duty ratio.*

UNIT-2 **09L+0T+06P=15 Hours**

INVERTERS:

Principle of operation of single phase full bridge square wave, Quasi-square wave, PWM inverters and comparison of their performance; Three phase inverters (120 & 180 degree); voltage control of single and three phase inverters.

PRACTICES

- DC-DC non isolated converters (Buck , boost) (MATLAB Simulation & Hardware).
- Single phase cyclo-converter with R and RL loads.
- Single phase series inverter with R and RL loads.
- Single phase parallel inverter with R and RL loads.
- Single phase AC Voltage Controller with R and RL Loads (MATLAB Simulation & Hardware).

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Selection of Power Semiconductor device as per application of converter.	Apply	1	1, 2, 6, 9
2	Compare the operation of two, three and six pulse converters and draw output waveforms with / without source and load inductance.	Analyse	1	1, 2, 9, 12
3	Classify choppers and outline the applications of SMPS.	Analyse	2	1, 2, 3, 9, 12
4	Design and analysis of DC/AC, AC/DC and AC/AC converters through experimentation.	Create	1, 2	1, 2, 9, 12
5	Illustrate the operation of AC voltage controller, cyclo-converter and its application.	Create	2	1, 2, 3, 9, 12

TEXT BOOKS:

1. Dr. P.S. Bimbra, “Power Electronics” 4th edition, Khanna publishers, 2021.
2. M.D. Singh and K.B. Khanchandani, “Power Electronics”, 2nd edition, Tata Mc-Graw Hill, 2017.

REFERENCE BOOKS:

1. Vedam Subrahmanyam, “Power Electronics Devices, Converters, Application”, 1st edition, New Age International, 2015.
2. Ned mohan, Tore M.Undeland and William P. Robbins, “Power Electronics Converters, Applications and Design”, 3rd edition, Wiley, 2022.