R18

Code No: 155CU

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, January - 2025

POWER ELECTRONICS

(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) List the major applications of power electronics in modern systems. [2]
b) Briefly explain natural commutation in thyristor circuits. [3]
c) How does an RLE load affect the performance of a single-phase fully-controlled converter? [2]
d) Explain the role of gating circuits in controlling the operation of a phase-controlled rectifier. [3]
e) What is the role of switching devices in DC-DC converters? [2]
f) Describe the steady-state waveforms of a buck converter. [3]
g) What are the key performance parameters of an inverter? [2]
h) How does the modulation index affect the output voltage and harmonic content in SPWM for single-phase inverters? [3]
i) What are the key factors to consider when designing a single-phase AC voltage regulator for an RL load? [2]
j) Compare the output quality of a cyclo-converter with that of a phase-controlled voltage regulator. [3]

PART – B

(50 Marks)

2. Explain the scope and applications of power electronics in various industries. Highlight how it is utilized in renewable energy, transportation, and industrial automation systems. [10]

OR

3.a) Explain the need for protection circuits in thyristors.
b) Discuss the working of a snubber circuit and its role in providing dv/dt protection. [5+5]

4. Analyze the operation of a single-phase half-controlled rectifier with an RL load. Include relevant waveforms and discuss the effect of the load on output voltage and current. [10]

OR

5. Describe the operation of a three-phase dual converter. How does it differ from the single-phase dual converter, and what are its applications in industrial systems? [10]

6.a) Describe the power circuit and steady-state waveforms of a boost converter.

b) Briefly explain the relationship between the duty ratio and the average output voltage in a boost converter with derivation. [6+4]

OR

7. Explain the working principle and power circuit of a buck-boost converter. Derive the relationship between the duty ratio and the average output voltage, and discuss the conditions under which the output voltage can be both greater than and less than the input voltage. [10]

8. Explain the three-phase 180° conduction mode of inverter with relevant waveforms. [10]

OR

9. Discuss the role and concept of modulation techniques in reducing harmonics and its effect on the harmonic spectrum in inverter output and describe how different modulation strategies impact harmonic content and efficiency. [10]

10. Explain the working principle of a single-phase voltage controller for an R load with detailed discussion on the effect of the firing angle on the output voltage waveform. Describe its applications in power systems. [10]

OR

11.a) What are the applications of cyclo-converters in industries such as steel manufacturing, traction, and motor drives?

b) Discuss how the cyclo-converter's ability to provide variable frequency and voltage contributes to these applications. [5+5]

---ooOoo---