Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S3 (PT) (S, FE) Examination June 2024 (2015 Scheme)

Course Code: EE305

Course Name: POWER ELECTRONICS

Max. Marks: 100   Duration: 3 Hours

(Graph sheets may be supplied on demand)

PART A

Answer all questions, each carries 5 marks.   Marks

1   Explain the working of thyristor using two-transistor analogy.   (5)

2   Describe, using neat circuit diagram, the RC triggering circuit for SCR.   (5) Mention its one major advantage over R triggering.

3   Explain and justify the theory of firing angle control for ideal dual converter   (5)

4   Sketch the diagram and output voltage waveform of a single-phase half bridge   (5) Voltage Source Inverter with R load and describe the working.

5   A single-phase full wave ac voltage controller (with two thyristors) has a   (5) resistive load of 10 Ω and input voltage is 120 V (rms), 60 Hz. The delay angle of both thyristors is $\pi/2$. Determine (i) rms output voltage (ii) input power factor (iii) average current of thyristors.

6   Explain single-phase full bridge inverter using single pulse modulation   (5) technique of voltage control.

7   With circuit diagram and waveforms, describe the working of Type-E chopper.   (5)

8   A boost regulator has an input voltage of 5 V. The average output voltage is 15   (5) V and average load current is 0.5 A. The switching frequency is 25 kHz. If inductance = 150 μH (in series with input side) and capacitance of 220 μF (parallel to output), determine (i) duty cycle (ii) ripple current of inductor ΔI.

PART B

Answer any two full questions, each carries 10 marks.

9   a)   Explain neatly the structure, principle of operation and symbol of GTO.   (5)

     b)   SCR with rating 1000 V and 200 A are available to be used in a string to handle   (5)

6 kV and 1 kA. Calculate the number of series and parallel units needed, if the derating factor is 0.1

10 a) Describe the variation of current and voltage during turn- on time of an SCR. (5)
Sketch relevant switching characteristics for the explanation

b) With the help of neat circuit diagrams, discuss 2 types of isolated gate (5)
triggering circuits for a thyristor. Also compare these two.

11 a) A single phase fully controlled bridge rectifier supplies a RLE load. The (5)
inductance L in the circuit is so large that the output current may be considered
to be virtually constant. Assume ideal SCRs used.
RMS supply voltage = 220 V, load resistance = 0.5 Ω, output dc current = 10
A. Determine:
(i) firing angle (α), if E = 135 V
(ii) Which source (ac or dc) is supplying power in the above case?

b) Describe a single-phase half-controlled converter with RL load along with (5)
necessary circuit diagram and waveforms.

PART C

Answer any two full questions, each carries10 marks.

12 Draw the circuit diagram and explain with necessary waveforms the working of (10)
3-phase fully controlled rectifier with RLE load for firing angel $\alpha = 60°$. Derive
the expression for output voltage.

13 a) Explain advantages and disadvantages of circulating type dual converter with (5)
that of non-circulating current type.

b) Differentiate CSI from VSI. (5)

14 Draw the circuit and explain the operation of a 3-phase bridge inverter with R (10)
load, operating in 180° conduction mode. Draw the output line voltage and
phase voltage waveforms. Derive expressions for output line voltage and phase
voltage.

PART D

Answer any two full questions, each carries 10 marks.

15 a) Distinguish the terms amplitude modulation index and frequency modulation (5)
index in sine PWM technique. How it affects the inverter output voltage.

b) Explain, with circuit diagram and relevant waveforms, the working of two-stage sequence controller with R load. (5)

16 a) In a multiple-pulse modulation method, five pulses are generated per half cycle of the reference signal. If the supply voltage is 220 V (rms), calculate the pulse width for an output voltage of 160 V (rms). (5)

b) Explain the working of a buck converter, with the help of a neat circuit diagram and waveforms of output voltage, inductor current and inductor voltage. (5)

17 a) A type-A chopper has dc source voltage 230 V, load resistance is 10 Ω. The voltage-drop across chopper during turn-on is 2 V. For a duty cycle of 0.4, calculate average and rms values of output voltage. (5)

b) With the help of relevant waveforms, derive the expression for output voltage of a Buck-Boost converter in continuous conduction mode of operation. (5)

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