

Register No.: Name:

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), MAY 2024 ELECTRICAL AND ELECTRONICS ENGINEERING (2020 SCHEME)

Course Code : 20EET306

Course Name: POWER ELECTRONICS

Max. Marks : 100

Duration: 3 Hours

PART A

(Answer all questions. Each question carries 3 marks)

1. Explain the optocoupler method of isolation.
2. With neat diagram, explain the structure of IGBT.
3. Explain the need of connecting freewheeling diode across load in a controlled rectifier.
4. Obtain an expression for average DC output voltage of a 1-phase half wave rectifier for RL load with firing angle.
5. Define Total Harmonic Distortion and Distortion factor.
6. Compare unipolar and bipolar pulse width modulation techniques applied to inverters.
7. Draw and explain class B chopper.
8. Buck-boost converter is referred to as an indirect converter. Justify.
9. With block diagram, explain an electric drive.
10. How are the load torque classified? Give an example for each type of load torque.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Sketch and explain the VI characteristics of SCR. Define latching current (8) and holding current.
b) Explain the significance of di/dt and dv/dt protection in thyristors and (6) describe the method employed for improving the same.

OR

12. a) Deduce the two-transistor model for a thyristor. Derive an expression (8) for anode current and based on this, list turn-on methods for SCR.
b) Explain reverse recovery characteristics of power diode with suitable (6) diagram.

MODULE II

13. a) Explain the working of RL load fed single phase fully controlled converter(10) for firing angle $\alpha = 60^\circ$ and $\alpha = 120^\circ$. Assume RL Load with large inductance. Sketch source voltage, load voltage and load current waveforms for both the cases.
- b) A single phase semiconverter has a load consisting of $R = 10 \Omega$ and $X_L = 50 \Omega$. The supply voltage is 230 V, 50 Hz. The thyristor is triggered at an angle of 30° . Check whether the load current is continuous and find the average value of the load voltage.
Hint : $\alpha < \phi$ current is continuous

OR

14. a) With the help of circuit diagram explain the working of three phase (10) fully controlled converter feeding a RL load with large inductance for $\alpha = 30^\circ$. Draw the source voltage, load voltage and load current waveforms
- b) A three phase fully controlled rectifier feeds a resistive load of 10Ω . The (4) supply voltage is 400 V, 50 Hz. Find the average value of output voltage if the firing angle is a) 45° , b) 60° .

MODULE III

15. a) Explain with circuit diagram and waveform, the working of a single- (8) phase full bridge inverter with RL load. Derive RMS value of output voltage.
- b) Derive an expression for RMS output voltage of resistive load fed (6) single-phase AC voltage regulator.

OR

16. a) Illustrate the operation of a three-phase voltage source bridge inverter(10) operating in 180° conduction mode with output line voltage and phase voltage waveform.
- b) Compare voltage source and current source inverters. (4)

MODULE IV

17. a) With circuit diagram, explain the working of Type E Chopper. (8)
- b) Explain the different types of control methods used in choppers. (6)

OR

18. a) With circuit diagram and relevant waveforms, derive the expression for (8) output voltage of a Boost regulator.
- b) Design a boost converter for an output of 30 V from a 12 V source. (6) Design for continuous inductor current and an output ripple voltage of less than 1%. The load is a resistance of 50Ω . Assume ideal components for this design and switching frequency as 25 kHz. Determine (a) Duty cycle (b) the filter inductance L (c) the filter capacitor C.

MODULE V

19. a) Explain regenerative braking control as applied to a separately excited (8)
DC Motor.
b) Explain the operation of a dual converter used for the speed control of (6)
a DC motor drive.

OR

20. a) Explain v/f control in Induction motor drive. (8)
b) Explain the working of a four-quadrant chopper drive. (6)
