

**Bihar Engineering University, Patna**  
**B.Tech. 5<sup>th</sup> Semester Examination, 2023**

Course: B.Tech.  
Code: 100506

Subject: Power Electronics

Time: 03 Hours  
Full Marks: 70

**Instructions:-**

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

**Q.1 Choose the correct answer of the following (Any seven question only):** **[2 x 7 = 14]**

- (a) Which of the given device is the most suitable power device for a higher frequency switching application.  
(i) SCR                      (ii) Power MOSFET                      (iii) GTO                      (iv) BJT
- (b) A single-phase controlled, a full-bridge converter is supplying a highly inductive DC load. The conductor is fed from a 220 V, 50 Hz, ac source. Find the fundamental frequency in Hz of the voltage ripple on the dc side  
(i) 300 Hz                      (ii) 220 Hz                      (iii) 100 Hz                      (iv) 50 Hz
- (c) The peak reverse recovery current of a power diode depends on \_\_\_\_\_.  
(i) peak inverse voltage                      (ii) temperature  
(iii) rate of current flow and storage charge                      (iv) storage charge
- (d) IGBT & BJT both possess \_\_\_\_\_.  
(i) low on-state power losses                      (ii) high on-state power losses  
(iii) low switching losses                      (iv) high input impedance
- (e) The SCR in forward blocking mode is \_\_\_\_\_.  
(i) in on state                      (ii) in natural state  
(iii) forward biased state                      (iv) in off state
- (f) In a thyristor-controlled rectifier, the firing angle of thyristor is to be controlled in the range of \_\_\_\_\_.  
(i) 0° to 90°                      (ii) 0° to 180°                      (iii) 90° to 180°                      (iv) 90° to 270°
- (g) A four-quadrant chopper can not be operated as \_\_\_\_\_.  
(i) Thyristor                      (ii) Cycloconverter  
(iii) One quadrant chopper                      (iv) Inverter
- (h) How many switches are used to build a three-phase to three-phase cycloconverter?  
(i) 10                      (ii) 14                      (iii) 18                      (iv) 24
- (i) In a step-down chopper, if  $V_s=100$  V and the chopper is operated at a duty cycle of 75%. Find the output voltage.  
(i) 25 V                      (ii) 75 V                      (iii) 100 V                      (iv) none of these
- (j) The thyristor is equivalent to a thyatron tube is \_\_\_\_\_.  
(i) SCR                      (ii) BJT                      (iii) TRIAC                      (iv) GTO

- Q.2**
- (a) A single-phase full converter delivers ripple current to RL load with  $R=10 \Omega$ . The source voltage is 200 V, 50 Hz. For a given firing angle of 30°, find rectification efficiency, voltage ripple factor, total harmonic distortion (THD). **[7]**
  - (b) Describe the structural features of power diode. How do the power diode differ from signal diode? **[7]**

- Q.3** (a) A battery is charged through a resistor R as shown in the Fig.1. If  $V_s = 220 \sin(\omega t)$  V,  $E = 80$  V, and  $R = 10 \Omega$ , calculate the battery charging current and power supplied to the battery. [10]

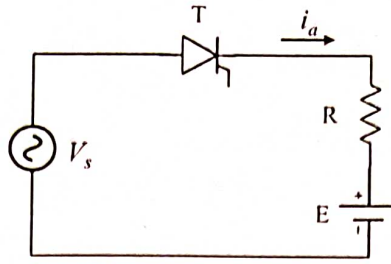


Fig.1

- (b) Write down any four applications of SCR. [4]
- Q.4** (a) A chopper has a resistive load of  $20 \Omega$  and input voltage  $V_s = 220$  V. When the chopper is ON, its voltage drop is 1.5 volts and chopping frequency is 10 kHz. If the duty cycle is 80%, determine the average output voltage and the chopper on time. [10]
- (b) Write about "Class A Chopper". Also draw suitable diagram. [4]
- Q.5** (a) Explain the I-V characteristics of a thyristor. Label the various voltages, currents and the operation modes. [7]
- (b) A 3-phase full converter delivers a ripples free load current of 10 A with a firing delay of  $45^\circ$ . The input voltage is 3-phase, 400 V, 50 Hz. Draw the waveform for source current and write the expression of Fourier series. Also, calculate the input power factor and THD. [7]
- Q.6** (a) A 3-phase bridge inverter delivers power to a resistive load from a 450 V DC source. For a star-connected load of  $10 \Omega$  per phase, determine the following for  $120^\circ$  model of operation: [9]
- RMS value of output line voltage
  - RMS value of load current
  - Load power factor.
- (b) Explain the process of  $dv/dt$  triggering and temperature triggering. [5]
- Q.7** (a) Write about voltage commutation and current commutation of a thyristor. [7]
- (b) Explain voltage source inverter and current source inverter. [7]
- Q.8** With the help of equivalent circuit, obtained the nature of waveform of phase voltage of a star connected resistive load fed from a three phase DC to AC bridge inverter operating in  $120^\circ$  conduction time. [14]
- Q.9** Write short notes on *any two* of the following: [7x2=14]
- Boost converter
  - Firing circuits for thyristor
  - Current source inverter

