

**CS/B.Tech/(ECE-New)/SEM-7/EC-705D/2013-14**

**2013**

**POWER ELECTRONICS**

**3 Hours**

**Full Marks : 70**

*figures in the margin indicate full marks.*

*are required to give their answers in their own words  
as far as practicable.*

**GROUP - A**

**( Multiple Choice Type Questions )**

**Choose the correct alternatives for any ten of the following :**

**10 × 1 = 10**

**Latching current can be defined as**

- a) minimum value of anode current to maintain continuous conduction
- b) maximum value of anode current to maintain continuous conduction
- c) minimum value of anode current below which SCR turns off
- d) maximum value of anode current above which the SCR turns off.

**[ Turn over**

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- ii) If gate current of SCR is increased, then forward break over voltage will
- a) increase                      b) decrease
- c) remain same                  d) become zero.
- iii) Function of snubber circuit is connected across SCR to
- a) increase  $\frac{dv}{dt}$                   b) decrease  $\frac{di}{dt}$
- c) suppress  $\frac{dv}{dt}$                   d) none of these.
- iv) Complementary communication is
- a) Class C chopper              b) Class D chopper
- c) Class B chopper              d) Class E chopper.
- v) Chopper control of DC motors provides variation in
- a) input voltage                  b) frequency
- c) current                          d) all of these.
- vi) A chopper can be used on
- a) PWM only                      b) FM only
- c) AM only                          d) both PWM and FM.

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The softness factor for soft recovery diodes is

- a) 1                                  b) >1
- c) <1                                d) -1.

The average current rating of a semiconductor diode will be maximum for

- a) full wave rectified ac      b) half-wave rectified ac
- c) pure ac                        d) pure dc.

Capacitor filter is ideal for currents which are

- a) small                          b) medium
- c) large                          d) very large.

When a thyristor is forward biased the number of blocked p-n junction is

- a) 1                                  b) 2
- c) 3                                  d) 4.

xi) A boost converter has  $V_s$  as the source voltage,  $\alpha$  as the duty cycle. The output voltage of the converter is given by

- a)  $V_s(1 + \alpha)$                       b)  $V_s / (1 + \alpha)$
- c)  $V_s / (1 - \alpha)$                       d)  $V_s(1 - \alpha)$ .

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xii) The advantage of switched mode power supply over linear power supply is

- a) less maintenance and longer life
- b) higher regulation and low cost
- c) reduced size and increased efficiency
- d) reduced cost and simplified circuitry.

xiii) Which of the following power semiconductor devices has the maximum switching frequency range ?

- a) TRIAC
- b) MOSFET
- c) Thyristor
- d) Power transistor.

#### GROUP - B

##### ( Short Answer Type Questions )

Answer any three of the following.  $3 \times 5 = 15$

2. Why  $\frac{dv}{dt}$  protection is necessary in SCR ? Explain the turn on process of an IGBT.
3. In a single-phase full controlled converter with RL load, find the average value of the output voltage with and without freewheeling diode. The supply voltage is 100V, 50 Hz. Consider continuous conduction mode.
4. Explain with the help of circuit diagram, the principle of operation of Boost converter. Deduce the expression of output voltage of such converter.

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What is the need of communication circuit ? Describe in brief the operation of an impulse communication circuit.

What are the basic properties of power diodes ? Mention the differences from general purpose diodes.

#### GROUP - C

##### ( Long Answer Type Questions )

Answer any three of the following.  $3 \times 15 = 45$

Explain the operation of a Buck converter with necessary diagram and waveforms. 7

A dc battery is charged from a constant dc source of 220 V through a chopper. The dc battery is to be charged from its internal emf of 90 V to 122 V. The battery has internal resistance of 1 ohm. For a constant charging current of 10A, calculate the range of duty cycle. 5

c) Explain why high switching frequency is advantageous for SMPS ? 3

a) A single-phase full controlled converter has an input supply voltage of 230V at 50 Hz. The load is highly inductive with a load resistance of  $R = 10$  ohms, Firing angle  $\alpha = 30^\circ$ . Calculate —

- i) dc output voltage
- ii) average load current
- iii) active power output
- iv) the r.m.s. value of input current and input p.f. 6

- b) Show the effect on output voltage, power and input p.f. when a free wheeling diode is connected across the load. 5
- c) In the above case, what happens if  $\alpha$  is increased beyond  $90^\circ$ . Explain whether inversion operation is possible with  $R$ - $L$  load. 4
9. a) Explain the principle of working of a three-phase bridge inverter with necessary circuit diagram. Assume  $120^\circ$  mode of conduction. Also draw the triggering sequence of each SCR, waveform of phase and line voltages. 8
- b) A single-phase full bridge inverter has  $R = 4 \text{ ohm}$ ,  $L = 35 \text{ mH}$ . The dc output voltage is  $230 \text{ V}$  and the output frequency is  $50 \text{ Hz}$ . Determine —
- i) the r.m.s. value of the fundamental load current
  - ii) the power absorbed by the load
  - iii) the r.m.s. and peak current of each SCR. 7
10. a) What is a cycloconverter? 3
- b) Explain the operation of dual converter (circulating and non-circulating current mode). 4
- c) A single-phase half-wave ac voltage controller feeds a load of  $20 \Omega$  with an input voltage of  $230 \text{ V}$ ,  $50 \text{ Hz}$ . Firing angle of thyristor is  $45^\circ$ . Determine (a) r.m.s. value of output voltage, (b) power delivered to load and input p.f. and (c) average input current. 8

Write short notes on any three of the following :

3 × 5

1. GTO

2. Class C commutation

3. Dynamic characteristics of IGBT

4. MTO

5. Schottky barrier diode.

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