Code: A-26

Subject: POWER ELECTRONICS

December 2005

Time: 3 Hours

Max. Marks: 100

NOTE: There are 9 Questions in all.

• Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.

Code: A-20

- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or best alternative in the following:

(2x10)

- a. The device which has the highest reverse blocking voltage is
 - (A) MOSFET.

(B) BJT.

(C) SCR.

- (D) IGBT.
- b. The relation between α_1 and α_2 , in a three phase dual converter is

(A)
$$\alpha_1 + \alpha_2 = 180^{\circ}$$

(B)
$$\alpha_1 - \alpha_2 = 180^{\circ}$$

(C)
$$\alpha_1 + \alpha_2 = 360^{\circ}$$

(D)
$$\alpha_1 + \alpha_2 = 0^{\circ}$$

- c. A class D chopper operates in
 - (A) a single quadrant.

(B) two quadrants.

(C) three quadrants.

- (D) four quadrants.
- d. A single phase Dual Converter uses
 - (A) natural commutation.
 - **(B)** forced commutation.
 - (C) both natural and forced commutation.
 - (D) none of this.
 - e. The output RMS voltage of a single phase AC voltage controller in on-off control mode with n cycles ON and m cycles OFF is

$$\mathbf{(A)} \quad \mathbf{v_0} = \mathbf{v_s} \left(\frac{\mathbf{n}}{\mathbf{m} + \mathbf{n}} \right)$$

$$\mathbf{(B)} \quad \mathbf{v}_{0} = \mathbf{v}_{s} \left(\frac{\mathbf{n}}{\mathbf{m} + \mathbf{n}} \right)^{2}$$

(C)
$$v_0 = v_s \sqrt{\frac{n}{m+n}}$$

$$\mathbf{(D)} \quad \mathbf{v}_{0} = \sqrt{\mathbf{v}_{s}} \left(\frac{\mathbf{n}}{\mathbf{m} + \mathbf{n}} \right)$$

- f. The minimum number of thyristors required for constructing a single phase cycloconverter is
 - **(A)** 2

(B) 4

(C) 8

- **(D)** 6
- g. The modulation technique that is used for harmonic minimisation is
 - (A) single pulse width modulation.
 - **(B)** multi pulse width modulation.
 - (C) sinusoidal pulse width modulation.
 - (**D**) none of the above.
- h. In the case of rheostatic braking
 - (A) power is fed back to source.
- **(B)** power is wasted in the form of heat.
- **(C)** power is stored in battery.
- **(D)** none of the above.
- i. The frequency of the average output D.C. voltage in the case of a three phase full bridge uncontrolled rectifier is
- **(A)** 12 times supply frequency.
- **(B)** 6 times supply frequency.
- **(C)** 3 times supply frequency.
- **(D)** 2 times supply frequency.
- j. The triac is a
 - (A) bi-directional uncontrolled switch.
 - **(B)** bi-directional controlled switch.
 - (C) unidirectional uncontrolled switch.
 - (D) unidirectional controlled switch.

Answer any FIVE Questions out of EIGHT Questions. Each question carries 16 marks.

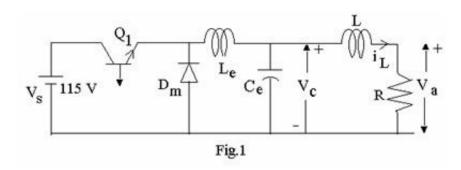
- Q.2 a. Draw the V-I characteristics of the SCR and explain the terms 'latching current' and 'holding current'. (10)
 - b. Compare the salient features of SCR and MOS-controlled thyristor. (6)
- Q.3 a. Explain the inversion mode of operation with waveform for a single-phase fully controlled Bridge converter.
 - b. Calculate the output dc voltages of a 3-phase fully controlled bridge ac-dc converters for

2/14/12 Code: A-20

constant load current with (i) firing angles of 0° , 30° , 45° and 60° . Assume a thyristor drop of 1.5 V and an ac line voltage of 220 V.

(8)

- Q.4 a. Explain the operation of a resonant pulse chopper with waveforms. (8)
 - b. A buck chopper is shown in Fig.1. The input voltage is V_s =115V, the average load voltage is V_a =62V, and the average load current is I_a =24A. The chopping frequency is f=25 KHz. The peak-to-peak ripples are 2.5% for load voltage, 6% for load current, and 12% for filter L_e current. Determine the values of L_e , L and C_e . (8)



- Q.5 a. Explain line side commutation with a circuit diagram and derive the expression for circuit turn-off time. (10)
 - b. Explain the process of 'natural commutation'. (6)
 - Q.6 a. Explain the operation of a single phase A.C. voltage controller with an inductive load. (8)
 - b. Explain single phase tap changing transformer operation with waveforms. (8)
- Q.7 a. Explain the operation of a single-phase cyclo-converter with RL load. (8)
 - b. Explain the technique for reduction of output harmonics in a cyclo-converter.

 (8)
 - Q.8 a. Explain the multiple pulse-width modulation technique for a single-phase inverter, with waveforms. (10)
 - b. Compare multiple pulse-width modulation with sinusoidal pulse-width modulation. (6)
- Q.9 a. With a neat block diagram describe the speed control of a d.c. drive. (10)
 - b. Draw the speed torque characteristics of A.C. induction motor for variable speed drive

2/14/12 Code: A-20

application.

(6)