Roll No. ..... Total Pages : 3

BT-7/M-21 **47134**

POWER ELECTRONICS

Paper–ECE-405N

Time Allowed : 3 Hours] [Maximum Marks : 75

Note : Attempt **five** questions in all, selecting at least **one** question from each Unit. All questions carry equal marks.

UNIT–IZ

1. (a) Explain, how Power electronics is different from Conventional electronics with the help of suitable examples. Also discuss merits and demerits of each one of them. 7

   (b) Describe a Power electronics converter giving its types and applications with suitable examples. 8

2. (a) Enumerate various types of Power transistors. Explain its working by sketching its various characteristics. Also explain, how it is different from Conventional transistors. 9

   (b) Discuss the power loss in a Diode during the reverse recovery transients. If the forward characteristic of a power diode can be represented by $v_f = 0.88 + 0.015i_f$, determine the average power loss and rms current for a constant current of 50A for 2/3 of a cycle. Describe in detail various protection schemes employed for bus-bar protection with the help of suitable illustrations. 6

UNIT–II

3. Explain construction, working and characteristics of a Thyristor with the help of a neat schematic diagram. Three series connected Thyristors, provided with Static and Dynamic equalizing circuits, have to withstand an off-state voltage of 8 kV. The static equalizing resistance is 8 $k\Omega$ and the dynamic equalizing circuit has $R_c = 40\ \Omega$ and $C = 0.06\ \mu F$. These three thyristors have leakage currents of 25 mA, 23 mA and 22 mA respectively. Determine voltage across each SCR in the off-state and the discharge current of each capacitor at the time of turn on. 15

4. (a) Discuss with relevant Waveforms class A and class D types of Communications employed for Thyristors. 9

(b) For the circuit shown in Fig. 1, peak thyristor current = 2.5 times the constant local current L = 18 μH and C = 4μF. Find the time elapsed form the instant thyristor is turned on to the instant it gets turned off. 6

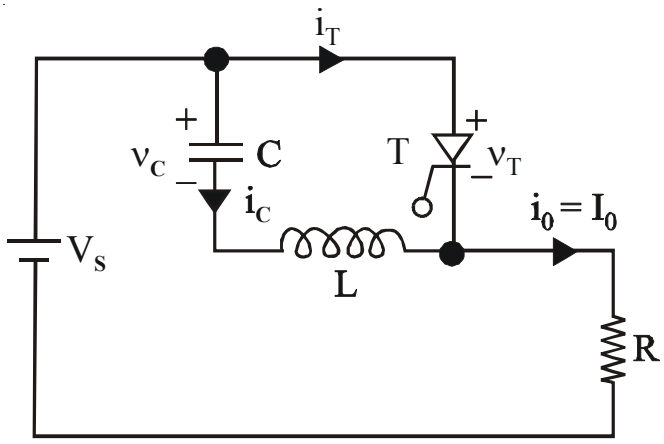

Fig. 1.

UNIT–III

5. A single phase one pulse SCR controlled converter feeds an RL load with a freewheeling diode across the load. Discuss, how freewheeling diode comes into play when supply voltage is passing through zero and becoming negative. Sketch waveforms for supply and load voltages, load current, supply current, freewheeling diode current and voltage across the SCR. Also, derive expressions for the load current as a function of time during conduction as well as freewheeling periods. Derive an expression for average load current as well. 15

6. (a) Sketch output voltage waveform for a 3-phase semiconverter for a firing angle delay of 75°. Indicate the conduction of various elements and discuss whether freewheeling diode comes into play on the assumption of continuous load current. Hence obtain an expression for the average output voltage by using both sine and cosine functions for the supply voltage. 7

(b) A separately excited dc motor fed from 3-phase semiconverter develops a full load torque at 1500 rpm when firing angle is zero, the armature taking 50 A at 400 A dc and having an armature circuit resistance of 0.5 Ω. Calculate the supply voltage per phase. Find also the range of firing angle required to give speeds between 1500 rpm and 750 rpm at full load torque. 8

UNIT–IV

7. (a) For a single phase voltage controller, develop a relation between conduction angle γ and firing angle α and plot their variation as a function of load phase angle ϕ. Under what conditions conduction angle γ becomes equal to π?

   (b) Discuss the operation of a single phase voltage controller with RL load when firing angle α is less than, or equal to, load phase angle ϕ. Hence show that for α less than ϕ, output voltage of the ac voltage controller cannot be regulated.

   (c) For a single phase voltage controller, discuss, how pulse gating is suitable for R load and not for RL load. Hence show that high frequency carrier gating is essential for RL loads. 15

8. (a) Discuss, why 3-phase to 1-phase cycloconverter requires positive and negative group phase controlled converters. Under what conditions, the groups work as inverters or rectifiers. How should the firing angles of the two converters be controlled ? 8

   (b) Describe 3-phase to 3-phase cycloconverter with relevant circuit arrangements using 18 SCRs and 36 SCRs. What are the advantages of 3-phase bridge circuit cycloconverter over 18-thyristor device ? 7

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