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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; June - 2017

Power Electronics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Justify any assumptions made.

UNIT - I

1 a. What is power electronics? What are the bases on which switching devices are classified? Give examples. 10

b. What are the relative advantages of 1GBTs over BJTs and MOSFETs? 4

c. Explain the peripheral effects of power converters and the remedies for the same. 6

2 a. Draw the switching model and switching waveforms of power MOSFET and define the switching times. 8

b. With the help of neat diagrams, explain the need to isolate the gate and base drives. Mention the methods used. 6

c. For the BJT switch of Fig. Q2(c)

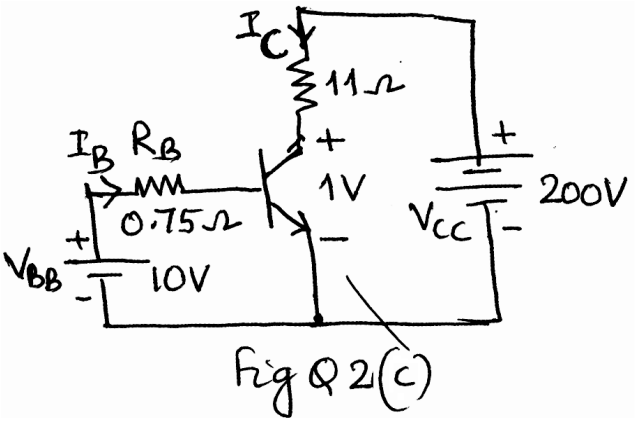

Fig Q 2(c) 6

(i) Calculate the force beta β_f of the transistor

(ii) Of the manufacture's specified β is in the range 8 to 40, calculate the minimum Overdrive Factor (ODF)

(iii) Obtain the powerless P_T of the transistor.

UNIT - II

3 a. Distinguish between converter grade and inverter grade thyristors mentioning their applications. 4

b. List the advantages of GTOs over BJTs and SCRs. 8

Contd….2

c. A thyristor string is formed by the series and parallel connection of thyristors. The voltage and current ratings of the strings are 6 kV and 4 kV respectively. Available thyristors have the voltage and current ratings 1.2 kV and 1 kA respectively. The string efficiency is 90% for the both series and parallel connections. Calculate the number of thyristors to be connected in series and parallel, if the maximum blocking current is 15 mA and ΔQ_{max} = 25 μC. Calculate the values of R and C. 8

4a. Briefly explain the different ways of turning on the thyristors. Which is the most widely used one? 6

b. Explain the need to protect thyristors against: (i) high di/dt and (ii) high dv/dt. Also mention the methods used for the same. 7

c. Design a UJT triggering current. The parameters of the UJT are V_S = 30 V, η = 0.51, V_v = 3.5 V, I_p = 10 μA and I_V = 10 mA. The frequency of oscillations is f = 60 Hz and the width of the triggering pulse is t_g = 50 μs. Assume V_D = 0.5 V. 7

UNIT - III

5 a. For a single phase full wave ac voltage controller feeding an RL load, draw the waveforms of source voltage, gating signals, output voltage, source and output current and voltage across one SCR. Briefly explain the operation of the circuit. 10

b. For a single phase half-wave ac voltage controller has a resistive load of R = 5 Ω and input voltage V_s = 120 V, 60 Hz. The delay angle of the thyristor are α = $\pi/3$. Determine; 10

(i) rms output voltage (ii) input power factor (iii) average input current.

6 a. A single phase half-wave converter (Controlled HWR) is operated from a 120 V, 50 Hz supply and the load resistance is R = 10 Ω. If the average output voltage is 25% of the maximum possible average output voltage. Calculate ;

(i) Delay angle α 10

(ii) The rms and average valves of output current

(iii) rms and average values of thyristor current

(iv) The input power factor.

b. Draw the circuit arrangement of a single phase fully controlled bridge converter feeding an RLE load. Sketch the ac supply voltage, firing signals, output voltage and the load current waveforms. Assuming continuous current mode of operation, derive the expression for the DC output voltage. 10

UNIT - IV

7 a. Briefly explain the principle of step-down chopper and the two control strategies used with choppers. Mention any two important applications of choppers. 10

Contd….3

b. A step-down chopper is reading an RLE load, if the supply voltage V_s = 220 V dc, R = 5 Ω, L = 7.5 mH, f = 1 kHz and E = 0 V. Calculate;
(i) The minimum and maximum values of the instantaneous load current
(ii) Maximum peak to peak load ripple current
(iii) Average value of load current
(iv) rms value of load current
(v) Effective input resistance. 10

8 a. Show how the principle of step-up chopper can be used to transfer energy from a low voltage dc source to high voltage dc source. 6

b. Briefly explain the following classes of choppers :
(i) Second quadrant chopper
(ii) First and second quadrant chopper. 6

c. For the chopper shown in Fig. Q8 (c) the DC source voltage is 230 V. The load resistance is R = 10 Ω. If the on state voltage drop across the chopper switch is 2 V and the duty cycle of the chopper is 0.4, Calculate;
i) The average and rms values of output voltage
ii) The chopper efficiency. 8

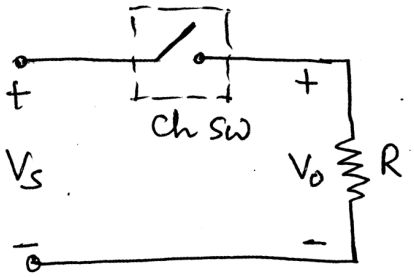

Fig Q 8(c)

UNIT - V

9 a. With the help of a neat circuit diagram and relevant waveform, explain the working of a single phase half bridge inverter. What is the disadvantage of this inverter? How is it overcome? 10

b. Define the performance parameters of an inverter. 6

c. Mention any two advantages and any two disadvantages of current source inverters. 4

10 a. What are the salient features of an UPS? Draw the block diagram of a typical UPS system and explain. 10

b. List the disadvantages of HVDC transmission. 6

c. Mention any two advantages and disadvantages of induction heating. 4

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