Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
MID TERM EXAMINATION - OCT 2023

Semester : Semester V - 2021
Course Code : EEE2019
Course Name : Sem V - EEE2019 - Power Electronics
Program : B.TECH

Date : 30-OCT-2023
Time : 2:00PM - 3:30PM
Max Marks : 50
Weightage : 25%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS **(5 X 2 = 10M)**

1. power converter is designed for an ac voltage controller for induction heating application andphase controlled technique is employed to control the converter. Suggest the suitable semiconductor device which is suitable in the power converter (C.O.NO 1) [Knowledge]
(CO1) [Knowledge]

2. While designing a Chopper for a battery operated vehicle, the features of high input impedance and low on state power loss are desirable. Suggest the suitable semiconductor device which is suitable in the power converter (C.O.NO 1) [Knowledge]
(CO1) [Knowledge]

3. A power converter is designed for battery operated vehicle which is intended to feed the power back to the source during braking operation. Suggest the suitable semiconductor device which is suitable in the power converter. (C.O.NO 1) [Knowledge]
(CO1) [Knowledge]

4. In a wood cutting application, A DC shunt motor is controlled by a single phase controlled rectifier. The supply specifications are Single phase 230V, 50Hz. The motor specifications are Ra=10ohms, La=1mH and Eb=100V. Compute the minimum firing angle of the rectifier.
(C.O.NO 2) [Knowledge]
(CO2) [Knowledge]

5. In a steel rolling mills, a DC shunt motor is controlled by a single phase controlled rectifier and it is required to rotate the spindle which is connected to a shaft of motor in anti-clock wise direction with the positive torque. Suggest the suitable power converter for the application.
(CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS **(2 X 10 = 20M)**

6. The data sheet of VS-VSK.230 PbF series SCR is shown in fig.1. This SCR has been used in the design of single phase controlled rectifiers to control the speed of a DC shunt motor. The magnitude of the gate pulse voltage is 10V, width of the gate pulse is 80µ sec and DC voltage source is of 200V Consider the required parameters from the data sheet and estimate the width of gate current pulse to turn on SCR for the following loads.

1. L= 2H
2. R=10Ω and L= 2H.

VISHAY. www.vishay.com

VS-VSK.230..PbF Series

Vishay Semiconductors

ON-STATE CONDUCTION						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**			**VALUES**	**UNITS**
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave			230	A
					85	°C
Maximum RMS on-state current	$I_{T(RMS)}$	As AC switch			510	A
Maximum peak, one-cycle on-state non-repetitive, surge current	I_{TSM}	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial $T_J = T_J$ maximum	7500	
		t = 8.3 ms			7850	
		t = 10 ms	100 % V_{RRM} reapplied		6300	
		t = 8.3 ms			6600	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied		280	kA^2s
		t = 8.3 ms			256	
		t = 10 ms	100 % V_{RRM} reapplied		198	
		t = 8.3 ms			181	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied			2800	$kA^2\sqrt{s}$
Low level value or threshold voltage	$V_{T(TO)1}$	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum			1.03	V
High level value of threshold voltage	$V_{T(TO)2}$	(I > π x $I_{T(AV)}$), $T_J = T_J$ maximum			1.07	
Low level value on-state slope resistance	r_{t1}	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum			0.77	mΩ
High level value on-state slope resistance	r_{t2}	(I > π x $I_{T(AV)}$), $T_J = T_J$ maximum			0.73	
Maximum on-state voltage drop	V_{TM}	I_{TM} = π x $I_{T(AV)}$, $T_J = T_J$ maximum, 180° conduction, average power = $V_{T(TO)}$ x $I_{T(AV)}$ + r_f x $(I_{T(RMS)})^2$			1.59	V
Maximum holding current	I_H	Anode supply = 12 V, initial I_T = 30 A, T_J = 25 °C			500	mA
Maximum latching current	I_L	Anode supply = 12 V, resistive load = 1 Ω, gate pulse: 10 V, 100 µs, T_J = 25 °C			1000	

fig.1

(CO1) [Comprehension]

7. 1. A VS-VSK.230.PbF series SCR datasheet is provided to design a firing circuit to turn on the SCR. The specifications are as follows

Maximum average on state current at 850 C is 230A
Low level of thresh hold voltage – 1.03V
High level of thresh hold voltage - 1.08V
Maximum on state voltage drop - 1.59V
Maximum holding current -500mA
Maximum latching current- 1000mA.
Minimum gate pulse width-100µ Sec
Gate pulse voltage-10V
For an application, If the SCR represented in data sheet is failed to trigger when the gate pulse magnitude of 10V and gate pulse width of 80µ sec are applied when connected to a load of L= 2H and DC source voltage of 200V. Identify the problem to trigger the SCR and suggest the value of minimum gate pulse width required to trigger the SCR and compute pulse width if R=20ohms and L=0.2H.

(CO1) [Comprehension]

PART C

ANSWER THE FOLLOWING QUESTION **(1 X 20 = 20M)**

8. A 30A, 470V and 875rpm Crompton DC shunt motor is used in steel rolling mills for coiler operation. This motor is controlled by three phase fully controlled converter. The value of armature winding resistance is 1Ω and inductance is 1mH. The supply specifications are 3-ϕ, 440V, 50 Hz supply. At the time of coiler operation, it is required to operate at full rated torque and to rotate the spindle at 600rpm. Assume the required data and compute the firing angle of the converter. **(C.O.NO 2) [Comprehension]**

(CO2) [Application]