Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 1

Winter Semester: 2021 - 22
Course Code: EEE 214
Course Name: Power Electronics
Program & Sem: B.Tech & VI Sem

Date: 26th April 2022
Time: 10:00 AM to 11:00 AM
Max Marks: 30
Weightage: 15%

Instructions:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks. (5Qx2M=10M)

1. 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]

a. SCR b. IGBT c. GTO d. LASCR

2. In a cement industry, three phase inverter is used to control the speed and torque characteristic of induction motor. The inverter is operated using carrier based PWM techniques where the carrier frequency is greater than 100 kHz. Suggest the suitable semiconductor switching device in the design of Inverter

(C.O.NO 1) [Knowledge]

a. MOSFET b. SCR c. GTO d. TRIAC

3. 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]

a. MOSFET b. SCR c. IGBT d. BJT

4. In designing a frontend converter in control of traction motor, 2N6394 model, ONSEMICONDUCTOR make SCRs are used. The ratings of the device are 12A RMS and blocking voltage of 800V. It is observed that during the transient conditions like large voltage spikes the SCRs are prone to be damaged with in no time. _____ circuit is used to protect the SCR.

(C.O.NO 1) [Knowledge]

5. Suggest the semiconductor switching device for the speed control of ceiling fan?

(C.O.NO 1) [Knowledge]

a. MOSFET b.TRIAC c. IGBT d. GTO

Part B [Thought Provoking Questions]

Answer the Question. The question carries TEN marks. (1Qx10M=10M)

6. The data sheet of VS-VSK.230..PbF series SCR is shown in Fig.1.This has been used in the design of single phase rectifiers to control a dc shunt motor. At the time of operation, it is observed that the gate current is 750mA and could not trigger the SCRs. For successful triggering, Identify the problem in the gate firing circuit.

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 data sheet of VS-VSK.230..PbF series SCR

If the same SCR is connected to a loads of i) L= 2H ii) R=10Ω and L= 2H, Compute the minimum width of gate current pulse required to turn on the SCR in above two cases and justify the answer. (C.O.NO 1) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. Question carries TEN marks. (1Qx10M=10M)

7. IRFZ44N n-channel enhancement MOSFET is used in a dc motor control circuit and PWM technique is used to vary the gate to source voltage of MOSFET. When the gate – to – source voltage (VGS) of a MOSFET with threshold voltage of 2 V, working in saturation is 4.5V, the drain current is observed to be 2A. Neglecting the channel width modulation effect and assuming that the MOSFET is operating at saturation, Compute the drain current for an applied VGS of 5.5V and 7.0V. Comment on the magnitude of drain current. (C.O.NO 1) [Comprehension]

Fig.2 dc motor controller with n-channel MOSFET as a switching device.

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BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Winter Semester: 2021 - 22
Course Code: EEE 214
Course Name: Power Electronics
Program & Sem: B.Tech & VI Sem

Date: 1st June 2022
Time: 10:00 AM to 11:00 AM
Max Marks: 30
Weightage: 15%

Instructions:

(iv) Read the question properly and answer accordingly.
(v) Question paper consists of 3 parts.
(vi) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks (5Qx2M=10M)

1. A three phase full controlled converter is fed from three phase 400V,50Hz star connected transformer. Compute the maximum average output voltage of the converter? (C.O.NO 2) [Knowledge]

   a. 575.0V b.540.8V c.420.7V d.231V

2. If the input supply frequency is 50Hz. The ripple frequency of average DC output voltage of three phase fully controlled rectifier is _____ (C.O.NO 2) [Knowledge]

   a. 300Hz b. 30 Hz c 50Hz d. 150Hz

3. A single phase controlled rectifier is used to roll steel sheets. In this case, it is required to rotate the motor in the anti-clock wise direction too. The firing angle of the converter is _____ (C.O.NO 2) [Knowledge]

4. A battery operated vehicle is used a step down chopper to control the traction motor, The range of duty cycle in step down chopper is _____ (C.O.NO 3) [Knowledge]

   a. 0 to 1 b.1 to infinity c.0 to .5 d.1 to 1.5

5. In a single phase PV grid interfacing, A step up DC-DC converter is used and the input voltage of the converter is 200V. The turn on time and total time period of the converter are 100micro sec 200micro sec respectively. The average DC output voltage of the converter, if the turn on time is reduced to four times is _____ (C.O.NO 3) [Knowledge]

Part B[Thought Provoking Questions]

Answer the Question. The question carries TEN marks. (1Qx10M=10M)

6. A 10A, 220V and 900rpm Benn make DC shunt motor is used in lathe machine applications. While shaping the job piece, it is required to rotate at rated speed in both directions at rated torque. The motor could not rotate at a firing angle of 5 degrees.

At the work place, single phase half wave and single phase fully controlled rectifiers are available. As an Engineer,

i. Identify the problem in the control circuit

ii. Choose the suitable motor and suggest value of firing angle at rated torque when back emf is reversed. (C.O.NO 2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The question carries TEN marks. (1Qx10M=10M)

7. A battery operated vehicle is controlled by a chopper and is connected to separately excited DC motor. The battery pack is made up of Li-Ion of voltage 450V DC. The motor specifications are 750V, 1000 rpm, 50A and Armature resistance of 0.5 ohms.

It is required to operate in first quadrant of speed and torque plane. Suggest the type of chopper and suggest the value of duty cycle to operate at 800rpm and rated torque. (C.O.NO 3) [Comprehension]

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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM EXAMINATION

Winter Semester: 2021 - 22 | **Date**: 29th June 2022

Course Code: EEE 214 | **Time**: 9:30 AM to 12:30 PM

Course Name: Power Electronics | **Max Marks**: 100

Program & Sem: B.Tech & VI Sem | **Weightage**: 50%

Instructions:

(vii) Read the question properly and answer accordingly.

(viii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks (10Qx2M=20M)

8. 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]

e. SCR f. IGBT g. GTO h. LASCR

9. In a cement industry, three phase inverter is controlled by a three phase AC Voltage controller. Phase controlled technique has been used to control the power converter. Suggest the suitable semiconductor switching device in the design of the converter. (C.O.NO 1) [Knowledge]

e. MOSFET f. SCR g. IGBT h. IGCT

10. A single phase fully controlled converter is fed from single phase 230V,50Hz supply system. Compute the maximum average output voltage of the converter?

(C.O.NO 2) [Knowledge]

a. 207.10V b.540.8V c.420.7V d.231V

11. If the input supply frequency is 60Hz. The ripple frequency of average DC output voltage of three phase fully controlled rectifier is _____

(C.O.NO 2) [Knowledge]

e. 360Hz b. 300 Hz c 50Hz d. 150Hz

12. In PV panel integration, a boost converter is used to step up the dc voltage, the range of duty cycle is _____

(C.O.NO 3) [Knowledge]

a. 0 to 1 b.1 to infinity c.0 to .5 d.1 to 1.5

13. In a single phase PV grid interfacing, A step up DC-DC converter is used and the input voltage of the converter is 200V. The turn on time and total time period of the converter are 100micro sec 200micro sec respectively. The average DC output voltage of the converter, if the turn on time is reduced to four times is _____

(C.O.NO 3) [Knowledge]

14. A single phase half wave AC voltage controller is connected electric heater of 1kW and controlled by using phase control technique. Compute the minimum value of rms output voltage, if the supply voltage is single phase 230V,50Hz supply?

(C.O.NO 4) [Knowledge]

a. 102.6V b. 12.6V c.0V d.162.6V

15. An induction heater is controlled by a single phase fullwave AC voltage controller is connected to heat the metal piece. The specifications of the source are single phase 230V, 50Hz, AC supply and load is 3kW. The average value of thyristor current is _____

(C.O.NO 4) [Knowledge]

16. In a single phase half bridge inverter, the supply voltage is 220V DC. The rms value of output voltage is _____

(C.O.NO 5) [Knowledge]

a. 440V b. 220V c. 110V d. 55V

17. A domestic fan is controlled by 800VA inverter. Assume the inverter is controlled by single phase half bridge and full bridge inverter separately. Comment on %THD in both the cases (C.O.NO 5) [Knowledge]

a. Full bridge is more b.equal c.Half bridge is more d. Cannot be determined

Part B[Thought Provoking Questions]

Answer all the Questions. Each question carries TWENTY marks. (2Qx20M=40M)

18. IRFZ44N n-channel enhancement MOSFET is used in a dc motor control circuit is shown in Fig.1. The PWM technique is used to vary the gate to source voltage of MOSFET to control the speed of a dc motor. A voltage of 1.5V has applied across gate – to – source voltage (VGS), at this condition, the drain current is 25 μA and the speed of the motor is zero. The data sheet of the MOSFET is presented in Fig.2.

a) Identify the reasons for the zero speed of the motor and mention the steps for the trouble shooting.

b) If a MOSFET has a threshold voltage of 2 V, V_{GS} under saturation is 4.5V, at this condition, the drain current is observed to be 2A. Neglecting the channel width modulation effect and assuming that the MOSFET is operating at saturation, Compute the drain current for an applied VGS of 5.5V and 7.0V. Comment on the magnitude of drain current.

(C.O.NO 1) [Comprehension]

Fig.1 dc motor controller with n-channel MOSFET as a switching device.

19. Assume the domestic inverter of rating 800VA is controlled by single phase half bridge and single phase full bridge inverters. The input dc Voltage of the inverter is 220V dc. While operation, it is observed that single phase half bridge inverter is producing more humming noise and generating more heat too.
    i. Identify the reason for the noise(4M)
    ii. Assume the required data and compute the rms value of fundamental output voltage of the single phase half bridge inverter(6M)
    iii. Compute the power loss due to 5^{th} order harmonics, if the load is 50 ohms(6M)
    iv. Identify the control parameters to vary the rms value of single phase full bridge inverter.(4M) (C.O.NO 5) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries TWENTY marks.(2Qx20M=40M)

20. A battery operated vehicle is controlled by a chopper and is connected to separately excited DC motor. The battery pack is made up of Li-Ion of voltage 400V DC. The motor specifications are 700V, 950 rpm, 30A and Armature

resistance of 0.05 ohms. It is required to operate in first quadrant of speed and torque plane.

i) Suggest the type of chopper (4M)

ii) Compute the value of duty cycle to operate at rated torque and speed. (8M)

iii) Assume the required data and control the motor at different torque and speed conditions. Comment on the variation of Duty cycle.(8M)

(C.O.NO 3) [Comprehension]

21. A fan manufacturing company has produced Type A fan as per the Bureau of Indian Standards (BIS) norms, i.e IS: 374-1992. Type A fan regulator shall be capable of reducing the fan speed at least 30% of the rated speed and test results are presented Fig. 2 (C.O.NO 4) [Comprehension]

DATA SHEETS

Type A fan tested on a standard regulator
Case 1: Supply voltage = 220V

Regulator Number	Voltage V_r Volts	Current Amps	Power Watts	Voltage V_c Volts	Speed RPM
1	81	0.100	0.81	200.000	132
2	112	0.150	16.80	181.000	187
3	131	0.180	23.58	164.000	219
4	150	0.210	31.50	143.000	247
5	220	0.250	55.00	0.044	315

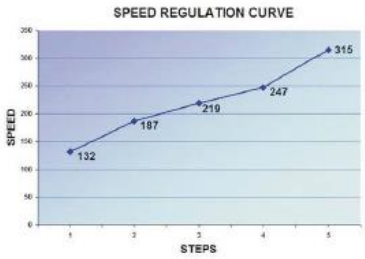

Fig. 2 Test results on a standard regulator

i) Suggest the suitable AC Voltage controller for the control (4M)

ii) Chose the data which is required and suggest the firing angles at 4 and 5 positions(12M)

iii) Comment on variation of firing angle at different positions(4M**)**