GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
POWER ELECTRONICS
EE402

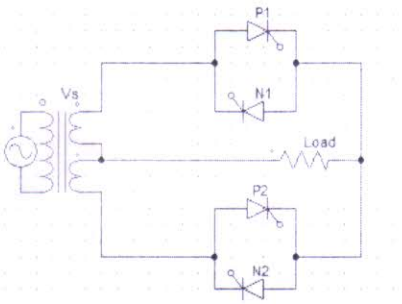
TIME ALLOTTED: 3 Hrs **FULL MARKS: 70**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	CO No.
1.	(i) In the positive half cycle from $\omega t = 0$ to π	1	CO1



a) P1 and P2 are forward biased
b) N1 and P2 are forward biased
c) P1 and N2 are forward biased
d) None of the mentioned

(ii) The forward break over voltage is the — 1 — CO4

a) anode-cathode voltage at which conduction starts with gate signal applied
b) anode-cathode voltage at which conduction starts with no gate signal applied
c) gate voltage at which conduction starts with no anode-cathode voltage
d) gate voltage at which conduction starts with anode-cathode voltage applied

(iii) The average value of voltage of a single-phase ac voltage controller is given by — 1 — CO2

a) $\frac{\sqrt{2}V}{\pi}(1+\cos\alpha)$

b) $\frac{\sqrt{2}V}{2\pi}(1+\cos\alpha)$

c) $\frac{\sqrt{2}V}{\pi}\cos\alpha$

d) $\frac{V}{\pi}\cos\alpha$

(iv)	Find the output voltage expression for a step down chopper with Vs as the input voltage and α as the duty cycle. a) $Vo = Vs/\alpha$ b) $Vo = Vs \times \alpha$ c) $Vo = Vs2/\alpha$ d) $Vo = 2Vs/\alpha\pi$	1	CO1
(v)	If a step down chopper operates in the continuous conduction mode, the ripple in load current is maximum when duty cycle is a) 0.25 b) 0.5 c) 0.75 d) 1.0	1	CO2
(vi)	A freewheeling diode across inductive load of a phase controlled converter will provide a) quick turn-on of SCR b) slow turn-off of SCR c) reduced utilization factor of transformer d) improved power factor	1	CO3
(vii)	If input DC voltage is constant, the output voltage of a single-phase bridge inverter can be controlled by a) Pulse width modulation b) Changing the switching frequency c) Pulse amplitude modulation d) All of these	1	CO2
(viii)	Each diode of a 3-phase half-wave diode rectifier conducts for a) 60° b) 120° c) 180° d) 90°	1	CO2
(ix)	An IGBT has three terminals called a) collector, emitter, base b) drain, source, base c) drain, source, gate d) collector, emitter, gate	1	CO1

(x) The effective input resistance R_i of a step down chopper is — 1 — CO1

a) a) $\frac{R}{D}$

b) RD

c) $\frac{R}{1-D}$

d) $(1-D)R$

(xi) When a Three Phase Voltage Source Inverter operates in 180 degree conduction mode, the rms line to line voltage is ------ — 1 — CO1

a) $V_{L(rms)} = \frac{\sqrt{2}}{\sqrt{3}}V$

b) $V_{L(rms)} = \frac{\sqrt{2}}{3}V$

c) $V_{L(rms)} = \frac{1}{\sqrt{3}}V$

d) $V_{L(rms)} = V$

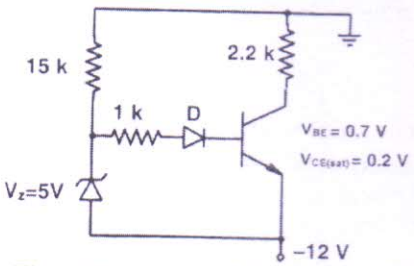
(xii) The output voltage waveform of a three phasesquare wave inverter contains — 1 — CO2

a) only odd harmonics
b) both odd and even harmonics
c) only even harmonics
d) only triplen harmonics

GROUP – B
(Short Answer Type Questions)
(Answer any *three* of the following) — **3 x 5 = 15**

		Marks	CO No.
2.	Explain the two transistor analogy of thyristor Derive an equation for anode current. State the condition for turn on.	5	CO1
3.	Why are freewheeling diode connected in rectifier circuits to copeup with *R-L* load? (Give waveforms).	5	CO2
4.(a)	Describe the different modes of operation using static V-I characteristics of thyristor.	3	CO2
(b)	Define Holding Current and Latching current.	2	CO2
5.	What are the different types of inverters ? Write difference between VSI and CSI.	5	CO2
6.	A three-phase inverter is supplied from a 580 V source. For a star connected resistive load of 20 Ω per phase, for 120° conduction, determine the i) r.m.s. value of phase voltage ii) r.m.s. value of switch current.	5	CO2

GROUP – C
(Long Answer Type Questions)
(Answer any *three* of the following) 3 x 15 = 45

		Marks	CO No.
7.a)	Explain with the help of circuit diagram, the principle of operation of step-up chopper.	6	CO2
b)	For a type A chopper, dc source voltage = 230 V, load resistance = 10 Ω. Take a drop of 2 V across chopper when it is on. For a duty cycle of 0.4, calculate i) average and runs values of output voltage ii) Chopper efficiency.	6	CO2
c)	What is the effect of source inductance on the performance of a single phase fully controlled converter.	2	CO3
8. a)	Why are freewheeling diodes used in rectifier circuit ?	6	CO3
b)	A chopper circuit is operating on Time Ratio Control (TRC) principle at a frequency of 2kHz on a 220 V d.c supply. If the load voltage is 170 V, compute the conduction and blocking period of thyristor in each cycle.	6	CO2
c)	Explain the operation of 3-phase six pulse bridge rectifier circuit when α=30 deg.	3	CO3
9. a)	Explain the working principle of a single phase a.c voltage regulator feeding a resistive load with neat circuit diagram.	7	CO2
b)	 The transistor used in the circuit shown below has a β of 30 and I_{CBO} is negligible. If the forward voltage drop of diode is 0.7V, then What amount of current through the collector?	5	CO3
c)	A single phase full bridge inverter has RLC load of R = 4 Ω , L = 35 mH, C = 155 μF. The dc input voltage is 230 V and the output frequency is 50 Hz. Find	2	CO1
10.a)	Explain the working of a full bridge three phase inverter with resistive load in 180 degree conduction? Draw the circuit diagrams and phase and line output voltages.	8	CO2
b)	What is the Pulse Width modulated Inverters? What are the different types of PWM Techniques are used in Inverters?	2	CO2
c)	Explain the following performance parameters: (a) Total Harmonic Distortion (b) Distortion Factor	5	CO2
11.	Write short note on (any three)	3X5=15	
a)	Different modes of operation using static V-I characteristics of thyristor.	5	CO1
b)	GTO	5	CO2
c)	Class C Chopper	5	CO2
d)	Effect of Source Inductor in Single Phase Rectifier	5	CO3
e)	Single Phase Semi Control rectifier	5	CO3