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BTECH
(SEM VI) THEORY EXAMINATION 2021-22
POWER ELECTRONICS

Time: 3 Hours**Total Marks: 100****Note:** Attempt all Sections. If you require any missing data, then choose suitably.**SECTION A****1. Attempt all questions in brief.****2*10 = 20**

Qno	Questions	CO
(a)	What are di/dt and dv/dt ratings of SCRs? What happens if these ratings are exceeded?	1
(b)	Give the merits and demerits of a GTO as compared to a conventional SCR.	1
(c)	Explain the following current ratings of SCR (i) Average ON state current (ii) RMS ON state current	2
(d)	What are the different methods for turning off (Commutation) of an SCR? Draw the power circuit diagram of Class C and D Commutation methods.	2
(e)	Explain the effect of freewheeling diode in power converters. Also, justify the statement "Freewheeling diode improves the power factor of the system".	3
(f)	Write the comparison between non-circulating current mode and circulating current mode of operation of Dual-Converters.	3
(g)	List the advantages and disadvantages of single-phase half-wave a.c. voltage controllers.	4
(h)	Distinguish between two-stage and multi-stage sequence control of a.c. voltage controllers. What are the advantages of multistage sequence control over two-stage sequence control?	4
(i)	Explain Pulse Width Modulation (PWM) technique and advantages of Sinusoidal Pulse Width Modulation (SPWM) technique.	5
(j)	Compare the constructional and operational differences between voltage source and current-source inverters.	5

SECTION B**2. Attempt any three of the following:****10*3 = 30**

Qno	Questions	CO
(a)	Draw the turn-off characteristic of an SCR and explain the mechanism of turn-off in detail.	1
(b)	A thyristor string is formed by the series and parallel connection of thyristors. The voltage and current ratings of the string are 6 kV, and 4 kA respectively. Available thyristors have the voltage and current ratings of 1.2 kV and 1 kA, respectively. The string efficiency is 90% for both the series and parallel connections. Calculate the number of thyristors to be connected in series and parallel.	2
(c)	A single-phase fully-controlled bridge circuit shown in Fig. 1 is used for obtaining a regulated d.c. output voltage. The RMS value of the a.c. input voltage is 230 V, and the firing angle is maintained at $\pi/3$, so that the load-current is 4 A.	3



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	<p align="center">Fig. 1.</p>	
	<p>(i) Calculate the d.c. output voltage and the active and reactive power input.</p> <p>(ii) Calculate the d.c. output voltage and the active and reactive power input if a freewheeling diode is used at the output. Assuming that the load resistance remains the same and the firing angle is maintained at $\pi/3$.</p>	
(d)	Explain the working of single phase to single-phase step up cycloconverters with power circuit diagram and waveforms.	4
(e)	With the help of neat circuit diagram and associated waveforms, explain the operation of single-phase full-bridge MOSFET based voltage source inverter with (i) Resistive load (ii) Inductive load.	5

SECTION C

3. Attempt any one part of the following: **10*1 = 10**

Qno	Questions	CO
(a)	Explain in detail the switching performance of BJT with relevant waveforms.	1
(b)	Latching current for an SCR inserted in between a DC voltage source of 200V and the load is 100 mA. Compute the minimum width of Gate Pulse current required to turn on this SCR in the case of load $R = 20 \Omega$ in series with $L = 0.2 \text{ H}$.	1

4. Attempt any one part of the following: **10 *1 = 10**

Qno	Questions	CO
(a)	With the help of a neat circuit diagram and associated waveforms, discuss the operation of Buck converter. List the advantages of Buck-Boost converter over Buck and Boost converters.	2
(b)	Consider the buck-boost converter of Fig. 2. The input voltage to this converter is $E_{dc} = 14 \text{ V}$. The duty cycle $\alpha = 0.6$ and the switching frequency is 25kHz. The inductance $L = 180 \text{ mH}$ and filter capacitance $C = 220 \text{ mF}$. The average load current $I_0 = 1.5 \text{ A}$.	2



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Fig. 2.

Compute:

- the average output voltage, E_0 ;
- the peak-to-peak output voltage ripple, ΔV_c ;
- the peak-to-peak current of inductor, ΔI ; and
- the peak current of the device I_p .

5. **Attempt any one part of the following:** **10*1 = 10**

Qno	Questions	CO
(a)	Explain the operation of a three-phase, fully-controlled bridge converter with inductive load with the help of suitable voltage and current waveforms at $\alpha = 30^\circ$ and derive the expression for average load voltage.	3
(b)	Describe the working of single-phase fully-controlled bridge converter with Resistive-Inductive (RL) load (i) Supply voltage and current, (ii) Load voltage and current.	3

6. **Attempt any one part of the following:** **10*1 = 10**

Qno	Questions	CO
(a)	<p>A single-phase a.c. voltage controller of Fig. 3 feeds power to a resistive load of 4Ω from 230 V, 50 Hz source.</p> <div style="text-align: center;"> </div> <p style="text-align: center;">Fig. 3.</p> <p>Determine and draw the suitable wave diagram of following:</p> <ol style="list-style-type: none"> the RMS output voltage and current for any firing angle α the peak values of average and RMS thyristor currents for any firing angle α. the minimum circuit turn-off time for any firing angle α. 	4
(b)	Describe the basic principle of working of a single-phase-to-single-phase step down cycloconverter for a bridge-type cycloconverter.	4



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7. Attempt any *one* part of the following:

10*1 = 10

Qno	Questions	CO
(a)	With the help of neat circuit diagram and waveforms, explain briefly the operation of three-phase bridge inverter with resistive inductive (RL) load in 180° conduction mode.	5
(b)	A single-phase half bridge inverter has R Load $R = 2$ ohm, and DC source voltage $V_s/2 = 115V$. Sketch the waveforms of following (i) Output voltage (ii) Output Current (iii) Thyristor current and diode current (iv) Power delivered to the load due to fundamental current	5

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