UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Power Electronics (PSEG 327)　　　　　　　　　　　**Semester: V**
Programme: B.Tech Electronics (IoT)　　　　　　　　　　　　**Max. Marks: 100**
No. of pages: 2　　　　　　　　　　　　　　　　　　　　　　**Time: 03 hrs.**
Instructions: All questions are compulsory.

SECTION A

S. No.		Marks	CO
Q 1	Can a forward voltage be applied to an SCR soon after its anode current has fallen to zero? Explain.	5	CO1
Q 2	An incandescent bulb of 10 Ω is connected through a half-wave controlled rectifier circuit to 220 V, 50 Hz, single phase source. Determine the power delivered to the load for a firing angle of 60^0.	5	CO2
Q 3	A step up chopper has output voltage of three times the input voltage. For a chopping frequency of 2000 Hz, determine off time period of chopper.	5	CO3
Q 4	Define integral cycle control in case of AC voltage controller.	5	CO4

SECTION B

Q 5	For an SCR, the gate-cathode characteristics has straight line slope of 150. For trigger source voltage of 20 V, and allowable gate power dissipation of 0.8 watt, determine the value of gate source resistance.	10	CO1
Q 6	A Crane is using a separately excited DC motor to carry some weight. This motor is operating from a single phase full bridge converter at a speed of 1400 rpm has an input voltage of 430 sin 314t and a back emf of 100 V. The SCRs are fired symmetrically at 45^0 in every half cycle and the armature has a resistance of 4Ω. Determine the average armature current and motor terminal voltage.	10	CO2
Q 7	For type A chopper feeding an RLE load, show that maximum value of rms current rating for the freewheeling diode, in case load current is ripple free, is given by $$0.3849 \ V_s/R \ (1 - E/V_s)^{3/2}$$ Where V_s is the supply voltage. **OR** Show that for a basic dc to dc converter, the critical inductance of filter circuit is given by $L = V_0 (V_s-V_0)/2fV_sP_0$. Where V_0, V_s, & P_0 are load voltage, source voltage, load power and chopping frequency respectively.	10	CO3
Q 8	A single phase voltage controller has input voltage of 230 V, 50 Hz and a load of R=20 Ω. For 8 cycles on and 4 cycles off, determine rms output voltage, input	10	CO4

	power-factor, average and rms thyristor current.		
	SECTION-C		
Q 9	Explain control strategies of chopper. An elevator is placed in a building to lift a weight up to 500 Kg. This elevator is fed from 300 V dc source through a chopper. The motor used in the elevator is DC series motor. The dc motor has the following parameters: $r_a = 0.04\ \Omega$, $r_s = 0.06\ \Omega$, $K_m = 0.008\ Nm/amp^2$. The average armature current of 200 A is ripple free. For a chopper duty cycle of 0.6 determine (a) input power from the source (b) motor speed and (c) motor torque	**20**	**CO3**
Q 10	A star connected load of 15 Ω per phase is fed from 230 V dc source through a 3-phase bridge inverter. Explain the operation in 180^0 conduction mode. Also draw associated circuits and waveforms. **OR** A star connected load of 40 Ω per phase is fed from 200 V dc source through a 3-phase bridge inverter. Explain the operation in 120^0 conduction mode. Also draw associated circuits and waveforms.	**20**	**CO4**

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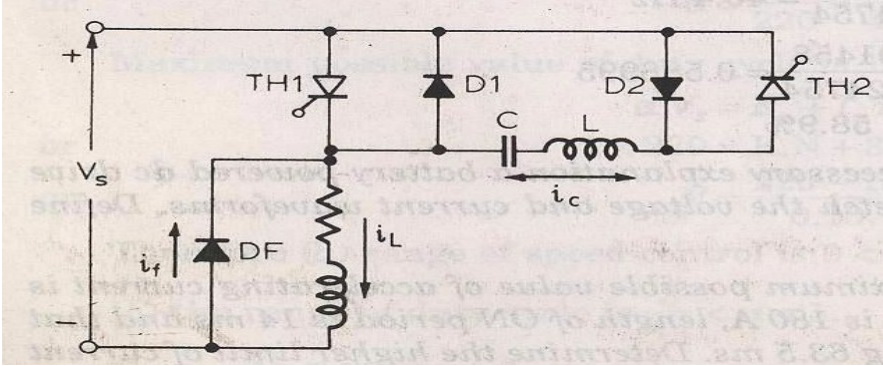
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SECTION A

S. No.	Attempt all questions.	Marks	CO
Q 1	Define latching and holding current as applicable to an SCR. Show these currents on static its V-I characteristics.	5	CO1
Q 2	An incandescent bulb of 50 Ω is connected through a full-wave controlled rectifer circuit to 220 V, 50 Hz, single phase source. Determine the input power factor for a firing angle of 30^0.	5	CO2
Q 3	Explain clearly the concept of multi-phase chopper.	5	CO3
Q 4	A single-phase full-bridge voltage source inverter (VSI) is fed from a 300 V battery. A pulse of 120^0 duration is used to trigger the appropriate devices in each half-cycle. Determine the rms value of the fundamental component of the output voltage.	5	CO4

SECTION B

Q 5	A 300 A SCR is to be used in parallel with a 400 A SCR. The on state voltage drops of the SCRs are 1.5 and 1.70 V respectively. Calculate the series resistance that should be connected with each SCR if the two SCRs have to share the total current 450 A in proportion to their ratings.	10	CO1
Q 6	A three-phase diode bridge rectifer is feeding a constant DC current of 100 A to a highly inductive load. If three-phase, 415 V, 50 Hz AC source is supplying to this bridge rectifer then determine the rms value of the current in each diode, in ampere. Also draw the associated waveforms.	10	CO2

Q 7	The speed of a separately excited dc motor is controlled below base speed by type A chopper. The supply voltage is 200 V dc. The armature circuit has R_a = 0.2 Ω and L_a = 10 mH. The motor constant is k = 0.1 V/rpm. The motor drives a constant torque load requiring an average current of 20 A. On the assumption of continuous armature current, determine
	
	    a- the range of speed control
	    b- the range of duty cycle.
	
	 OR
	A step-up chopper has input dc voltage of 140 V and output voltage of 420 V. If the conduction time of the thyristor chopper is 120 μs, compute the pulse width of the load voltage. In case pulse width of the load voltage is increased to two times its previous width, for constant frequency operation, calculate the new value of average
		10	CO3

	output voltage.		
Q 8	A single phase bridge type Cycloconverter feeds a resistive load. For an output frequency equal to one-third of the input frequency, sketch output voltage waveforms for a firing angle of 30^0. Also derive an expression for the rms output voltage.	10	CO4

SECTION-C

Q 9	Figure 'A' shows a chopper circuit operating at 100 Hz. The load current at steady state is continuous but varies between 3 A and 10 amp. Sketch the waveshape of
	
	  a- the load current
	  b- the current through the freewheeling diode D_f
	  c- the current through the commutating capacitor.
	
	Figure A
		20	CO3

Q 10	A star connected load of 25 Ω per phase is fed from 330 V dc source through a 3-phase bridge inverter. Explain the operation in 180^0 conduction mode. Also draw associated circuits and waveforms. **OR** A star connected load of 50 Ω per phase is fed from 350 V dc source through a 3-phase bridge inverter. Explain the operation in 120^0 conduction mode. Also draw associated circuits and waveforms.	20	CO4