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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program/course: B.Tech Mechatronics **Semester – V**
Subject: Power Electronics & Drives **Max. Marks : 100**
Code :ELEG 341 **Duration : 3 Hrs**
No. of page/s:2

SECTION A (20 MARKS)

Attempt all questions. Each question carries 4 marks.

Q1- [CO1]Compare TRIAC and SCR.

Q2- [CO2] An electric heater of 1500 Ω is connected through a full-wave controlled rectifier circuit to 230 V, 50 Hz, single phase source. Determine the power delivered to the load for a firing angle of 60^0.

Q3- [CO2] An incandescent bulb is connected to a 500 V DC source through a power electronic device. The bulb operates at 250 V DC. Draw the waveform for the output voltage of power electronic device.

Q4- [CO4] Discuss the problem associated with single phase half bridge inverter.

Q5- [CO5] Deduce constant power drives.

SECTION B (40 MARKS)

Attempt all questions. Each question carries 10 marks.

Q6- [CO1] Explain two transistor model of SCR.

Q7- [CO2] A single phase transformer with secondary voltage of 230 v, 50 hz delivers power to a heater through a full wave controlled rectifier circuit. The resistance of heater is 10 Ω for a firing angle delay of 30^0 determine rectification efficiency, voltage form factor, voltage ripple factor, & peak inverse voltage.

Q8- [CO2, CO5] A fan is fed from a single phase semi-converter with an ac source voltage of 230 V, 50 Hz. This fan uses a separately excited DC motor of 110 V, 1000 rpm, 10 A.The dc motor has an armature resistance of 1 Ω. Assuming continuous load current, compute developed torque at the firing angle of 45^0 and speed of 1000 rpm.

Q9- [CO3, CO5] An elevator is placed in a building to lift a weight up to 500 Kg. This elevator is fed from 500 V dc source through a chopper. The motor used in the elevator is DC series motor. The dc motor has the following parameters: $r_a = 0.06\ \Omega$, $r_s = 0.08\ \Omega$, $K_m = 0.008$ 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

SECTION C (40 MARKS)

Attempt both questions. Each question carries 20 marks.

Q10- [CO4] A star connected load of 30 Ω per phase is fed from 440 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 60 Ω per phase is fed from 420 V dc source through a 3-phase bridge inverter. Explain the operation in 120^0 conduction mode. Also draw associated circuits and waveforms.

Q11- [CO5] An industrial blower type load is driven by a three phase squirrel cage induction motor. Show that rotor current is maximum when motor runs at a slip s=1/3. Find also an expression for maximum rotor current. Also determine the maximum current in terms of rated current for the motor running at (1) 1455 rpm (2) 1350 rpm. No load rotational losses are negligible.

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SECTION A (20 MARKS)

Attempt all questions. Each question carries 4 marks.

Q1- [CO1] Define firing failure and false firing in case of SCR.

Q2- [CO2] Power flow from 1-phase source to load R can be controlled through the use of a thyristor. Discuss why this method of power flow control is called phase controlled converter.

Q3- [CO3] Discuss control strategies in DC chopper.

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Q4- [CO4] What is the purpose of connecting antiparallel diodes with thyristor in the inverter circuit. Explain how these diodes come in to play.

Q5- [CO5] Deduce constant torque drives.

SECTION B (40 MARKS)

Attempt all questions. Each question carries 10 marks.

Q6- [CO1] Discuss the problems associated with the series operation of SCRs and how these are overcome.

Q7- [CO3] A step-up chopper has input dc voltage of 210 V and output voltage of 420 V. If the conduction time of the thyristor chopper is 240 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 output voltage.

Q8- [CO3, CO5] A conveyer belt is placed in a Shopping Mall to carry a weight up to 1000 Kg. This belt is fed from 500 V DC source through a chopper. The motor used for motion is DC series motor. The dc motor has the following parameters: $r_a = 0.04\ \Omega$, $r_s = 0.06\ \Omega$, $K_m = 0.004$ Nm/amp^2. The average armature current of 300 A is ripple free. For a chopper duty cycle of 0.5 determine (a) input power from the source (b) motor speed and (c) motor torque

Q9- [CO2, CO5] A Crane is using a separately excited DC motor to carry some weight. This Crane is operating from a single phase semiconverter at a speed of 1400 rpm has an input voltage of 330 sin 314t and a back emf of 80 V. The SCRs are fired symmetrically at 30^0 in every half cycle and the armature has a resistance of 4Ω. Determine the average armature current and motor torque.

SECTION C (40 MARKS)

Attempt both questions. Each question carries 20 marks.

Q10- [CO4] A star connected load of 10 Ω per phase is fed from 420 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 10 Ω per phase is fed from 420 V dc source through a 3-phase bridge inverter. Explain the operation in 120^0 conduction mode. Also draw associated circuits and waveforms.

Q11- [CO5] Determine the value of slip for maximum rotor current in a 3-phase induction motor in case of fan type load. Also determine the speed of motor if the ratio of maximum rotor current and rated rotor current is (a) 2.5 (b) 1.5. No-load rotational losses are negligible.