

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program/course: B.Tech Electrical
Subject: Power electronics and drives
Code: PSEG 324
No. of page/s:2

Semester – V
Max. Marks : 100
Duration : 3 Hrs

SECTION – A

Note: All questions are compulsory
M)

(5 x 4M = 20

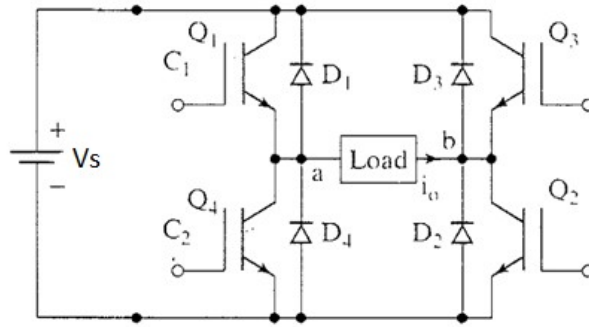
- Q1) [CO1] Explain the different methods to turn on the thyristor?
Q2) [CO1] Explain the functions and advantages of freewheeling diodes in controlled rectifiers?
Q3) [CO2] Explain the disadvantages of the harmonics present in the inverter system?
Q4) [CO3] The fully controlled thyristor converter is fed to an RL load from a single phase sources. If the firing angle is zero. The dc output of the converter is 300 V. What will be the voltage for a firing angle of 60 degrees assuming continuous condition?
Q5) [CO3] Draw the speed torque characteristics for an sep-excited dc motor controlled from armature voltage control.

SECTION – B

Note: Attempt all the following questions

(4 x 10M = 40 M)

- Q6) [CO1] Explain how semi converter provides better power factor compared to full converter when both are working as rectifier with RL load.
- Q7) [CO2] Show that in the case single phase AC voltage controller fed to a RL load, the load current i_o is sinusoidal if the firing angle is same as the impedance angle with the help of mathematical equations and draw the necessary waveforms.
- Q8) [CO4] In the single-phase bridge inverter of Fig below , the load current is $I_o = 540 \sin (\omega t - 45^\circ)$ The dc supply voltage is $V_s = 300$ volts.
- Draw waveforms of V_o , I_o and I_s . Indicate on the waveforms of i_o and I_s the devices that are conducting during various intervals of time.
 - Determine the average value of the supply current and the power from the dc supply.



Q9) [CO3] The two-quadrant chopper (class –D) is used to control the speed of the dc motor (whose rated speed 1500 rpm) and also for regenerative braking of the motor.

- Draw and analysis the chopper circuit with the help of waveforms ,when operated to control its speed of the motor from 1200 rpm to 1500 rpm
- Draw and analysis the chopper circuit with the help of waveforms ,when operated for regenerative braking of the motor from an 1500 rpm to 1300 rpm

SECTION – C

Note: Attempt all the following questions

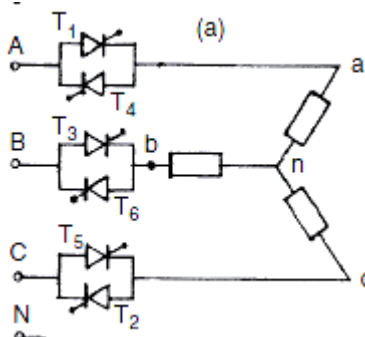
(2 x 20M = 40 M)

Q10)[C05] State the condition for getting the inversion mode of operation in case of single phase line commuted full wave converter with RL (highly inductive load). Briefly explain the operation of such a converter

- Derive the equation for average output voltage
- Plot average output voltage for firing angle (0° , 45° , 90°)
- Draw the waveforms of supply voltage, supply current, load voltage, load current , thyristor current for a firing angle of 90°

[OR]

Q11)[C04] Analyze fully controlled three-phase three-wire AC voltage controller connected to an resistive load for a firing angle $\alpha < 60^\circ$, Illustrate with appropriate waveforms(line and phase) and equivalent circuit diagrams.



Q12)[C05]In the three-phase bridge inverter operated at 120° commutation mode, with a dc supply voltage is 600 V. Analyze the circuit with the help of necessary circuit diagram , waveforms and determine the rms value of the load line-to-line voltage and load phase voltage.



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- Q1)[C01] Define forward and reverse breaking voltage for an SCR?
Q2) [C01] Explain the advantages of six pulse converter ?
Q3) [C02] Derive the expression for average output voltage for the step-down converter in terms of duty cycle.
Q4) [CO2] Justify, Is turn-on time of a SCR constant ? what factors influence its value?
Q5)[CO3] Draw the speed torque characteristics for a 3Ph induction motor controlled from stator voltage control.

SECTION – B

Note: Attempt all the following questions

(4 x 10M = 40 M)

Q6)[C03]The two-quadrant chopper (class –C) is used to control the speed of the dc motor (whose rated speed 1500 rpm) and also for regenerative braking of the motor.

a) Draw and analysis the chopper circuit with the help of waveforms ,when operated to control its speed of the motor from 1200 rpm to 1500 rpm

b) Draw and analysis the chopper circuit with the help of waveforms ,when operated for regenerative braking of the motor from an 1500 rpm to 1300 rpm

Q7)[C04]The speed of a 10 hp, 220 V, 1200 rpm separately excited dc motor is controlled by a single-phase full converter . The rated armature current is 40 A. The armature resistance is $R_a=0.25\Omega$ and armature inductance is $L_a = 10$ mH. The ac supply voltage is 265 V. The motor voltage constant is $K \Phi =0.18$ V/rpm. Assume that motor current is continuous and ripple-free. For a firing angle $\alpha =30^\circ$ and rated motor current, determine the

- (a) Speed of the motor.
(b) Motor torque.
(c) Power to the motor.

Q8)[C03] A single Phase voltage controller is connected to RL load. Discuss the working when firing angle is more than the load pf angle. Illustrate your answer with waveforms. Hence derive the expression for the output current in terms of source voltage, load impedance, firing angle etc.

Q9)[C05]

- Discuss the features that the firing circuits for thyristors should possess.
- Describe the resistance firing circuit used for triggering SCRs. Is it possible to get a firing angle greater than 90° with resistance firing? Illustrate your answer with appropriate waveforms.

SECTION – C

Note: Attempt all the following questions

(2 x 20M = 40 M)

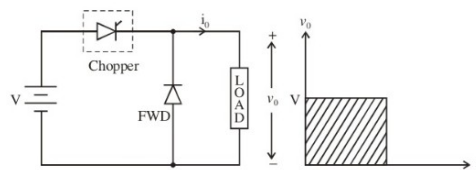
Q10)[C03]

- Draw and explain the operation of speed control of a Sep Exited DC shunt motor fed by a single phase semi converter for the continuous and ripple free motor current. Draw also the associated voltage and current waveforms.
- A 220 V, 1500 rpm, 10 A sep- excited dc motor has an armature resistance of 1 ohms. Is fed from a single phase fully controlled bridge rectifier with an AC source voltage of 230V, 50 Hz. Assuming continuous and ripple free current calculate:

$$E = K_\phi \omega \wedge T = K_\phi I$$

- Motor speed at a firing angle of 30° and Torque of 5 NM
- Developed torque at firing angle of 45° and speed of 1000rpm

Q11)[C04] Explain how forced commutation can be achieved to turn-off the main thyristor (shown below) by the application of a pulse of large reverse voltage across the thyristor reducing the anode current to zero rapidly the circuit shown below. Draw also the associated circuit diagram and all waveforms.



OR

Q12)[C05] In the three-phase bridge inverter operated at 180° commutation mode, with a dc supply voltage is 600 V. Analyze the circuit with the help of necessary circuit diagram, waveforms and determine the rms value of the load line-to-line voltage and load phase voltage.