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| **Name:**<br>**Enrolment No:** | UPES |

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, April/May 2018**

**Course: Power Electronics & Drives PSEG 324** **Semester: VI**
**Program: B.Tech PSE**
**Time: 03 hrs.** **Max. Marks: 100**

**Instructions: All questions are compulsory.**

## SECTION A

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Obtain fully labelled static V-I characteristics of a thyristor. | **4** | **CO1** |
| Q 2 | An incandescent bulb of 10 Ω is connected through a single phase half-wave controlled rectifier circuit to 220 V, 50 Hz, 1-ϕ source. Determine the power delivered to the load for a firing angle of $60^0$. | **4** | **CO2** |
| Q 3 | Discuss the control strategies employed in a DC chopper circuit. | **4** | **CO3** |
| Q 4 | A dc-dc converter can be considered as dc equivalent to ac transformer with continuously variable turns ratio. Justify. | **4** | **CO3** |
| Q 5 | Compare merits and demerits of DC & AC drives. | **4** | **CO5** |

## SECTION B

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| Q 6 | A 300V DC voltage drives a circuit consisting of thyristor 'T', inductor L of 3 mH, and a 50 μF capacitor in series. The thyristor is turned on at t=0s. Assume the circuit is relaxed initially. Determine,<br>a. thyristor conduction time<br>b. voltage across thyristor and capacitor after thyristor is turned off.<br>c. Draw relevant waveforms | **10** | **CO1** |
| Q 7 | Analyze the 1-ϕ full controlled converter driving a RLE load for discontinuous load current and draw the source voltage $V_s$, output voltage $V_o$, load current $I_l$ and source current $I_s$ waveforms as a function of time when extinction angle $\beta > \pi$. | **10** | **CO2** |
| Q 8 | A step down dc-dc converter has a resistive load of R=20Ω and input voltage Vs= 220V. When the converter remains on its voltage drop across the switch is 1.5V and chopping frequency is 10kHz. If the duty cycle is 80%, determine<br>a. Average output voltage<br>b. RMS output voltage<br>c. Converter efficiency<br>d. Effective input resistance | **10** | **CO3** |

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| Q 9 | a. Discuss the purpose of di/dt and dv/dt protection in SCR circuits.<br>b. Discuss the cause of circulating current in dual converter. Also, suggest a method to minimize the same.<br>(5+5) | **10** | **CO1,2** |
| | **SECTION C** | | |
| Q 10 | A star connected load of 15 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.<br>(OR)<br>A 1-ϕ full bridge inverter has RLC load of R=4Ω, L=35mH and C= 155μF. The dc input voltage is 230V and output frequency is 50Hz.<br>a. Find an expression for load current up to fifth harmonic. Also, calculate<br>b. Rms value of fundamental load current<br>c. Power absorbed by load and fundamental power<br>d. Rms and peak currents of each thyristor<br>e. Conduction times of thyristors and diodes if only fundamental component was considered. | **20**<br>**(4*5=20)** | **CO4** |
| Q 11 | a. Give the general circuit layout of 1-ϕ dc drives. Enlist various 1-ϕ dc drives used. (5)<br>b. A separately excited dc motor drives a rated load torque of 85Nm at 1200rpm. The field circuit resistance is 200Ω and armature circuit resistance is 0.2Ω. The field winding connected to 1-ϕ 400V source is fed through 1-ϕ full converter with 0° firing angle. The armature circuit is also fed through another full converter from the same 1-ϕ 400V source. With magnetic saturation neglected and the motor constant is 0.8V-sec/A-rad. For ripple free armature and field currents, determine<br>i. Rated armature current<br>ii. Firing angle delay of armature converter at rated load<br>iii. Speed regulation at full load<br>iv. Input pf of armature converter and drive at rated load.<br>(3+3+3+6=15) | **20** | **CO5** |

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## SECTION A

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Discuss the need of static equalizing circuit for SCR series operation. | **4** | **CO1** |
| Q 2 | Discus in brief the need for freewheeling diode for controlled rectifier operation. | **4** | **CO2** |
| Q 3 | Describe the principle of dc chopper operation. | **4** | **CO3** |
| Q 4 | Define pulse width modulation. List various PWM techniques. | **4** | **CO4** |
| Q 5 | Give the general circuit layout for a 1-ϕ dc drive. | **4** | **CO5** |

## SECTION B

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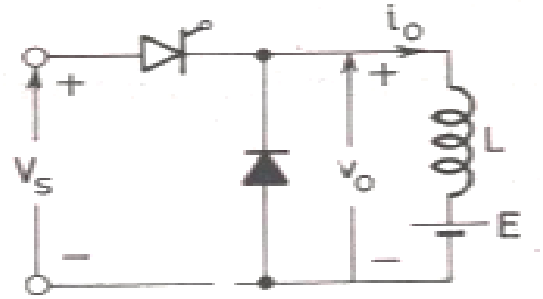
|---|---|---|---|
| Q 6 | Discuss the turn on mechanism of SCR with the help of dynamic characteristics. | **10** | **CO1** |
| Q 7 | A 1-ϕ full converter bridge is connected to RLE load. The source voltage is 230V, 50Hz. The average load current of 10A is continuous over the working range. For R=0.4Ω and L= 2mH. Determine,<br>a. Firing angle delay for E= 120V<br>b. Firing angle delay for E= -120V<br>c. For a. & b. indicate which source is delivering power to the load. Also draw time variations of output voltage and load currents for both parts. | **10** | **CO2** |
| Q 8 | The chopper circuit shown in figure below is fed from 500V dc source. For the load, L= 0.06H. For a duty cycle 0.2, find the chopping frequency to limit the amplitude of load current ripple to 10A.<br>Also draw relevant output voltage and load current waveforms.<br>  | **10** | **CO3** |

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| Q 9 | a. Differentiate between an SCR and a TRIAC.<br>b. The power factor for semi converters is better than that of full converters. Justify.<br>(5+5) | **10** | **CO1,2** |
| | **SECTION C** | | |
| Q 10 | A star connected load of 15 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.<br>Or<br>For a 1-ϕ full bridge inverter Vs= 230V dc, T= 1ms. The load consists of RLC in series with R= 1Ω, $X_L$= 6Ω and $X_C$= 7Ω.<br>a. Sketch the waveforms for load voltage $v_o$, fundamental component of load current $i_{o1}$, source current $i_s$ and voltage across thyristor 1. Indicate devices under conduction during different intervals of one cycle.<br>b. Find the power delivered to load due to fundamental component of current.<br>c. Check whether forced commutation is required or not. Assume thyristor turn off time as 100μs. (10+5+5) | **20** | **CO4** |
| Q 11 | a. Obtain the characteristics of a dc series motor indicating the two regions of constant torque mode and constant power mode. Also write the basic performance equations for a dc series motor drive.<br>(8)<br>b. A 220V 1500 rpm 10A separately excited dc motor has an armature resistance of 1Ω. It is fed from a 1-ϕ fully controlled bridge rectifier with an ac source voltage 230V, 50Hz. Assuming constant load current, determine<br>i. motor speed for a firing angle of 30° and load torque of 5Nm<br>ii. developed torque at firing angle of 45° and speed of 1000rpm.<br>(6+6) | **20** | **CO5** |