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Total Number of Pages : 02

M.Tech
P1ELBC03

1st Semester Regular/Back Examination 2019-20
POWER CONVERSION DEVICES AND DRIVES

BRANCH : ELECTRI & ELECTRO ENGG (POWER SYSTEM ENGG), ELECTRICAL AND ELECTRO ENGG

Max Marks : 100

Time : 3 Hours

Q.CODE : HRB734

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Only Short Answer Type Questions (Answer All-10) (2 x 10)

- a) What is damper winding and why it is used in synchronous machine ?
- b) What is Kron's primitive machine? Draw it's basic diagram.
- c) Explain with example of Pseudo stationary coil.
- d) What is the average voltage of a single phase fully controlled rectifier feeding a purely resistive load ?
- e) What is soft starting of induction motor ?
- f) What is the impact of non-sinusoidal excitation on induction motor ?
- g) What is the difference between static Kramer drive and static Scherbius drive ?
- h) Write down the comparison between VSI controlled drive and CSI controlled drive .
- i) Variable frequency control of induction motor yields high torque to current ration during stating. Why ?
- j) Draw the torque-speed characteristics of three-phase induction motor in four-quadrant mode of operation.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- a) Draw and explain the two-pole machine representation of 3-phase synchronous machine with damper bars. Derive its voltage equation.
- b) Explain the four quadrant operation of a motor driving a hoist load.
- c) A drive has the following parameters: $J= 10 \text{ kg-m}^2$, $T= 100-0.1N$, N-m. Passive load torque $T_L= 0.05N$, N-m, where N is the speed in rpm. Initially the drive is operating in steady-state. Now it is to be reversed. For this motor characteristics is changed to $T= -100-0.1N$, N-m. Calculate the time of reversal.
- d) Derive the dynamic modeling of 3-phase synchronous machine under 3-phase fault.
- e) A single phase 230V , 1kW heater is connected across 1-phase , 230V , 50 Hz supply through an SCR. For firing angle delay of 45° , calculate the power absorbed in the heater element.
- f) A single -phase full -converter feeds power to RLE load with $R=6\Omega$, $L=6 \text{ mH}$ and $E=60V$. The ac source voltage is 230V, 50Hz. For continuous conduction, find the average value of load current for a firing angle delay of 50° .
- g) A 3-phase full- converter charges a battery from a three-phase supply of 230V, 50 Hz. The battery emf is 200V and its internal resistance is 0.5Ω . On account of inductance is connected in series with the battery, charging current is constant at 20A. Compute the firing angle delay and the supply power factor.
- h) Explain the working of a three-phase ac regulator with neat sketch diagram and waveforms. Write it's various application.

- i) Explain the working principle of CSI drives of three-phase induction motor with neat sketch diagram.
- j) Derive the mathematical equation of torque for studying the analysis and performance of three-phase induction motor.
- k) Explain the operation of multistep transformer tap changer with neat sketch diagram.
- l) A 2200V, 2600 kW, 735 rpm, 50 Hz, 8 pole, 3-phase squirrel cage induction motor has following parameters referred to the stator:
 $R_s = 0.075\Omega$, $R_r' = 0.1\Omega$, $X_s = 0.45\Omega$, $X_r' = 0.55\Omega$. Stator winding is delta connected and consists of two sections connected in parallel.
Calculate starting torque and maximum torque as a ratio of rated torque, if the motor is started by star-delta switching.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** Explain the principle of operation of four-quadrant operation of Chopper. Show that for a basic dc to dc converter, the critical inductance of the filter circuit is given by $L = \frac{V_0^2 (V_s - V_0)}{2fV_s P_0}$, where V_0 , V_s , P_0 and f are load voltage, source voltage, load power and chopping frequency respectively. **(16)**
- Q4** Explain the operation of circulating mode and non-circulating mode of dual converter with neat sketch diagram and waveforms. Give a comparison between them. Write down various applications. What are the advantages and disadvantages of dual converter? **(16)**
- Q5** Write down brief construction and principle of operation of three phase induction motor along with equivalent circuit referred to primary side and draw its phasor diagram and write down various mathematical expression. **(16)**
- Q6** Derive the detail dynamic modeling of induction machine in synchronous reference frame with neat sketch diagram. Derive the mathematical modeling of voltage and torque. Write down the electrical transient model in terms of voltage and current. **(16)**