Hall Ticket No | | | | | | | | | | | Question Paper Code: AEE013

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech VI Semester End Examinations (Regular) - May, 2019

Regulation: IARE – R16

SOLID STATE ELECTRIC MOTOR DRIVES

Time: 3 Hours **(EEE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Explain the operation of single phase fully controlled converter fed separately excited DC motor in continuous current mode. Sketch the waveforms of output voltage and current. Derive the expression for torque – speed relation. **[7M]**

   (b) A separately excited DC motor, operating from a single phase half controlled converter at a speed of 1400 rpm, has an input voltage of 330 Sin 314t and a back emf 80 V. The SCR's are fired symmetrically at α=30^0 in every half cycle and the armature has a resistance of 4Ω. Calculate the average armature current and the motor torque. **[7M]**

2. (a) Explain the operation of three phase half controlled converter fed separately excited DC motor in continuous current mode. Sketch the waveforms of output voltage and current for firing angle α=120^0. Derive the expression for Torque – Speed relation. **[7M]**

   (b) A separately excited D.C motor is supplied from 230 V, 50 Hz source through a single phase half controlled converter. Its field is fed through single-phase semi converter with zero degree firing angle delay. Motor resistance R_a = 0.5 Ω and motor constant = 0.5 V-sec/rad. For rated load torque 10 N-m at 1000 rpm and for continuous ripple free current, determine the firing angle delay of the armature converter. **[7M]**

UNIT – II

3. (a) List the different braking methods of separately excited DC motor. Explain regenerative braking in detail. Is it possible to achieve regenerative braking in DC series motor? Justify your answer. **[7M]**

   (b) A 200V, 1500rpm, 50A separately excited motor with armature resistance of 0.5 ohm is fed from a circulating current dual converter with AC source voltage 165V. Determine converter firing angle for the following operating points i) Motoring operation at rated motor torque and 1000rpm.
   ii) Braking Operation at rated motor torque and 1000rpm. **[7M]**

4. (a) Explain the operation of four quadrant operation of chopper fed DC motor with different modes of operations. **[7M]**

   (b) A 230V, 1750 rpm, 74A DC motor has an armature resistance of 0.180 ohm and is driven with its armature supplied from a class A chopper and 240V DC source, given rated operation on 230V. The chopping frequency is constant at 500Hz. If the average armature current is equal to the rated value and t_{on} is at the setting that gives the largest harmonic content, determine the
   i) Motor speed, ii) The rms armature current iii) The rms and line current ripple factor. **[7M]**

UNIT – III

5. (a) Discuss briefly the stator voltage control scheme of induction motors using AC voltage regulators and give its applications. Also draw and explain the speed torque curves. **[7M]**

   (b) A 440 V, 50 Hz, 4 pole, 1420 rpm, delta connected squirrel cage induction motor has the following parameters referred to the stator:

   R_s=0.35 Ω, $R_{r'}$=0.4 Ω, X_s=0.7 Ω, $X_{r'}$=0.8 Ω

   The motor is fed from a voltage source inverter. The drive is operated with a constant (V/f) control up to 50 Hz and at rated voltage above 50 Hz. Calculate the frequency for motoring operation at 950 rpm and full load torque. **[7M]**

6. (a) Explain the closed loop operation of CSI fed induction motor drive with block diagram. **[7M]**

   (b) A three phase squirrel cage induction motor drives drives a blower type load. No load rotational losses are negligible. Show that rotor current is maximum when the motor runs at a slip of 1/3. Find also an expression for maximum rotor current. **[7M]**

UNIT – IV

7. (a) What is the importance of slip power recover schemes and explain the operation of static Kramer's with detailed analysis? **[7M]**

   (b) The rotor of a 4 pole, 50Hz wound rotor induction motor has a resistance of 0.3Ω per phase and runs at 1440rpm at full load. Calculate the external resistance per phase which must be added to lower the speed to 1320rpm, the torque being the same before. **[7M]**

8. (a) Discuss the speed control of three phase induction motor in sub-synchronous range using static Scherbius drive. **[7M]**

   (b) If 40Ω is the resistance and 0.75 is the duty cycle for the induction motor speed control using chopper, what is the effective value of resistance R_e. **[7M]**

UNIT – V

9. (a) Explain the operation of separate controlled synchronous motor by voltage source inverter. **[7M]**

   (b) A 500kW, three phase 3.3kV, 50Hz,0.8pf lagging, Y- connected synchronous motor has following parameters: X_s=15 ohm and rated field current is 10A. Assuming armature resistance is negligible calculate the i) The armature current at half rated torque and rated field current ii) The power factor at half rated torque and rated field current. **[7M]**

10. (a) Describe cyclo converter fed synchronous motor with neat diagrams. **[7M]**

    (b) A synchronous motor is controlled by a load commutated inverter, which in turn is fed from a line commutated converter. Source voltage is 6.6 kV, 50 Hz. Load commutated inverter operates at a constant firing angle α_l=140^0 and when rectifying α_l= 0^0. DC link resistance R_d=0.1 Ω. Drive operates in self controlled mode with a constant (V/f) ratio. Motor has the details: 8 MW, three-phase, 6600 V, 6-pole, 50 Hz, unity power factor, star connected, X_s=2.8 Ω, R_s=0 Ω. Determine source side converter firing angles for motoring operation at the rated current and 500 rpm. What will be the power developed by motor? **[7M]**

– ○ ○ ◯ ○ ○ –