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Question Paper Code : 91495

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Sixth Semester

Electrical and Electronics Engineering

EE6601 – SOLID STATE DRIVES

(Regulations 2013)

(Common to PTEE 6601 – Solid State Drives for B.E. (Part-time)

Fifth Semester – Electrical and Electronics Engineering – Regulations – 2014)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Write down the fundamental torque equation of motor-load system with constant inertia.
2. What are the components of load torque ?
3. What are the assumptions made for the purpose of steady state performance analysis of converter fed dc motor drives ?
4. Write down the control strategies of chopper.
5. What are the drawbacks of stator voltage control of induction motor drives ?
6. What is meant by field weakening mode in induction motor ?
7. What is the need of delay circuit in open loop v/f control of synchronous motor drives ?
8. Write down the disadvantage of self control techniques.
9. Define mechanical time constant.
10. Write down the transfer function of speed feedback filter used in dc drive system.

PART – B (5×13=65 Marks)

11. a) Derive the equation to analyse the steady state stability of equilibrium points in the speed torque plane. (13)

(OR)

b) i) A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with a gear tooth ratio of 0.1 and efficiency of 90%. The load has a moment of inertia of 10 kg-m^2 and a torque of 10 N-m. Other load has translational motion and consists of 1000 kg weight to be lifted up at an uniform speed of 1.5 m/s. Coupling between this load and the motor has an efficiency of 85%. Motor has inertia of 0.2kg-m^2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to the motor shaft and power developed by the motor. (9)

ii) Draw the typical load torque-speed characteristics of fan, high speed hoist, traction and constant power loads. (4)

12. a) Explain motoring and braking operation of three phase fully controlled converter fed dc separately excited motor in detail with necessary waveforms and equations. (13)

(OR)

b) Explain the four quadrant operation of chopper fed dc separately excited motor in detail with neat diagram and waveforms. (13)

13. a) A three phase, star connected, 60 Hz, 4 pole induction motor has the following parameters for the per phase approximate equivalent circuit referred to the stator. $R_s = R_r' = 0.024\ \Omega$ and $X_s = X_r' = 0.12\ \Omega$. The motor is controlled by variable frequency control with a constant (v/f) ratio.For an operating frequency of 12 Hz, Calculate :

i) The breakdown torque as a ratio of its value at the rated frequency for both motoring and braking.

ii) The starting torque and rotor current in terms of their values at the rated frequency. (13)

(OR)

b) Explain the drive strategy for constant air gap flux controlled induction motor drive in detail with neat diagram and equations. (13)

14. a) Explain the open loop v/f control of synchronous motor in detail with neat diagram. (13)

(OR)

b) Explain the self controlled synchronous motor drive operation employing load commuted thyristor inverter with constant margin angle control. (13)

15. a) Derive the transfer function of a separately excited dc motor with armature control. **(13)**

(OR)

b) Explain the design of speed controller for dc motor load system with inner current control and outer speed control loop. **(13)**

PART – C **(1×15=15 Marks)**

16. a) A 220 V, 875 rpm, 150 A separately excited dc motor has an armature resistance of 0.06 Ω. It is fed from a single phase fully controlled rectifier with an ac source voltage of 220 V, 50 Hz. If armature circuit resistance of motor is 0.85 mH, calculate motor torque for a = 60° and speed = 400 rpm. **(15)**

(OR)

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 of 140° and when rectifying a = 0°, dc link inductor resistance R_d = 0.1 Ω. Drive operates in self control mode with a constant (v/f) ratio. Motor has the details : 8 MW, 3 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 :

i) Motor operation at the rate current and 500 rpm. What will be the power developed by the motor ?

ii) Regenerative braking operation at 500 rpm and rated motor current Also calculate power supplied to the source. **(15)**