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Question Paper Code : 52960

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Sixth Semester

Electrical and Electronics Engineering

EE 6601 — SOLID STATE DRIVES

(Regulation 2013)

(Common to PTEE 6601 — Solid State Drives for B.E. Part time — Fifth Semester — Electrical and Electronics Engineering — Regulation 2014)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define active load torque.
2. What are the drawbacks of mechanical braking systems?
3. What are the drawbacks of converter fed dc motor drives?
4. Why are self commutated power devices preferred over thyristors in dc-dc converters?
5. Why speed control of induction motor using stator voltage control is suited for fan and pump drives?
6. Why current source inverter fed drives are more reliable than voltage source inverter fed drives?
7. What is self control mode operation of synchronous motors?
8. What are the classifications of permanent magnet synchronous motors?
9. What is the necessity of closed loop control in electric drives?
10. What are the points to be remembered in designing a controller for a drive?

PART B — (5 × 13 = 65 marks)

11. (a) Explain the speed–torque conventions in the four quadrant operation of motor driving a hoist load. (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 $0.2\,kg-m^2$ 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) A 200V, 875 rpm, 150 A separately excited DC motor has an armature resistance of $0.06\,\Omega$. It is fed from a single phase fully controlled rectifier with an AC source voltage of 220 V 50Hz. Assuming continuous conduction, calculate

(i) Firing angle for rated motor torque and 750 rpm.

(ii) Firing angle for rated motor torque and (–500rpm).

(iii) Motor speed for alpha = 160 degrees and rated torque. (13)

Or

(b) Explain three phase fully controlled converter in discontinuous conduction mode operation with necessary circuit diagram, waveforms and equations. (13)

13. (a) Explain theory and operation of energy efficient induction motor driven with constant v/f control in detail with necessary circuit diagram and equations. (13)

Or

(b) A Y–connected squirrel cage induction motor has following ratings and parameter: 400 V, 50 Hz, 4pole, 1370 rpm, $R_s = 2\,\Omega$, $R'_s = 3\,\Omega$, $Xm = X'_r = 3.5\,\Omega$. Motor is controlled by voltage source inverter at constant v/f ratio. Inverter allows frequency variation from 10 to 50Hz.

(i) Obtain the plot between the breakdown torque and frequency.

(ii) Calculate starting torque and current of this drive of the ratio of their values when motor is started at rated voltage and frequency. (13)

14. (a) Explain the operation of self controlled synchronous motor in constant margin angle control technique. (13)

Or

(b) Explain synchronous motor power factor control by the control of field excitation in detail with phasor diagram and 'V' curves. (13)

15. (a) Derive the transfer function of DC motor load system with armature control. (13)

Or

(b) Explain the closed loop operation of armature voltage control with field weakening mode operation with neat diagram. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A 2.8 KW, 400 V, 50 HZ, 4 pole, 1370 rpm, delta connected squirrel cage induction motor has following parameters referred to the stator $R_s = 2\,\Omega$, $R'_r = 5\,\Omega$, $X_s = X'_r = 5\,\Omega$, $X_m = 80\,\Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate

(i) motor terminal voltage at 1200 rpm and

(ii) motor speed, current and torque for the terminal voltage of 300 V. (15)

Or

(b) Explain the step by step procedure of design of speed controller for closed loop control of separately excited dc motor with armature voltage control. (15)

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