CBCS SCHEME

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17EE82

Eighth Semester B.E. Degree Examination, July/August 2022
Industrial Drives and Applications

Time: 3 hrs.

Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Draw and explain the block diagram of an electrical drive. **(08 Marks)**
   b. What are the advantages of electrical drives? **(06 Marks)**
   c. A motor drives a rotational load which is coupled to the motor through a reduction gear with a = 0.25 and efficiency 92%. The load has moment of inertia of 20kg – m^2 and a torque of 20N-m. Motor has a moment of inertia of 0.2kg-m^2 and runs at a constant speed of 1400rpm. Determine equivalent inertia refered to motor shaft, equivalent torque refered to motor shaft and power developed by the motor. **(06 Marks)**

OR

2 a. Explain the components of load torques and mention their dependencies on motor speed. **(06 Marks)**
   b. Derive the condition of the steady state stability of an equilibrium point of a motor – load system. **(07 Marks)**
   c. A motor – load system has motor torque $T = 1450 – 0.95W_m$ and load torque $T_\ell = 0.5W_m$. Calculate the equilibrium speed and check the steady state stability of the equilibriums point. **(07 Marks)**

Module-2

3 a. Explain different classes of motor duty. **(10 Marks)**
   b. A motor operates on a continuous duty. The initial temperature is 30°C. The heating time constant is 60 min. After 10min, the temperature is 50°C. Determine the steady state temperature and temperature after 20 min. **(05 Marks)**
   c. A constant speed drive has the following duty cycle :
   i) Uniform load of 500KW for 5 min
   ii) Regenerative power of 400Kw returned to supply for 4 min
   iii) Remain idle for 2 min
   Estimate power rating of the motor assuming losses to be proportional to $(power)^2$. Also find motor torque if motor runs at 1420 rpm at rated power. **(05 Marks)**

OR

4 a. Explain fully controlled fullwave rectifier control of a separately excited DC motor. Draw torque – speed characteristics for various values of α. **(10 Marks)**
   b. A 200V, 150A, 875rpm separately excited DC motor has an armature resistance of 0.05Ω. It is fed from a single phase fully controlled full wave rectifier with AC source voltage of 220V, 50Hz. Assuming continuous conduction mode, calculate :
   i) Firing angle for rated torque and 750rpm
   ii) Motor speed for $\alpha = 150°$ and rated torque. **(10 Marks)**

Module-3

5 a. Explain the stator voltage control of 3 – phase induction motors. **(06 Marks)**
   b. Explain star – delta starting of 3 – phase induction motors with the help of a neat diagram. **(07 Marks)**
   c. A 400V, star connected, 3–ϕ, 6 pole, 50Hz induction motor has $R_S = R_r' = 1\Omega$, $X_s = X_r' = 2\Omega$. For regenerative braking operation, find maximum over hauling torque. **(07 Marks)**

OR

6 a. Explain variable frequency control of 3 – phase induction motors. **(05 Marks)**
   b. Explain regenerative braking of 3 – phase induction motors. **(05 Marks)**
   c. A 2 – 8KW, 400V, 50Hz, 4 pole, 1370 rpm, delta connected squirrel cage induction motor has following parameters refered to stator.
   $R_S = 2\Omega$, $R_r' = 5\Omega$, $X_S = 5\Omega$, $X_r' = 5\Omega$, $X_m = 80$. Motor speed is controlled by stator voltage control when driving a fan load, it runs at rated speed and rated voltage. Calculate motor terminal voltage and current at 1200rpm. **(10 Marks)**

Module-4

7 a. Explain cyclo converter control of 3 – phase induction motors. **(10 Marks)**
   b. Explain current source inverter control of induction motors. **(10 Marks)**

OR

8 a. Explain starting of synchronous motors from fixed frequency supply. **(10 Marks)**
   b. A star connected squirrel cage induction motor has following parameters :
   400V, 50Hz, 4-pole, 1370rpm, $R_S = 2\Omega$, $R_r' = 3\Omega$, $X_S = X_r' = 3.5\Omega$, $X_m = 55\Omega$. It is controlled by a current source inverter at a constant flux. Calculate motor torque, speed and stator current when operating at 30Hz and rated slip speed. **(10 Marks)**

Module-5

9 a. Explain torque – stepping rate characteristics of stepper motor. **(06 Marks)**
   b. Explain drive circuits for stepper motors. **(06 Marks)**
   c. Explain unipolar drive for variable reluctance motor of low power rating. **(08 Marks)**

OR

10 a. Explain industrial drives for textile mills. **(10 Marks)**
   b. Ex industrial drives for steel rolling mills. **(10 Marks)**

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