USN | | | | | | | | | | |

10EE74

Seventh Semester B.E. Degree Examination, July/August 2022

Industrial Drives and Applications

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

1 a. With a neat block diagram, state essential parts of an electrical drive system. Explain them briefly. **(10 Marks)**

b. What is an electrical drive? Mention the advantages of electrical drives over other types of drives. **(04 Marks)**

c. A drive has following parameters:
$J = 1\ kgm^2$; $T = 0.15 - 0.01$ N, Nm and passive load torque $T_\ell = 0.005$ N, Nm 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 altered such that $T = -0.15 - 0.01$ N, Nm. Calculate the reversal time. **(06 Marks)**

2 a. Derive a relationship between load torque and motor torque for steady state stability. **(06 Marks)**

b. Explain the method of determining the power rating for short time duty. **(06 Marks)**

c. A constant speed drive has the following duty cycle:
(i) Load rising from 0 to 400 KW for 5 min.
(ii) Uniform load of 500 kN for 5 min.
(iii) Regenerative power of 400 KW returned to the supply for 4 min.
(iv) Remains idle for 2 min.
Estimate the power rating of the motor. Assume losses to be proportioned to $(power)^2$. **(08 Marks)**

3 a. Explain the dynamic braking of DC separately excited motor. **(05 Marks)**

b. Describe the working of single phase half controlled rectifier control of d.c. separately excited motor. **(07 Marks)**

c. A 200 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 a.c. source voltage of 220 V, 50 Hz. Assuming continuous conduction, calculate:
(i) Firing angle for rated motor torque and 800 rpm.
(ii) Motor speed for $\alpha = 150°$ and rated torque. **(08 Marks)**

4 a. Explain the chopper control of d.c. series motor for motoring and regenerative braking. **(08 Marks)**

b. A 220V, 600 rpm, 500A, separately excited motor has armature and field resistance of 0.02 Ω and 10.2 Ω respectively. Armature is fed from a 3-ph fully controlled rectifier and field from half controlled single phase rectifier. A 3-wire 3-ph ac source with a line voltage of 440 V is available. Armature rectifier is fed a 3-ph transformer with Y-Δ connection and field rectifier from a 1-ph transformer.
(i) Output voltage of transformers must be such that for zero firing angles rated voltages are maintained across the motor armature and field. Calculate transformer turns ratios.
(ii) With the transformer turns ratio as in (i), calculate firing angles of the armature rectifier for rated torque, field and 400 rpm. **(12 Marks)**

PART – B

5 a. Explain the analysis of 3-ph induction motor fed from non-sinusoidal supply. **(08 Marks)**

b. A 3-ph, 400 V, 50 Hz, 6 pole, 925 rpm, star connected induction motor has the following parameters: $R_s = 0.2\ \Omega$, $R'_r = 0.3\ \Omega$, $X_s = 0.5\ \Omega$, $X'_r = 1.0\ \Omega$. The motor is to be braked by plugging from its initial full load speed of 925 rpm. Calculate:

(i) The initial braking current and torque as a ratio of their full load values.

(ii) The values of resistance required to be inserted in motor circuit to reduce the maximum braking current to 1.5 times full load current. Stator to rotor turns ration is 2. **(12 Marks)**

6 a. Explain 3-ph voltage source inverter control of induction motor with neat diagram i.e. circuit diagram and waveforms. **(12 Marks)**

b. Explain the speed control of three phase induction motor by static rotor resistance control. **(08 Marks)**

7 a. Explain the stability of synchronous motor drive during transients due to load disturbance. **(08 Marks)**

b. A 400 KW, 3-ph, 3.3 KV, 50 Hz, unity pf, 4-pole, star connected synchronous motor has the following parameters: $R_s = 0$; $X_s = 12\ \Omega$; rated field current = 10 A. The machine is controlled by variable frequency control at a constant v/f ratio. Calculate:

(i) The torque and field current for rated armature current, 900 rpm and 0.8 leading pf.

(ii) Armature current and p.f. for regenerative braking torque equal to rated motor torque, 900 rpm and rated field current. **(12 Marks)**

8 a. Explain the operation of self controlled synchronous motor drive employing load commutated thyrister inverter. **(10 Marks)**

b. Draw and explain the schematic diagram of various stages in the reversing hot rolling mills and mention the requirement of the drives. **(10 Marks)**

* * * * *