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EE 181602

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Roll No. of candidate | | | | | | | | | | |

2023

B.Tech. 6th Semester End-Term Examination

Electrical Engineering

ELECTRIC DRIVES

New Regulation (w.e.f 2017 – 18) & New Syllabus (w.e.f 2018 – 19)

Full Marks – 70 Time – Three hours

The figures in the margin indicates the full marks for the questions.

Answer Question No. 1 and any *four* from the rest.

1. Answer the following questions : (10 × 1 = 10)

(i) Active torques are those which are

(a) Changed with time

(b) Associated with change in kinetic energy

(c) Associated with change in potential energy

(d) Associated with frictional force

(ii) The equivalent moment of inertia of a body of weight W moving vertically at V m/sec referred to motor shaft with angular speed ω rad/sec. is

(a) $J = m(V/\omega)^2$ (b) $J = W/g(V/\omega)^2$

(c) $J = m(\omega/V)^2$ (d) $J = W(V/\omega)^2$

(iii) During starting of a dc shunt motor under no-load condition the energy transferred from the source is equal to (ω_0 = no-load speed)

(a) $0.5J\omega_0^2$ (b) $J\omega_0^2$

(c) $4\pi\ \omega_0^2$ (d) $3/2(J\omega_0^2)$

(iv) In a 3-phase induction motor the rheostatic braking can be employed by

(a) Connecting an external 3-phase resistance with the stator circuit

(b) Replacing 3-phase supply by dc supply

(c) Reversing the phase sequence of the supply

(d) Reducing the supply voltage $\sqrt{3}$ times

[Turn over

(v) In regenerative braking of a motor

(a) The braking energy is dissipated as heat in the motor circuit

(b) The motor torque reverses to produce braking effect

(c) The motor acts like a generator and the stored kinetic energy in the system being fed back to source

(d) The motor is disconnected from the supply

(vi) In V/F control of 3-phase induction motor, the voltage is increased by 10%, in order to keep air gap flux constant, what is the % change in the frequency?

(a) Frequency is decreased by 10%

(b) Frequency is decreased by 20%

(c) Frequency is increased by 10%

(d) Frequency is increased by 20%

(vii) Which duty cycle has on load and off load periods?

(a) Intermittent duty

(b) Short time duty

(c) Continuous duty with constant load

(d) Continuous duty with variable load

(viii) Which of the following is an example of multi type motor?

(a) Lathe machines (b) Cranes

(c) Motor with single shaft (d) None of the above

(ix) Which of the following drive is used in tape drive for video recorder?

(a) Synchronous mofor drive (b) BLDC motor drive

(c) Induction motor drive (d) All of the above

(x) Commutator less dc motor is:

(a) DC series motor with converter

(b) SRIM with load side converter

(c) Synchronous motor with load side converter

(d) DC separately excited motor

2. (a) Compare Individual Drive with Group Drive. (5)

(b) Give an example of Active Load and explain what makes it active. (4)

(c) A winch drive hoists a weight of 1 ton vertically at a uniform speed of 1m per minute. Calculate the equivalent moment of inertia of the weight referred to the motor shaft which rotates at 500 rpm. (6)

3. (a) Give a scheme for automatic starting of a dc shunt motor and briefly explain its working. (6)

(b) How braking torque is developed in a.c. rheostatic braking of an induction motor? (4)

(c) A 220V dc shunt motor is running at 1000 rpm and delivering 5kw of power. The shunt field resistance and the effective armature resistance are 220Ω and 0.5Ω respectively. The reverse current braking is applied with a restriction that, braking current is limited to 2.5 times the load current. Draw the circuit diagram for the braking operation with all parameters labelled. (5)

4. (a) Explain the regenerative braking of separately excited dc motor with chopper control circuit. (5)

(b) A 230 V, 960 rpm and 200 A separately excited dc motor has an armature resistance of 0.02 Ω. The motor fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230V. Assuming continuous conduction, calculate,

(i) Duty ratio of chopper for motoring operation at rated torque and 350 rpm.

(ii) Duty ratio of the chopper for braking operation at rated torque and 350 rpm.

(iii) If maximum duty ratio of chopper is limited to 0.95 and minimum permissible motor current is twice the rated, calculate the maximum permissible motor speed obtainable without field weakening and power fed to the source. (6)

(c) Derive the transfer function of the dc motor drive with constant flux and constant load torque for transient operation. (4)

5. (a) For variable frequency control of induction motor explain the following point:

(i) for speed below base speed (v/f) ratio is maintained constant, why?

(ii) for speed above base speed, the terminal voltage is maintained constant, why? (4)

(b) Explain the static rotor resistance speed control of IM drive. (5)

(c) A 3-phase, 440 V, 6-pole, 50 Hz, delta-connected slip-ring induction motor has rotor resistance of 0.2Ω and leakage resistance of 1Ω per phase referred to stator. When driving a fan load it runs at full load at 4% slip. What resistance must be inserted in the rotor circuit to obtain a speed of 850 rpm? Neglect the stator impedance and magnetizing branch. Stator to rotor turns ratio is 2.2. (6)

6. (a) Derive the power rating of an electric motor with continuous duty with variable load by the method of:

(i) Equivalent current and,

(ii) Equivalent torque. (8)

(b) The heating and cooling time constants of a 100Kw motor are 90 and 120 minutes respectively. Find the rating of the motor when subjected to a duty cycle of 18 minutes on certain load and 30 minutes on no load. Assume that the losses are proportional to square of the load. (4)

(c) Enumerate the similarities between a BLDC motor and a self-controlled synchronous motor drive. (3)

7. (a) Explain the process of load equalization. (5)

(b) Explain the working of BLDC motor drive for servo applications with suitable circuit and waveforms. (7)

(c) List the advantages of chopper fed dc drives. (3)