



Attempt all question
Assume any missing data

Q1: (20 Mark)

- (i) Discuss the two main drive circuits for stepper motors.
- (ii) A 250-W, 230 V, 50-Hz capacitor-start motor has the following constants for the main and auxiliary windings: Main winding, $Z_m = (4.5 + j 3.7)$ ohm. Auxiliary winding $Z_a = (9.5 + j 3.5)$ ohm. Determine the value of the starting capacitor that will place the main and auxiliary winding currents in quadrature at starting.

Q2: (20 Mark)

- a) Explains the principle of operation of switched reluctance motor, torque production and modes of operation.
- b) A universal series motor has resistance of 30Ω and an inductance of 0.5 H. When connected to a 250 V d.c. supply and loaded to take 0.8 A, it runs at 2000 r.p.m. Estimate its speed and power factor, when connected to a 250 -V, 50 -Hz a.c. supply and loaded to take the same current.

Q3: (25 Mark)

- a) Explain the connection diagram and torque wave form of three phase six pulse Brushless dc motor
- b) A two phase servo motor has rated voltage applied to its reference phase winding. The T-speed characteristics of the motor with $V_a = 115$ V, 60 Hz, applied to its control phase winding is shown in fig.1 the moment of inertia $J = 10.5 \text{ kg.m}^2$, and the viscous friction of the load is negligible.
- 1- Obtain the transfer friction between shaft position and control voltage V_a
 - 2- Obtain expression for the shaft position due to the application of a step voltage $V_a = 115$ V to the control phase winding.

Q4: (25 Mark)

- a- A 2-pole permanent magnet stepper motor requires 6 steps per revolution. Determine: (i) the number of stator phases, (ii) the sequence of excitation, (iii) draw a cross sectional view of the stepper motor.
- b- Describe the different design forms of synchronous reluctance motor.



- c- A 3-phase, 50 Hz, 4-pole, synchronous reluctance motor has an $X_d = 8 \Omega$ and $X_q = 3 \Omega$, $R_a = 0$, rotational losses may be ignored. The motor is connected to a 550 V supply. Determine: T_{max} , pf_{max} and the power output for this condition.

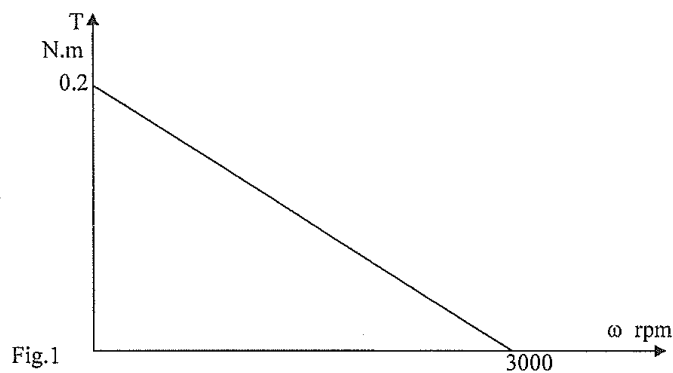


Fig.1

With my best wishes
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