

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140401

Roll No.

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B.Tech.

(SEM. IV) THEORY EXAMINATION 2013-14

ELECTRICAL MACHINES & AUTOMATIC CONTROL

Time : 3 Hours

Total Marks : 100

Note :— Attempt all questions. All questions carry equal marks.

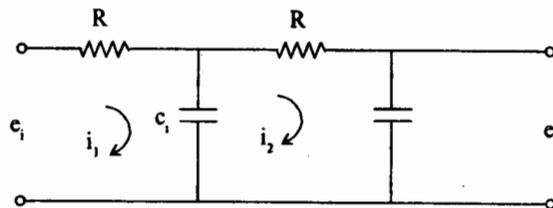
1. Attempt any two parts of the following : (10×2=20)
- (a) What are the losses in a transformer ? Write an expression for calculating the efficiency of a transformer. Develop the condition for maximum efficiency.
- (b) A 5 KVA, 200/400 V, 50 Hz single phase transformer gave the following test results :
- Open circuit test : 200 V, 0.7 A, 60 W on low voltage side
Short circuit test : 22 V, 16 A, 120 W on high voltage side
- (i) Find the voltage regulation at full load, 0.9 p.f. lagging.
- (ii) Determine the load for maximum efficiency and the value of this efficiency at unity p.f.
- (c) Why is the starting current high in dc motor ? How does the starter reduce the starting current to a safe value ?
- A 120 V dc shunt motor has an armature resistance of 0.2 Ω and a field resistance of 60 Ω. The full load line current is 40 A and full load speed is 1800 rpm. If the brush contact drop is 3 V, find the speed of the motor at half load.

2. Attempt any two parts of the following : (10×2=20)

- (a) Discuss the methods of starting :
- wound rotor induction motor and
 - cage rotor induction motor.
- (b) A 3 phase star connected alternator is excited to give 6599 V between lines on open circuit. It has resistance of 0.5Ω and a synchronous reactance of 5Ω per phase. Determine the terminal voltage at full load current of 130 A when the load power factor is :
- 0.8 lagging
 - 0.6 leading.
- (c) What is a two phase servomotor ? Draw its torque-speed characteristics for various control voltages.

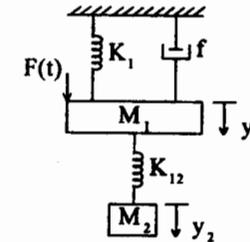
3. Attempt any four parts of the following : (5×4=20)

- Define the terms plants, process, systems and disturbances.
- Derive the transfer function of the network shown below :



- Explain the force-current analogy of translational mechanical system. Draw the analogous electrical system.
- Write the differential equation of the system shown below.

Also obtain an analogous electrical circuit based on force-current analogy.



- Write a short note on servo mechanism system.
- Consider the following ramp function.

$$f(t) = 0 \quad \text{for } t < 0$$

$$= At \quad \text{for } t \geq 0$$
 where A is a constant. Write the Laplace transform.

4. Attempt any two parts of the following : (10×2=20)

- A unity feedback control system is characterized by open

$$\text{loop transfer function } G(S) = \frac{K(S+13)}{S(S+3)(S+7)}$$

Using Routh-criterion, calculate the range of values of K for which the system is stable. Also check if $K=1$, all the roots of the characteristics equation of the system have damping factor greater than 5.

- Obtain the unit-step response of a unity-feedback system whose open-loop transfer function is

$$G(S) = \frac{5(S+20)}{S(S+4.59)(S^2+3.41S+16.35)}$$

- Sketch the polar plot of the transfer function given below.

Determine whether the plot crosses the real axis. If so, determine the frequency at which the plot crosses the real axis and the corresponding magnitude $|G(j\omega)|$

$$G(S) = \frac{1}{S^2(1+S)(1+2S)}$$

5. Attempt any two parts of the following : (10×2=20)

(a) A unity feedback control system has an open-loop transfer

$$\text{function } G(S) = \frac{K}{S(S+2)(S+4)}$$

Sketch the root locus plot of the system determining the following :

- (i) Centroid, number and angle of asymptotes.
- (ii) Angle of departure of root loci from the poles.
- (iii) Breakaway point if any.
- (iv) The value of K and the frequency at which the root loci cross the $j\omega$ -axis.

(b) Draw the Bode plot for the transfer function :

$$G(S) = \frac{10}{S(S+0.5S)(1+0.01S)}$$

From the plot, determine :

- (i) Gain cross-over frequency
- (ii) Phase cross-over frequency
- (iii) Gain margin and phase margin
- (iv) Stability of the system.

(c) Write short note on P, PI and PID controllers.