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

PAPER ID : 3988 Roll No. 0 9 0 3 2 4 0 0 4 1

B. Tech.

(SEM. IV) THEORY EXAMINATION 2010-11

ELECTRICAL MACHINES AND AUTOMATIC CONTROL

Time : 3 Hours *Total Marks : 100*

Note : Attempt **all** questions.

1. Attempt any **two** parts : **(10×2=20)**

   (a) What is meant by three phase transformer groups ? What are the possible connections for a 3-ϕ transformer bank ?

   (b) What is an autotransformer ? State its merits and demerits over the 2-winding transformer. A 1100/2200 V single phase transformer is rated at 1000 KVA, if the two windings are connected in series to form an autotransformer determine its voltage and power.

   (c) Why is starter necessary for starting a d.c. motor ? Explain briefly working principle of a 3-point starter.

   A 220 V d.c. shunt motor having an armature resistance of .25Ω carries an armature current of 50 A and runs at 600 r.p.m. if the flux is reduced by 1% by field regulator, find the speed of motor, assuming the torque to remain same.

2. Attempt any **two** parts : **(10×2=20)**

   (a) Derive the equation for the torque developed by a 3-ϕ induction motor. Draw a typical torque-slip curve and deduce the condition for maximum torque.

(b) What is a two-phase servomotor ? Draw its torque-speed characteristics for various control voltages.

(c) A-3 phase, star-connected alternator is rated at 1600 KVA,13500 V. The armature effective resistance and synchronous reactance 1.5 Ω and 30 Ω respectively per phase. Calculate the percentage regulation for load of 1280 kW at power factor of :

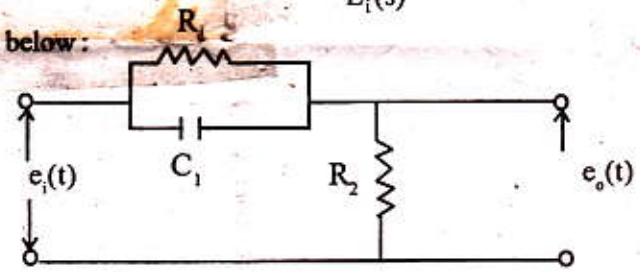
(i) .8 lagging

(ii) .8 leading.

3. Attempt any **four** parts : **(5×4=20)**

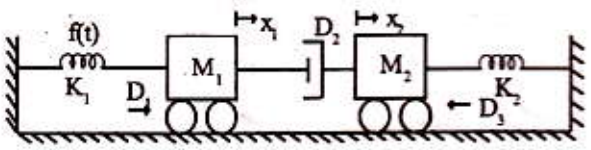
(a) Distinguish with suitable example between the open and closed loop control system.

(b) Derive the transfer function $\frac{E_o(s)}{E_i(s)}$ of the network shown below :



(c) Define force-voltage analogy and force-current analogy translational mechanical system.

(d) Obtain f -V analogous network for the system shown in fig. and also write the differential equation.



(e) Write the mathematical expression and draw the characteristics for input test signals.

(f) A thermometer has a time constant of 15.33 sec. It is quickly taken from a temperature 0°C to a water bath having a temperature 100°C. What temperature will be indicated after 60 sec ?

4. Attempt any **two** parts : **(10×2=20)**

(a) A unity feedback control system is characterized by open loop transfer function $G(s)=\frac{K(s+13)}{s(s+3)(s+7)}$:

(i) Using Routh-criterion, calculate the range of values of K for the system to be stable.

(ii) Check if K=1, all these roots of the characteristics equation of the above system have damping factor greater than 5.

(b) The open loop transfer function of unity feedback system is given by :

$$G(S)=\frac{K}{S(1+ST)}$$

Where 'K' and 'T' are positive constants. By what factor should the amplifier gain be reduced so that the peak overshoot of unit step response of the system is reduced from 75% to 25%.

(c) Sketch the polar plots for the following functions :

(a) $G(s)=\frac{1}{s(1+s)(1+2s)}$

(b) $G(s)=\frac{10(s+1)}{s+10}$

5. Attempt any **two** parts : **(2×10=20)**

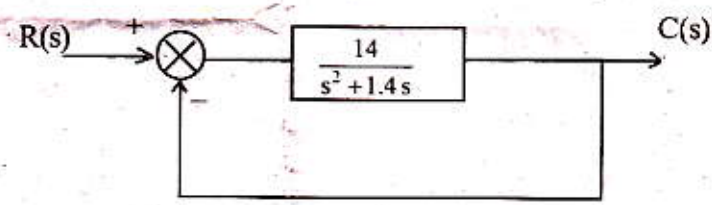
(a) The open loop transfer function of control system is given by :

$$G(s)\,H(s) = \frac{K}{s(s+6)(s^2+4s+13)}$$

Sketch the root locus and determine the break away point, the angle of departure from complex poles and the stability condition.

(b) Write short note on proportional control action and integral control action.

A closed loop control system with unity feedback is shown in fig. By using derivative control the damping ratio is to be made 7. Determine the value of T_d. The input system is unit step.



(c) Draw the Bode plot for the transfer function

$$G(s) = \frac{50}{s(1+.25s)(1+.1s)}$$

From the graph determine :

(i) gain crossover frequency
(ii) phase crossover frequency
(iii) G.M. and P.M.
(iv) stability of the system.