53 (IE 702) INSC

2015

INSTRUMENTATION SYSTEM COMPONENTS

Paper : IE 702

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions out of Seven.*

1. *(a)* What is synchro and explain its constrution and working principle ? 10

   (b) Give *any two* applications of synchro with neat diagram. 10

2. *(a)* Write short note on Tachogenerator with suitable application. 10

   (b) Explain the operating principle of Stepper Motor and draw the driver circuit and logic Translator. 10

3. A servo system is shown in the *Fig. 01*. The two phase Servo Motor develops a torque in accordance with the equation $T_M = K_1 e_c - K_2 d\theta_M / dt$ where

$$K_1 = 0{\cdot}6 \times 10^{-3}\ N\text{-}m\ /volt;$$

$$K_2 = 2 \times 10^{-3}\ N\text{-}m\ /(rad/sec);$$

Parameters of the given system are :

Synchro sensitivity, $K_S = 120\, volts/rad;$

Amplifier gain, $K_A = 20\ amps/volt$; Load inertia, $J_L = 2{\cdot}5 \times 10^{-5}\ kg - m^2$; Viscous Friction, $B_L = 1 \times 10^{-5}\ N$ - M/(rad/sec);

$(w_L/w_m) = 1/50$; $(w_L/w_S) = 1$; Motor inertia and Friction are negligible. Draw the block diagram of the system and therefore obtain the transfer function $\theta_L(s)/\theta_R(s)$.

(Any missing constants are treated as unity*)

20

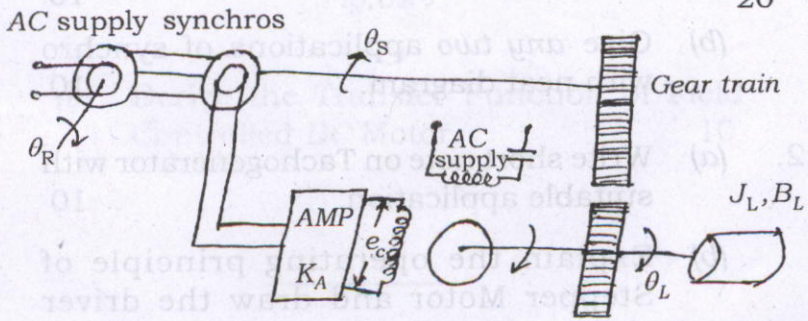

Fig.01

4. *(a)* Derive the overall gain for AC servomotor ? 10

(b) What is the effect of negative Feedback in performance of closed loop system and explain the Feedback pneumatic load cell (*or*) any suitable one example. 10

5. Define the Hydraulic System. Derive the transfer Function for Hydraulic Controllers (ie *P, PI, PD* and *PID*). 20

6. *(a)* Explain the construction and operation of pitot valve and two stage valve in Hydraulic System. 10

(b) Derive the Transfer Function of pneumatic PID Controller. 10

7. *(a)* Consider the System in *Fig. 02*. An Armature Control *dc* Servomotor drives a load consisting of the Moment of inertia J_L. The torque developed by the motor is *T*. The moment of intertia of the motor rotor is J_M. The angular displacement of the motor rotor and the load elements are θ_m and θ, respectively. The gear ratio is $n = \theta/\theta_m$. Obtain the transfer function $\theta(s)/E_i(s)$ 10

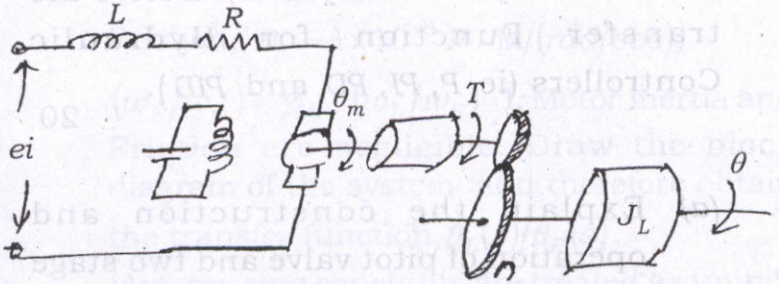

Fig.02

(b) Derive the Transfer Function of Field Controlled *DC* Motor. 10