**53 (IE 702) INSC**

**2014**

# 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 are the trade names of synchronous ? 3

*(b)* What are the applications of synchro and discuss *any one* briefly. 7

*(c)* Explain the construction and working principle of synchro with neat sketch. 10

2. *(a)* What are the applications of servomotor ? 3

*(b)* Derive the Transfer Function for *AC* servomotor. 7

*(c)* Give the physical realization and derive the Transfer Function of Hydraulic PI and PI controller. 10

3. *(a)* What is the working principle of stepper motor ? Discuss the operation of driver circuit and logical sequence in stepper motor. 10

*(b)* What is the principle of negative Feedback Transducer and explain the operation of servo operated Electromagnetic Flowmeter. 10

4. *(a)* Define the term Tachogenerator and give its types. Discuss the speed regulator as application of Tachogenerator. 10

*(b)* Explain the Construction, Operation and Equivalent circuit of *any one* of pneumatic valve. 10

5. *(a)* Write the construction and principle of operation of pitot valve and two stage valve in Hydraulic system. 10

*(b)* Give *any two* applications of stepper motor. 6

*(c)* Distinguish between Pneumatic system and Hydraulic system. 4

6. An *ac-dc* servo system is shown in *Fig. 1*. The sensitivity of the synchro error detector is $kg\ volts/rad$ and the gain of the generator is $kg\ volts/field\ amp$. The *dc* motor is separately excited and has a back *emf* constant of $K_b$ $volts/(rad/sec)$ and a torque constant of $K_T\ N\text{-}m/amp$. Motor inertia and friction are negligible. Draw the block diagram of the system indicating the transfer function of each block. Obtain $\theta_L(S)/\theta_R(S)$. The system parameters are given below : 20

$K_S = 30\,volts/rad$ ; $K_A = 7\,volts/volt$

$R_f = 120\,ohms$ ; $L_f = 3\,Henrys$

$K_g = 115\,volts/Field\ amp$ ; $R_a = 1 \cdot 2\,ohm$

$K_b = 1 \cdot 5 volts/(rad/sec)$ ; $J_L = 0 \cdot 8 kg\text{-}m^2$

$B_L = 1 N\text{-}m/(rad/sec)$ ; $\dot{\theta}_L / \dot{\theta}_M = \dot{\theta}_S / \dot{\theta}_M = 1$

Demodulator constant $K_d = 0 \cdot 9 volts/volt$

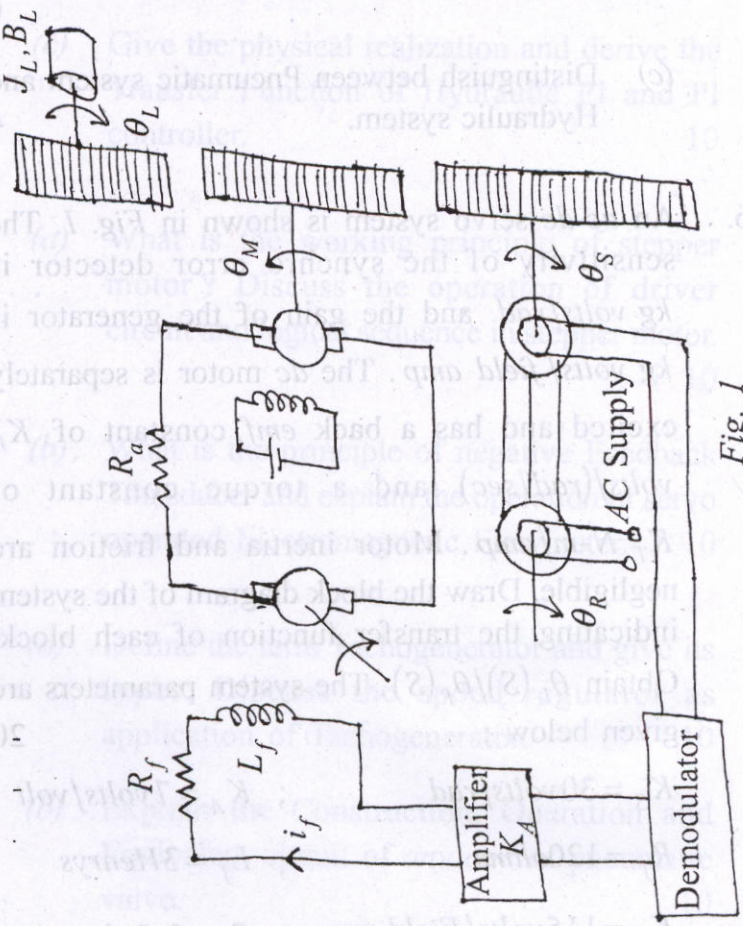


*Fig. 1*

7. Consider the system in *Fig. 2* with $R_a = 12\Omega$, $L_a = 0 \cdot 2H$, $K_b = 1 \cdot 2\ volt/(rad/sec)$, $\dot{\theta}_L/\dot{\theta}_M = 1/4$, $K_t = 0 \cdot 8\ volt/(rad/sec,)$ $K_p = 2\ volt/rad$. Moment of inertia of load, $J_L = 2 \cdot 4\ N\text{-}m/(rad/sec^2)$. Moment of inertia of motor shaft, $J_m = 0 \cdot 2\ N\text{-}m/(rad/sec^2)$. Coefficient of viscous friction of load, $B_L = 0 \cdot 02\ N\text{-}m/(rad/sec)$. Coefficient of viscous friction motor shaft, $B_M = 0 \cdot 1N\text{-}m/(rad/sec)$. Find the transfer functions $\theta_L(S)/E_a(S)$, $Y_2(S)/E_a(S)$ & $Y_1(S)/E_a(S)$. 20

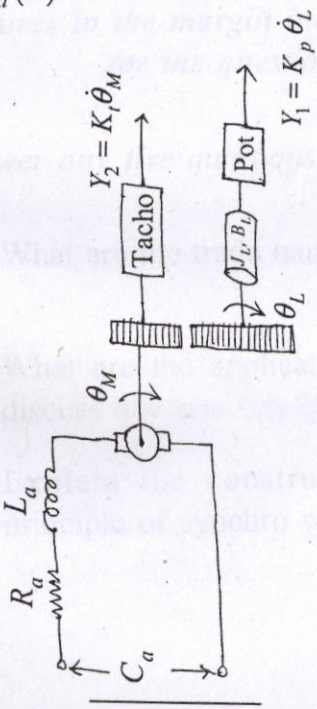


*Fig. 2*