53 (IE 702) INSC

2014

INSTRUMENTATION SYSTEM COMPONENTS

Paper : IE 702

Full Marks : 100

Pass Marks : 30

Time : Three hours

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

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

1. *(a)* Explain the construction and working principle of synchro with neat diagram. 10

   (b) Distinguish between synchro used as low torque measuring device and error detector. 10

2. *(a)* How the Tachogenerators are classified and explain it with suitable examples ? 10

(b) Derive the overall gain for AC servomotor. 10

3. *(a)* What are the different control actions ? Give its transfer function, advantages and disadvantages. 10

(b) Explain the construction, operation and applications of stepper motor. 10

4. *(a)* Discuss about negative Feedback Transducer with suitable example. 10

(b) Explain about hydraulic valve with suitable example. 10

5. Define the pneumatic system. Derive the transfer function for pneumatic controller (i.e P, PI, PT and PID). 20

6. *(a)* The Block diagram for position control system is shown below *(Fig. 1)* 10

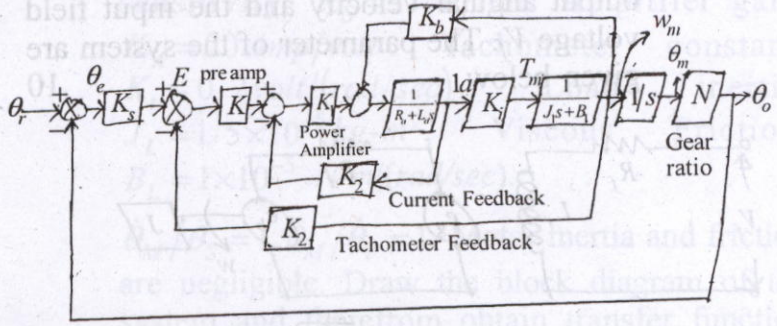

Fig. 1

(i) Find the loop Transfer Function $\theta_o(s)/\theta_e(s)$ (the outer feedback path is open)

(ii) Find the closed loop Transfer Function $\theta_o(s)/\theta_r(s)$.

(b) A control system is shown in below *Fig. 2*. The armature controlled *d.c.* motor is connected to a *d.c.* generator. Determine the transfer function of the system relating the output angular velocity and the input field voltage V_f. The parameter of the system are given below 10

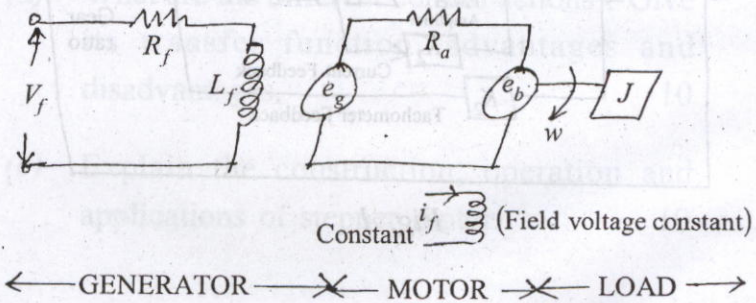

Fig. 2

Motor back *emf* constant $K_b = 1V/(rad/sec)$

Motor torque constant $K_T = 1Nm/A$

Combined inertia of motor and load $J = 0 \cdot 5 \times 10^{-14} kg\text{-}m^2$

Friction is negligible, $R_f = 1000\Omega$, $L_f = 20H$, $R_a = 50Ohm$; L_a is negligible.

7. The schematic diagrams of a servo system is shown in *Fig. 3*. The two phase servomotor develops a torque in accordance with the equation

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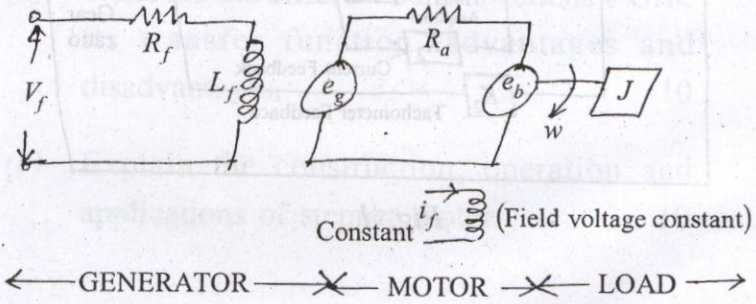

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7. The schematic diagrams of a servo system is shown in *Fig. 3*. The two phase servomotor develops a torque in accordance with the equation

$T_m = K_1 e_c - K_2 \dot{\theta}_M$ where $K_1 = 1 \times 10^{-5}$ *N-m/volt*, $K_2 = 0 \cdot 25 \times 10^{-5}$ *N-m/(rad/sec)*. The other parameter of the system are : Synchro sensitivity, $K_S = 1 volt/rad$. Amplifier gain, $K_A = 20\, Amp/volt$. Tachometer constant, $K_t = 0 \cdot 2 volt/(rad/sec)$. Load inertia, $J_L = 1 \cdot 5 \times 10^{-5}\, kg\text{-}m^2$, Viscous Friction, $B_L = 1 \times 10^{-5}$ *N-m/(rad/sec)*.

$\dot{\theta}_M / \dot{\theta}_S = 1$, $\dot{\theta}_M / \dot{\theta}_T = 1$. Motor inertia and friction are negligible. Draw the block diagram of the system and therefrom obtain transfer function $\theta_M(s)/\theta_R(s)$. 20

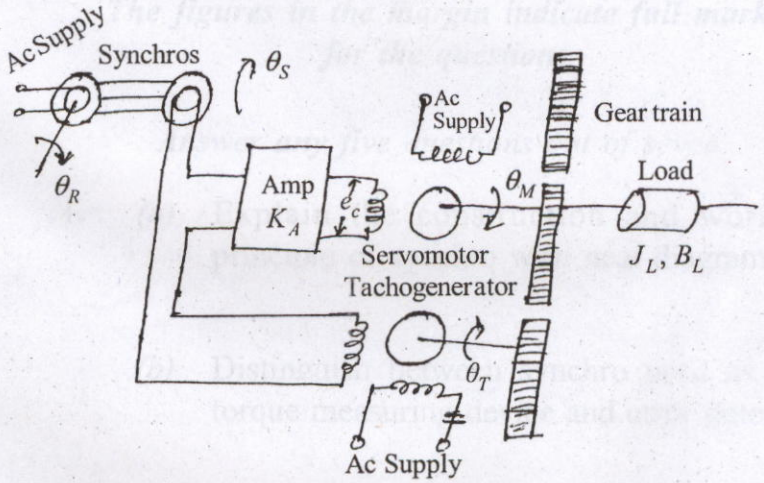

Fig. 3