Total No. of printed pages = 4

CAI-501/Control Systems/5th Sem/2015/M

CONTROL SYSTEMS

Full Marks – 70

Pass Marks – 28

Time – Three hours

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

Answer any *five* questions.

1. Convert the block diagram to signal flow graph and determine the transfer function using Mason's gain formula. 14

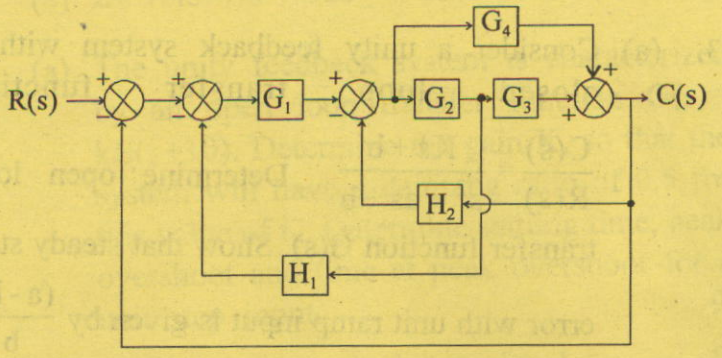

Fig. 01

[Turn over

2. (a) Derive the transfer function and time constants of armature control DC motor. 7

(b) Determine the transfer function $Y_2(s)/F(s)$ of the system shown in Fig. 02. 7

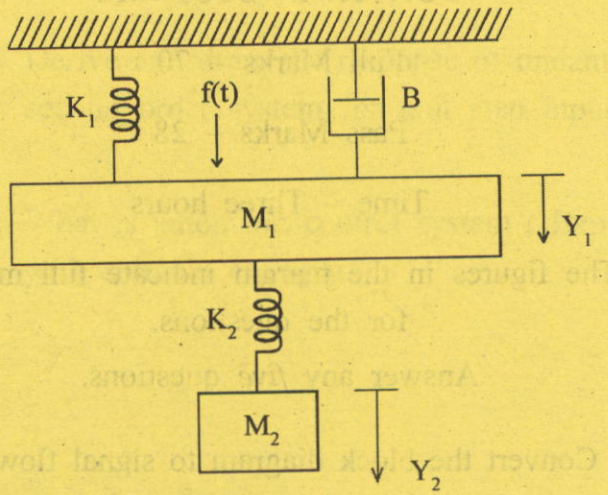

Fig. 02

3. (a) Consider a unity feedback system with a closed loop transfer function $\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2+as+b}$. Determine open loop transfer function G(s). Show that steady state error with unit ramp input is given by $\frac{(a-k)}{b}$. 5

(b) For servomechanisms with open loop transfer function given below, explain what type of input signal give rise to a constant steady state error and calculate their values. 9

(i) $G(s) = \dfrac{20(s+2)}{s(s+1)(s+3)}$

(ii) $G(s) = \dfrac{10}{(s+2)(s+3)}$

(iii) $G(s) = \dfrac{10}{s^2(s+1)(s+2)}$

4. Using Routh criterion, determine the locations of the roots of the following characteristic equations and comment on the stability of the system. $2\times7=14$

(a) $3s^4 + 10s^3 + 5s^2 + 5s + 3 = 0$

(b) $2s^6 + 4s^5 + s^4 - 32s^3 + 51s^2 + 3s + 15 = 0$

5. (a) The unity feedback system is characterized by an open loop transfer function $G(s) = k/s(s+10)$. Determine the gain K, so that the system will have a damping ratio of 0.5 for this value of K. Determine settling time, peak overshoot and time at peak overshoot for a unit step input. 9

(b) Explain the standard test signal. 5

6. (a) Derive the transfer function of AC servomotor. 7

(b) Give suitable example for synchro and explain it. 7

7. (a) Derive and draw the response of undamped second order system for unit step input. 7

(b) What is automatic control system ? Explain with suitable example. 7