USN

NEW SCHEME

Fourth Semester B.E. Degree Examination, July 2007
EC / TE / EE / IT / ML / BM
Control Systems

Time: 3 hrs.] [Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Define a control system. Explain the difference between open loop and closed loop control systems with one example for each. **(08 Marks)**

b. For the mechanical system shown in fig.1(b), i) Draw the mechanical network ii) Write the differential equation of the system. **(12 Marks)**

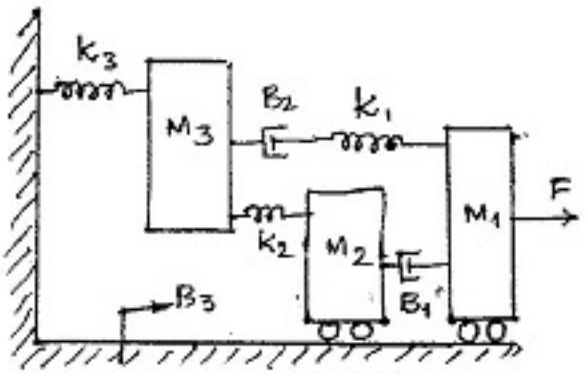


Fig.1(b)

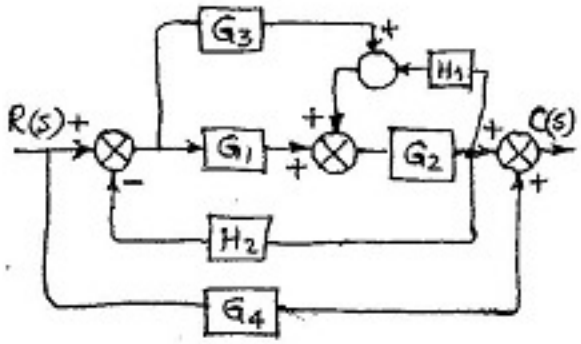


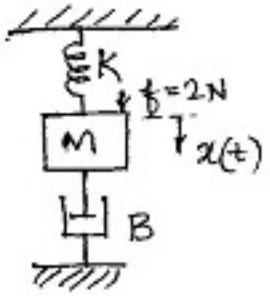
Fig.2(a)

2 a. Obtain $\frac{C(s)}{R(s)}$ of the system shown in fig.2(a) by using block diagram reduction method: **(08 Marks)**

b. Draw the signal flow graph for the system of equation given below and obtain the over all transfer function $\frac{X_6}{X_1}$ using MGF

$$X_2 = G_1X_1 - H_1X_2 - H_2X_3 - H_6X_6$$
$$X_3 = G_1X_1 + G_2X_2 - H_3X_3$$
$$X_4 = G_2X_2 + G_3X_3 - H_4X_5$$ **(12 Marks)**
$$X_5 = G_4X_4 - H_5X_6$$
$$X_6 = G_5X_5$$

3 a. For a spring mass damper system shown in fig.3(a), an experiment was conducted by applying a force of 2 Newtons to the mass. The response x(t) was recorded using an xy plotter and the experimental result is as shown in fig.3(a) below. Find the values of M, K and B. **(08 Marks)**



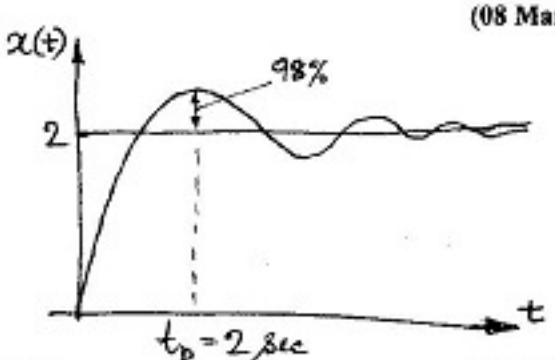


Fig.3(a)

Contd.... 2

b. Consider unity FBCS, whose OLTF is given by $G(s)=\frac{0.4s+1}{s(s+0.6)}$. Obtain the response to step input. For the same, calculate rise time, maximum peak overshoot, peak time and settling time. **(06 Marks)**

c. A unity FB system has $G(s)=\frac{K}{s(s+2)(s^2+2s+5)}$

i) For a unit ramp input, it is desired $e_{ss} \leq 0.2$, find K

ii) Determine e_{ss} if input $r(t)=2+4t+\frac{t^2}{2}$. **(06 Marks)**

4 a. Derive the condition on the impulse response so that the system is bounded input bound output (BIBO) stable. **(06 Marks)**

b. A unity FB system has $G(s)=\frac{K}{s(s+2)(s+4)(s+6)}$ using RH criteria; find the range of K for stability. Also find K_{max} and W_{max}. **(07 Marks)**

c. Determine the range of value of K (K>0) such that the characteristic equation is:
$s^3+3(K+1)s^2+(7K+5)s+(4K+7)=0$
has roots more negative than S = -1. **(07 Marks)**

5 a. State the different rules for the construction of root locus. **(08 Marks)**

b. Sketch the root locus diagram of a control system having,
$G(s)=\frac{K(s+1)}{s(s-1)(s^2+4s+16)}$ **(12 Marks)**

6 a. State and explain Nyquist stability criterion. **(07 Marks)**

b. Sketch the Nyquist plot of a unity feedback control system having the open loop transfer function $G(s)=\frac{5}{s(1-s)}$. Determine the stability of the system using Nyquist stability criterion. **(13 Marks)**

7 a. The open loop transfer function of a unity FBCS is given by,
$G(s)=\frac{K}{s(1+0.001s)(1+0.25s)(1+0.1s)}$
Determine the value of K so that the system will have a phase margin of 40^0. What will be the gain margin then? Use Bode plot. **(14 Marks)**

b. With figure define the frequency domain specifications. **(06 Marks)**

8 a. Given $G(s)H(s)=\frac{12}{s(s+1)(s+2)}$. Draw the polar plot and hence determine if system is stable and its gain margin and phase margin. **(12 Marks)**

b. The OLTF of an unity FBCS is, $G(s)=\frac{K}{s(s+a)}$

i) Find the values of K and a so that m_r = resonant peak = 1.04 and w_r = resonant frequency = 11.55 rad/sec.

ii) For the values of K and a found in part (i), calculate the settling time and bandwidth of the system. **(08 Marks)**