Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Control Systems

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define control system. Write the differences between open loop control system and closed loop control system. **(08 Marks)**

b. For the mechanical system shown in Fig.Q1(b) the analogous electrical network based on F-V analogy. **(08 Marks)**

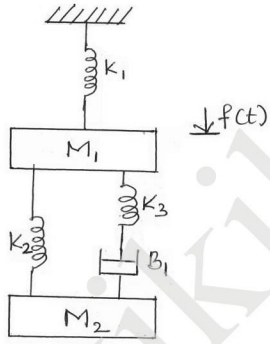

Fig.Q1(b)

OR

2 a. Define transfer function. derive an expression for the transfer function of a closed loop, negative feedback system. **(04 Marks)**

b. Reduce the block diagram shown in Fig.Q2(b) using block diagram reduction rules and obtain C(S)/R(S). **(06 Marks)**

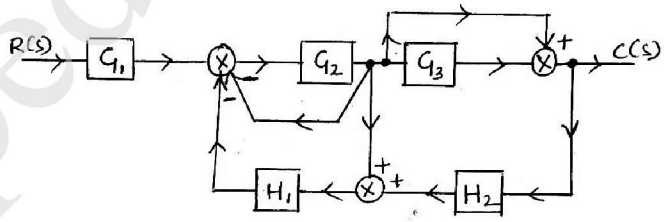

Fig.Q2(b)

c. Find $\frac{C(S)}{R(S)}$ using Mason's gain formula. **(06 Marks)**

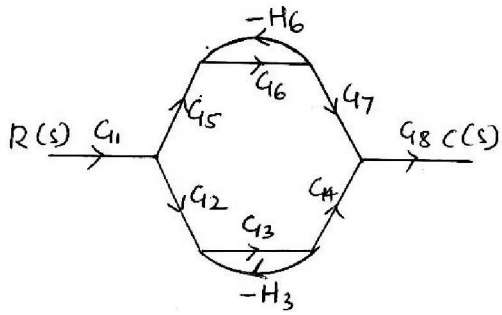

Fig.Q2(c)

Module-2

3 a. With the help of graphical representation and mathematical expression, explain the following test signals.
i) Step signal ii) Ramp signal iii) Impulse signal iv) Parabolic signal. **(08 Marks)**

b. Derive an expression for the underdamped response of a second order feedback control system for step input. **(08 Marks)**

OR

4 a. Define the following terms with respect to an underdamped second order system :
i) Peak time (T_p) ii) settling time (T_S) iii) Delay Time (T_d). **(06 Marks)**

b. A unity feedback system has $G(S) = \frac{40(s+2)}{s(s+1)(s+4)}$.
Determine : All error co-efficient ii) Error for ramp input with magnitude of 4. **(06 Marks)**

c. Derive the expression for rise time(T_r). **(04 Marks)**

Module-3

5 a. A feedback control system has a characteristic equation :
$s^6 + 2s^5 + 9s^4 + 16s^3 + 24s^2 + 32s + 16 = 0$.
How many poles are : i) in the left half of s-plane ii) on the imaginary axis iii) on the right half of the s-plane. **(06 Marks)**

b. For a unity feedback system, $G(s) = \frac{k}{s(1+0.4s)(1+0.25s)}$. Find the range of values of 'k', marginal value of 'K' and frequency of sustained oscillations. **(06 Marks)**

c. Explain the Routh's stability criterion for assessing the stability of a system. **(04 Marks**

OR

6 a. Explain the angle condition and magnitude condition. **(04 Marks)**

b. Sketch the complete root locus for the system having $G(s)H(s) = \frac{k}{s(s+1)(s+2)(s+3)}$. **(12 Marks)**

Module-4

7 a. Sketch the bode plot for the transfer function :

$$G(s) = \frac{ks^2}{(1+0.2s)(1+0.02s)}$$

Determine the value of k for the gain cross-over frequency to be 5 rad/sec. **(10 Marks)**

b. Define : i) Gain margin ii) Phase margin iii) Gain cross-over frequency. **(06 Marks)**

OR

8 a. For a certain control system :

$$G(s)H(s) = \frac{k}{s(s+2)(s+10)}$$

Sketch the Nyquist plot and hence calculate the range of values of k for system stability. **(10 Marks)**

b. State and explain the Nyquist stability criterion. **(06 Marks)**

Module-5

9 a. Explain a typical system with digital controller. **(06 Marks)**

b. Explain the spectrum analysis of sampling process. **(10 Marks)**

OR

10 a. Obtain the state transition matrix for

$$A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}.$$ **(08 Marks)**

b. List the properties of state transition matrix. **(04 Marks)**

c. Define : i) state ii) state variables. **(04 Marks)**