Code No: 125DU

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, November/December - 2017
CONTROL SYSTEMES ENGINEERING
(Common to ECE, ETM)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART – A

(25 Marks)

1.a) Explain about various types of control systems with examples briefly. [2]
b) Briefly explain about the characteristics of feed-back signal. [3]
c) Why test signals are needed? Explain various test signals used in feed-back control systems. [2]
d) Define time constant and explain its importance. [3]
e) Explain the concept of stability of a control system with an example. [2]
f) Distinguish between qualitative stability and conditional stability of a control system. [3]
g) What is compensation? Explain different types of compensators. [2]
h) Define gain margin and phase margin in frequency domain stability analysis. [3]
i) Discuss the significance of state Space Analysis. [2]
j) Define state variables. [3]

PART – B

(50 Marks)

2.a) Explain the operation of ordinary traffic signal, which control automobile traffic at roadway intersections. Why are they open loop control systems? How can traffic be controlled more effectively?
b) For the system represented in below figure 1, obtain transfer function $\frac{C}{R_1}, \frac{C}{R_2}$. [5+5]

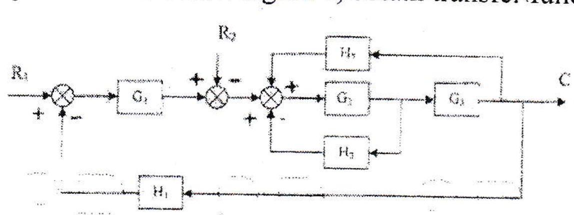

Figure 1

OR

3.a) Derive the transfer function of the following electrical network $\frac{V_o(s)}{V_i(s)}$ figure 2.

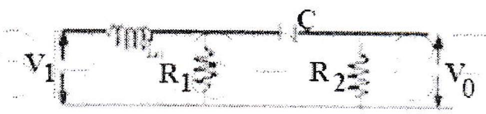

Figure 2

b) For a signal flow graph in below figure 3, determine the overall gain by masons gain formula. [5+5]

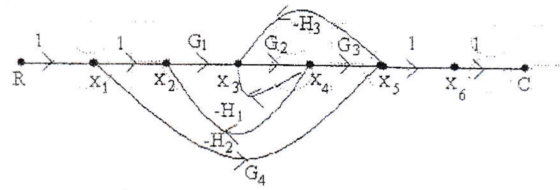

Figure 3

4.a) A unity feedback system is characterized by an open-loop transfer function $G(s)= K/s(s+5)$. 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 to peak overshoot for a unit-step input.

b) The open-loop transfer function of a servo system with unity feedback is $G(s)=10/s(0.1s+1)$. Evaluate the static error constants (K_p, K_v, K_a) for the system. Obtain the steady-state error of the system when subjected to an input given by the polynomial $r(t)=a_0+a_1t+a_2t^2/2$. [5+5]

OR

5.a) A unity feedback system has forward transfer function $G(s) = 20/(s+1)$. Determine and compare the response of the open and closed loop systems for unit step input. Suppose now that parameter variation occurring during operating conditions causes G(s) to modify to $G'(s)=20/(s+0.4)$. What will be the effect on unit-step response of open and closed loop systems? Comment upon the sensitivity of the two systems to parameter variations.

b) The response of a system subjected to a unit step input is $c(t) = 1 + 0.2e^{-60t}-1.2e^{-10t}$. Obtain the expression for the closed loop transfer function of the system. Also determine the undamped natural frequency and damping ratio of the system. [5+5]

6.a) Apply R-H criterion to determine stability of the system with the following characteristic equation $2s^4+10s^3+5s^2+5s+10=0$. Find the number roots with positive real parts, if any.

b) Explain the limitations of Routh's stability criteria. [5+5]

OR

7. Plot the root locus for the system with $G(s)H(s) = \frac{K(s+1)(s+3)}{s^3}$. Sketch the root locus and determine the range of K for which the system is stable. [10]

8. Sketch the Bode plots for a system $G(s) = \frac{15(s+5)}{s(s^2+16s+100)}$. Hence determine the stability of the system. [10]

OR

9.a) Explain the effect of addition of a pole at the origin on the polar plot of a given system.

b) Sketch the polar plot and hence find the frequency at which the plot intersects the positive imaginary axis for the system $G(s) = \frac{0.1}{s(1+s)(1+0.1s)}$. Also find the corresponding magnitude. [5+5]

10.a) Obtain the state variable representation of an armature controlled D.C Servomotor.

b) Derive the state models for the system described by the differential equation in phase variable form. [5+5]

$$\dddot{y} + 4\ddot{y} + 5\dot{y} + 2y = 2\ddot{u} + 6\dot{u} + 5u.$$

OR

11.a) Obtain the solution of a system whose state model is given by X = AX(t) +BU(t); X(0) =X_0 and hence define state Transition matrix.

b) Obtain the state model of the system shown in below figure 4. Consider the state variables as i_1, i_2 and v. [5+5]

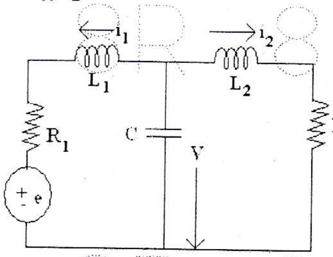

Figure 4

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