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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Sixth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; June/July - 2015

Control System

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer any **FIVE** full questions, selecting at least **TWO** full questions from **each part**.*

PART - A

1 a. Distinguish between open – loop and closed – loop control system with examples. Also define Linear and Non – linear control system. 8

b. Obtain electrical analogous circuit for the system given below using F.I. Analogy. 12

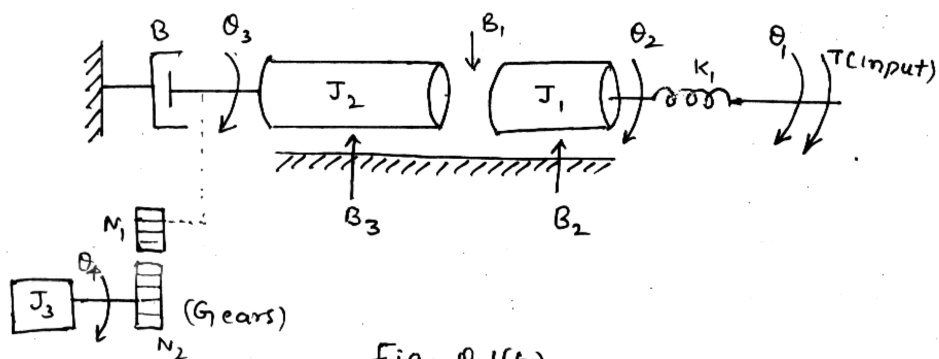

Fig. Q.1(b)

2 a. Draw a block diagram for the electric circuit shown and calculate transfer function $E_0(s)/E_i(s)$ 10

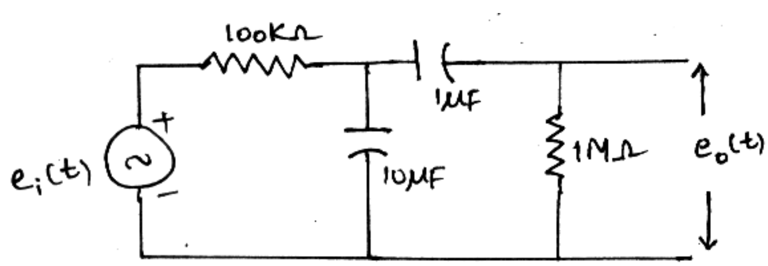

Fig. Q.2(a)

b. Solve the following using Mason's gain formula for calculating Transfer Function. 10

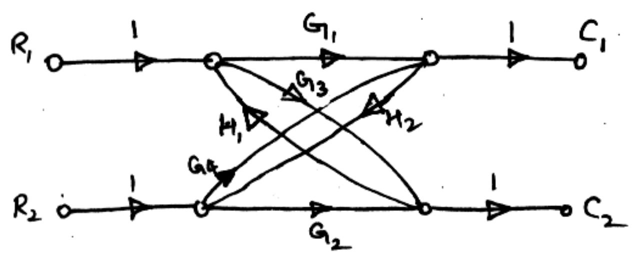

Fig Q. 2.(b)

3 a. Find K_P, K_V, K_a and steady state error for a system with open – loop transfer function as

$$G(s)H(s)=\frac{10(s+2)(s+3)}{s(s+1)(s+5)(s+4)}$$ 8

Assume the input as $r(t) = 3 + t + t^2$

b. A system has 30% overshoot and settling time of 5 second for an unit step input. Determine: i) The transfer function ii) Peak time (t_p) 6

iii) Output response. (Assume e_{ss} as 2%)

c. For the system shown in figure, determine :

i) Constant 'a' which makes damping ratio as 0.7.

ii) Find the value of Overshoot, M_p%. 6

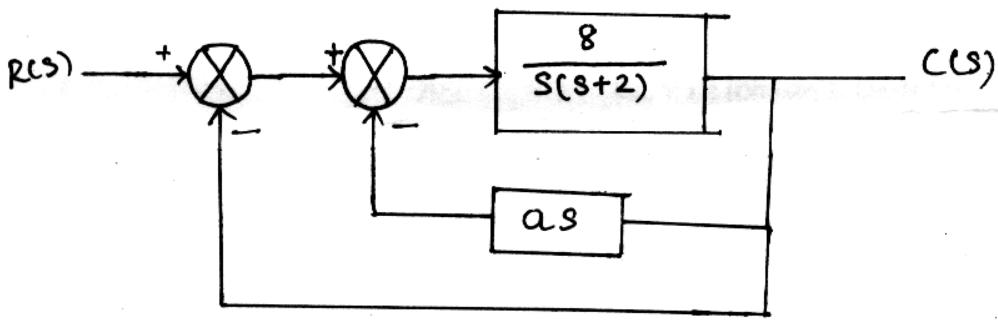

Fig Q.3.(c)

4 a. A feedback control system has an open – loop transfer function of $G(s)H(s)=\frac{Ke^{-s}}{s(s^2+2s+1)}$. 6

Determine the maximum value of 'K' for closed loop stability.

b. Check the stability of the given characteristic equation 7

$s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$ using Routh's method.

c. A unity feedback system has $G(s)=\frac{K(s+13)}{s(s+3)(s+7)}$ using Routh's criterion. Calculate the range of 'K' for which system has closed loop poles more Negative then '-1'. 7

PART - B

5.a. For $G(s)H(s)=\frac{K}{s(s+3)(s^2+3s+3)}$, Sketch the complete Root – locus and comment on stability. 12

b. Explain different steps involved in plotting root locus. 8

6 a. State and explain Nyquist stability criterion. 6

b. Construct the complete Nyquist plot for a unity feedback control system where $G(s)H(s)=\frac{K}{s(s^2+2s+2)}$. Find Maximum value of 'K' for which the system is stable. 14

7 a. Mention any five comments on correlation between time Domain and frequency domain. 5

b. For the function $G(s)H(s) = \frac{5(1+2s)}{(1+4s)(1+0.25s)}$ draw the bode plot. 15

8 a. Find the response of the system

$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix} u(t), X(0) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ and $y(t) = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} X$ to the following input, 12

$u(t) = \begin{bmatrix} U_1(t) \\ U_2(t) \end{bmatrix} = \begin{bmatrix} u(t) \\ e^{-3t}u(t) \end{bmatrix}$ where u(t) = unit step function.

b. Write state space equation for, 8

$h_a \frac{di_a}{dt} + R_a i_a + k_b \theta = v_a(t)$ and $\frac{jd^2\theta}{dt^2} + f\frac{d\theta}{dt} = T_a(t)$ where $T_a(t) = K_t i_a$

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