Printed Pages: 3 **Sub Code: NIC501**

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B.TECH.
(SEM-V) THEORY EXAMINATION, 2018-19
CONTROL SYSTEM-I

Time: 3 Hr ***[Total Marks :100]***

Note: Attempt questions from each Section as per instructions.

SECTION-A

1. Attempt ALL parts . **(2*10=20)**

(a) Classify control Systems and explain the difference between open loop control system & closed loop control system
(b) Explain the term: Gain Margin and Phase Margin
(c) What is the condition of breakaway point in root locus plot? Determine the breakaway point for the system function H(s)G(s) = $\frac{K}{s(s+1)(s^2+4s+5)}$
(d) Define the Routh Hurwitz stability criteria.
(e) What are the advantages of state variable techniques over transfer function approach?
(f) What is condition of controllability of state variable system.
(g) Determine the static position error constant for H(s) = 1 and G(s) = $\frac{50}{(s+5)(s+7)}$
(h) Explain the effect of adding a pole in forward path of the transfer function.
(i) Determine the step response of the system having transfer function as $\frac{C(s)}{R(s)} = \frac{600}{(s+10)(s+60)}$
(j) Explain the use of incremental encoder.

SECTION-B

2. Attempt any THREE parts. **[10*3=30]**

a) **(i)** Using block diagram reduction techniques to obtain the transfer function of the following?

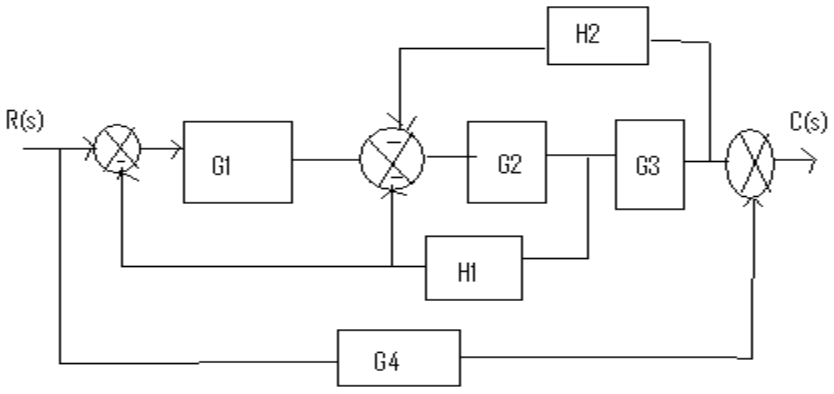

Figure 1

(ii) For a general second order system, obtain the response of the system, if it is subjected to unit step input?

b)(i) Find the transfer function of the following using mason gain formula:

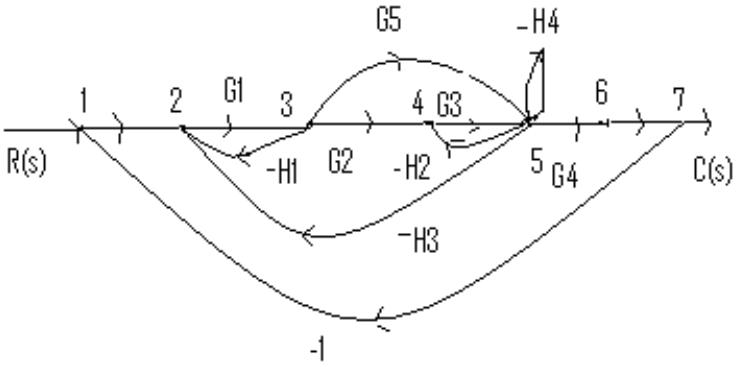

Figure 2

(ii) Explain the correlation between the time domain and frequency domain analysis and explain?

c) (i) The open loop transfer function of unity feedback system is given by k/(s+1)(s+3)(s+7) .Discuss the stability of the system using Routh Hurwitz's criteria to determine the range of k. Also find the value of K for the sustained oscillation condition

(ii) Derive the expressionfor rise time and peak time for time domain response of second order control system

d) (i) Explain the nature of response terms contributed by various types of roots and conclude about the BIBO stability and state the difference between Absolute and Relative Stability.

(ii) A single input single output system is given as below. Test for the controllability & Observability for this system?

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 1 & 1 \end{bmatrix} \quad C = [\,1 \quad 0 \quad 0\,]$$

e) (i) Obtain the Nyquist plot for $H(s)G(s) = \frac{10}{s^2(s+1)(s+5)}$

(ii) What is the role of sensors and encoders in control system ? Explain the construction and principle of operation of a potentiometer

SECTION-C

Attempt all FIVE questions. Attempt one part of each. **[10*5 =50]**

3. Attempt any one part:

(a) Obtain the transfer function $\frac{Y1(s)}{F(s)}$from the following model (figure 3)

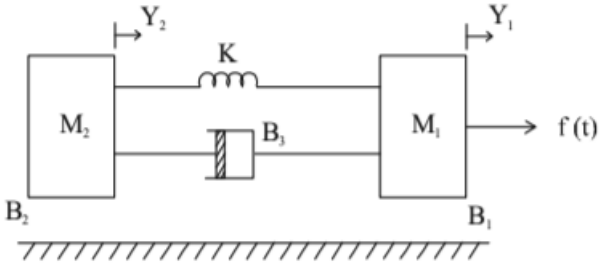

Figure 3

(b)Find the state variable representation of the following transfer function :$\frac{Y(s)}{U(s)} = \frac{2s^2+6s+5}{(s+1)^2(s+2)}$

4. Attempt any one part:

(a)Draw the root locus plot for the value of K when system with open loop gain as

$$G(s)H(s) = \frac{k}{s(s+1)(s^2+4s+5)}$$

(b) Sketch the bode plot for the following transfer function $H(s)G(s) = \frac{2(s+0.25)}{s^2(s+1)(s+0.5)}$ and comment on stability of the system

5. **Attempt any one part:**

(a) The open loop transfer function of a unity feedback control system is given as

$G(s) = \frac{K}{s(s+a)}$. Determine the value of K and T if it is desired that all the roots of closed loop system must lie on region towards the left of line s = -a . The system satisfies the conditions: $M_r = 1.1$ and $\omega_r = 12$ rad/sec. Also calculate the value of settling time and bandwidth

(b) What is steady state error ? Derive its expression. For step and ramp inputs in type 1 system, what will be its value

6. Attempt any one part:

(a) Draw the equivalent mechanical system of the given system(fig 4).Hence,write the set of equilibrium equatons for it and obtain electrical analogus circuits using F-V analogy

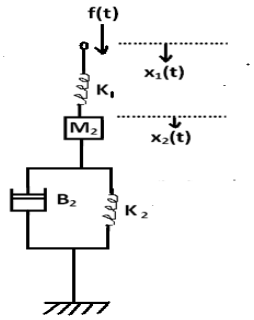

Figure 4

(b) Explain the mathematical modelling of a DC motor as used in control system

7. Attempt any one part:

(a) Using Signal flow graph determine transfer function of the following equation**:**

$$X_2 = A_{21}X_1 + A_{23}X_3$$
$$X_3 = A_{31}X_1 + A_{32}X_2 + A_{33}X_3$$
$$X_4 = A_{42}X_2 + A_{43}X_3$$
$$X_5 = A_{45}X_4 + A_{35}X_3$$

(b)What is the effect of adding a zero to the forward path transfer function ? Explain with relevant characteristics