Seat No:-_____

GANPAT UNIVERSITY
B.TECH SEM.4th ELECTRICAL ENGINEERING
REGULAR EXAMINATION MAY-JUNE 2013
2EE403: CONTROL SYSTEM ENGINEERING

TIME:-3 HOURS TOTAL MARKS-70

INSTRUCTION:-
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Section-I

Que-1 (a) Derive the solution of non-homogeneous state equation. (6)

(b) Solve the given state equation, for initial condition $X_0 = \begin{bmatrix}1\\1\end{bmatrix}$ (6)

$$\dot{X} = AX$$

$$A = \begin{bmatrix}1 & 4\\-2 & -5\end{bmatrix}$$

OR

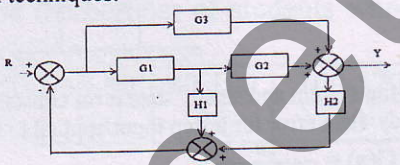
Que-1 (a) Sketch the root locus plot for the system having open loop transfer function is given by (9)

$$G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+13)}$$

(b) Draw the block diagram state space equation (3)

$$X = A\dot{X} + BU$$
$$Y = CX + DU$$

Que-2 (a) The block diagram of control system is shown below. Determine the overall transfer function by block diagram reduction techniques. (7)

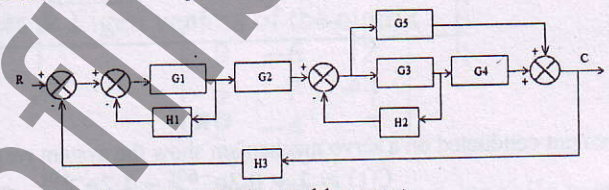


(b) Verify whether the following system is controllable or not. (4)

$$\begin{bmatrix}\dot{x}1\\\dot{x}2\end{bmatrix} = \begin{bmatrix}-2 & 0\\0 & -1\end{bmatrix}\begin{bmatrix}x1\\x2\end{bmatrix} + \begin{bmatrix}1\\1\end{bmatrix}u$$

OR

Que-2 (a) The block diagram of control system is shown below. Determine the overall transfer function by block diagram reduction techniques. (7)

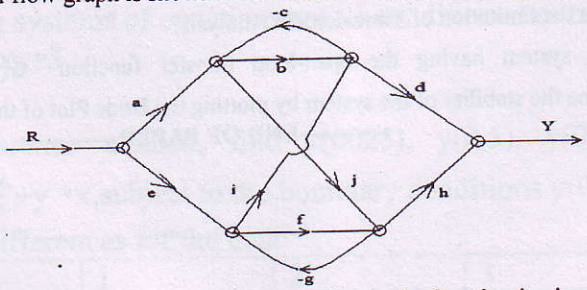


(b) Verify whether the following system is observable or not. (4)

$$\begin{bmatrix}\dot{x}1\\\dot{x}2\end{bmatrix} = \begin{bmatrix}0 & 1\\-2 & -3\end{bmatrix}\begin{bmatrix}x1\\x2\end{bmatrix} + \begin{bmatrix}0\\1\end{bmatrix}u$$

$$y = \begin{bmatrix}1 & 1\end{bmatrix}\begin{bmatrix}x1\\x2\end{bmatrix}$$

Que-3 (a) The system signal flow graph is shown below. Find the transfer function of the system. (6)



(b) Determine the stability of the system whose overall transfer function is given below. (6)

$$\frac{C(s)}{R(s)} = \frac{2s+5}{s^5+1.5s^4+2s^3+4s^2+5s+10}$$

Section-II

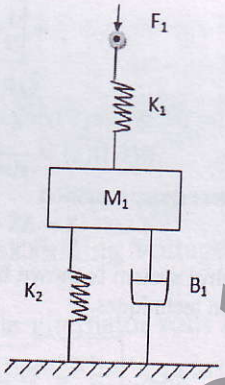
Que-4 (a) Discuss the stability of the system using Nyquist criterion for a system with open loop transfer fuction. $G(s)H(s) = \frac{20}{(1+0.1s)(1+0.5s)}$ **(8)**

(b) Explain F-V Analogy. **(4)**

OR

Que-4 (a) Derive the transfer function for armature controlled DC motor. **(6)**

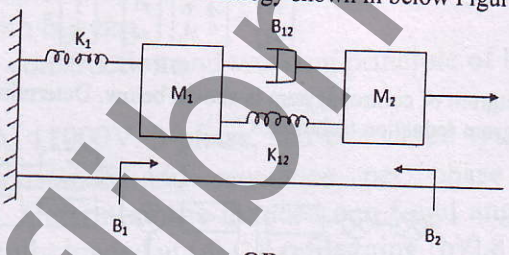
(b) Write the system equations & Draw F-V Analogy shown in below Figure. **(6)**



Que-5 (a) Explain types of the system and steady state error constants for the same. **(3)**

(b) Find out the steady-state error for a step input applied to a unity feedback system with the open transfer function $G(s) = \frac{10}{s^2+14s+50}$. **(2)**

(c) Write the system equations & Draw F-I Analogy shown in below Figure. **(6)**



OR

Que-5 (a) Measurement conducted on a servo mechanism show the system response to be **(5)**

$$C(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t},$$

When subjected to a unit step input. Obtain the expression for closed loop transfer function, the damping ratio and undamped natural frequency of oscillations.

(b) $T(s) = \frac{C(s)}{R(s)} = \frac{W_n^2}{S^2+2\zeta W_n S+W_n^2}$ **(6)**

Derive expressions of (i) Rise time, tr (ii) Peak time, tp and (iii) Peak overshoot, Mp for the system of above equation.

Que-6 (a) What are the limitation of Time domain Analysis? **(2)**

(b) For the system having the open-loop transfer function $G(S)H(S) = \frac{10}{S(S+1)(S+10)}$. **(10)**

Determine the stability of the system by plotting the Bode Plot of the system.

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