Code No: RT22026 **R13** SET - 1

II B. Tech II Semester Supplementary Examinations, April-2018
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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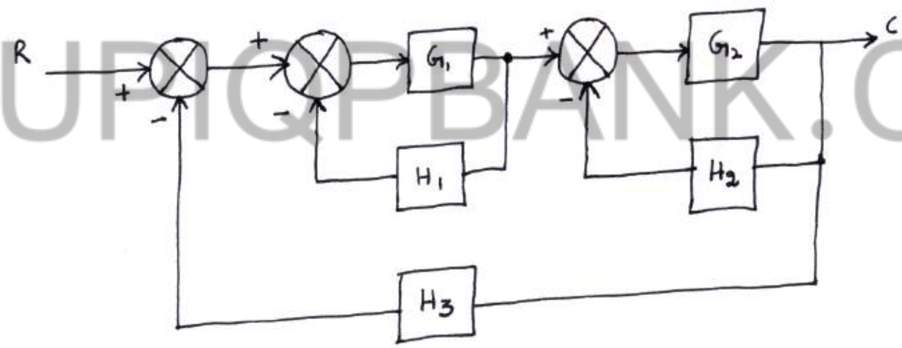
PART-A

1. a) What do you mean by mechanical translational systems (3M)
   b) What is the use of Mason's gain formula? (3M)
   c) Define steady state response and steady state error. (3M)
   d) What conclusion can be made if there is a row of all zeros in the Routh array? (2M)
   e) Define resonant frequency. (2M)
   f) What is the difference polar plot and Nyquist plot. (3M)
   g) Why frequency domain compensation is normally carried out using the Bode plots? (3M)
   h) What are the two conditions to be satisfied by the state variables? (3M)

PART-B

2. a) List the properties of signal flow graphs. (6M)
   b) Obtain the transfer function of the following by using block diagram reduction technique. (10M)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3. a) Derive an expression for the time response of a second order system excited by a unit step input (8M)

   b) A closed loop system has two complex conjugate poles at $s_1, s_2 = -2 \pm j1$. Determine the form of transfer function and values of natural frequency of oscillations of the system (ω_n), Peak time (T_p), Rise time (T_r), Settling time (T_s) and Peak Overshoot(M_p) assuming standard second order system. (8M)

4. a) State and explain the Routh stability criterion (8M)

   b) Determine the stability of the system having characteristic equation (8M)

   $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$

5. Sketch the Bode plot for the following transfer function and find the system gain K for the gain cross over frequency to be 10 rad/s. (16M)

$$G(s) = \frac{K\,s2}{(1+s)(1+0.2s)(1+0.02s)}$$

6. a) List the limitations of lag, lead, lag-lead compensators. (6M)

   b) Explain the realization of basic lag compensator using a Bode plot. (10M)

7. Given the system (16M)

   $\dot{x}(t) = A\,x(t) + B\,u(t),$

   $Y(t) = C\,x(t)$

   Where $A = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & 0 & -1 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$, $C = [\,1 \;\; 0 \;\; 1\,]$ Determine the state controllability, output controllability and observability of the system