TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

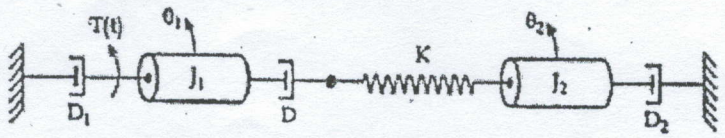
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BAS	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Control System *(EE 504)*

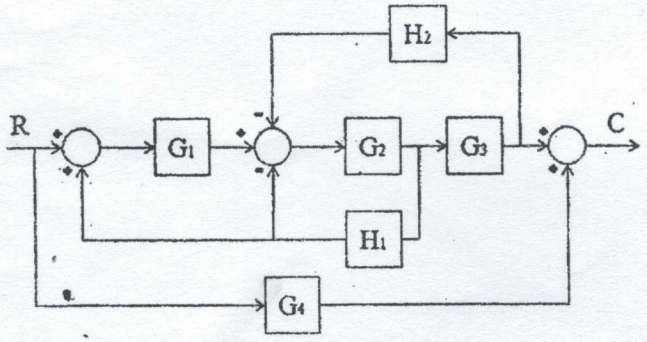
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is control system? "When feedback is added on a control system, it's response is faster." Illustrate this statement mathematically. [2+6]

   b) Find the transfer function, $\frac{\theta 2(S)}{T(S)}$, for the mechanical rotational system of figure below. Also draw the T-V and T-I analogy circuit of the system. [8]



2. a) Determine the transfer function C/R for the block diagram below by signal flow graph (SGF) techniques. [8]



   b) The open loop TF a unity feedback control system is given as

$$G(S) = \frac{k}{s(s^2+s+1)(s+2)+k}$$

   Determine the range of gain k for the system to be stable. Also determine the value of k which will cause the sustained oscillation and corresponding oscillation frequency. [5+3]

3. a) The open loop transfer function of a control system is given by

$$G(S)H(S) = \frac{k}{s(s+4)(s^2+4s+20)}$$

   Sketch the root locus for $0 \le K \le \infty$ and determine the breakaway point, the angle of departure from complex poles and the stability conditions. [10]

   b) Write short notes on followings: [3+3]

   (i) Characteristics of PI and PD control actions
   (ii) Nyquist stability criterion

4. a) Sketch the polar plot of the system whose open loop transfer function is given by

$G(S)H(S)=\frac{1}{s(1+s)(1+2s)}$. Also comment on stability. [8]

b) Discuss the advantages and limitations of state space analysis of control systems. Find the transfer function for the system represented by following state space model. [2+6]

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

$$y=\begin{bmatrix}1 & 0\end{bmatrix}x$$

5. Design a suitable lead compensating network for $G(S)=\frac{k}{s^2(1+0.25s)}$ to meet the following specification [16]

$K_a=10\ sec^{-1}$

$P.M\geq 35°$

***