No. of Printed Pages : 4 **BIEL-020**

B.Tech. – VIEP – ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

Term-End Examination

00146 **June, 2015**

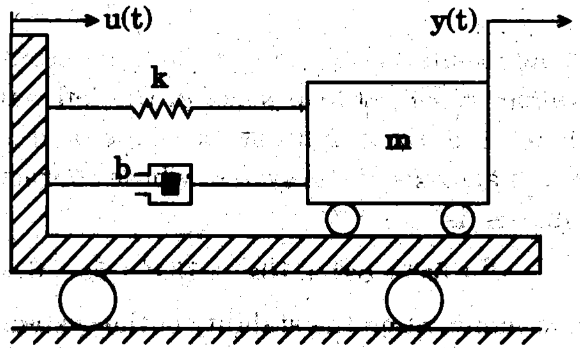
BIEL-020 : CONTROL ENGINEERING

Time : 3 hours *Maximum Marks : 70*

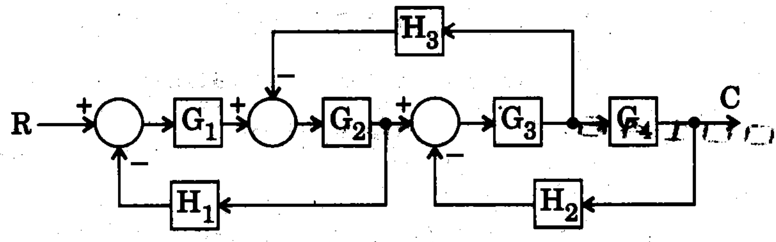
Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permissible. Use of graph paper and semi-log sheet is permissible.*

---

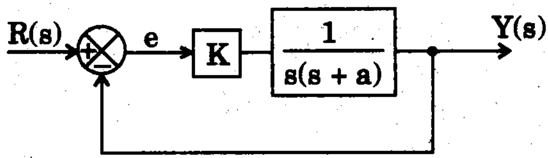
1. Consider the spring mass damper system mounted on a massless moving cart. Find the mathematical model and transfer function of the system taking displacement of the cart u(t) as input and displacement of the mass y(t) as output. *10*



2. Find the transfer function $\frac{C(s)}{R(s)}$ for the block diagram by block diagram reduction technique. *10*



3. Consider the following system :



(a) Calculate 'K' and 'a' so that settling time (t_s) is 2 sec. (taking 2% tolerance) and Maximum Peak overshoot (M_P) is 20% for a step input.

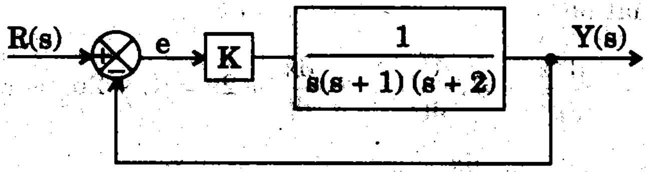
(b) What is the value of 'K_v' using the value of 'K' and 'a' obtained in Q.3(a) ? *7+3*

4. Using Routh stability criterion, determine the number of closed loop poles in the left half of 's' plane, the right half of 's' plane and on the imaginary axis of the system whose characteristic equation is

$$s^6 + 5s^5 + 8s^4 + 10s^3 + 13s^2 + 5s + 6 = 0.$$

Also comment on the stability of the system. *10*

5. Consider the system given in the figure below :



Sketch the Root locus in the graph paper as 'K' varies from 0 to ∞, showing all relevant steps and points. Also find the value of 'K' for which the closed loop system is stable. *7+3*

6. Consider a unity feedback system with open-loop transfer function $G(s) = \dfrac{1}{s(s+2)}$.

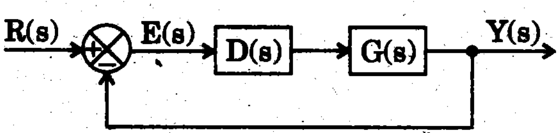
(a) Draw a suitable Nyquist contour with mathematical equation for each part.

(b) Sketch Nyquist plot in plane paper showing all necessary calculations.

(c) Comment on the stability. *3+5+2*

7. An uncompensated system is given as below

where $G(s) = \dfrac{1}{s^2}$;



Using Root locus analysis design a lead compensator D(s) of the form $D(s) = \dfrac{K(s+z)}{(s+p)}$; such that settling time $t_s \leq 4$ sec. (taking 2% tolerance) and maximum peak overshoot $M_P \leq 16{\cdot}30\%$. *10*

8. A system is given by the following differential equation :

$$\frac{d^3x}{dt^3} + 5 \cdot \frac{d^2x}{dt^2} + 3 \cdot \frac{dx}{dt} + 2x = u_1 + 2u_2 + u_3$$

$$y_1 = 4 \cdot \frac{dx}{dt} + 3u_1$$

$$y_2 = 3 \cdot \frac{d^2x}{dt^2} + 2u_2 + 3u_3$$

Obtain a state space representation of the system. *10*

9. Write short notes on any ***two*** of the following : *2×5=10*

(a) Controllability and Observability

(b) Fuzzy Control

(c) Effect of addition of a pole to O/L transfer function