No. of Printed Pages : 4

BIEE-021

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

00403

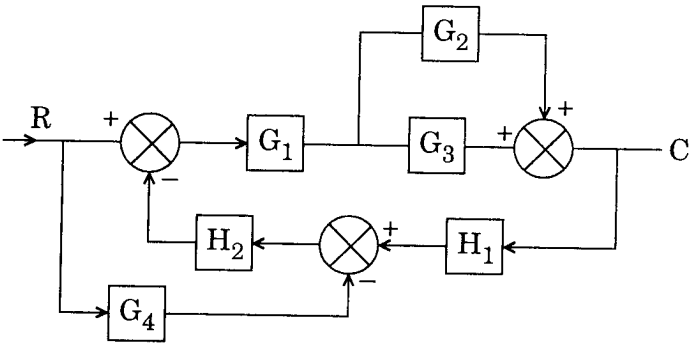
December, 2018

BIEE-021 : CONTROL SYSTEMS

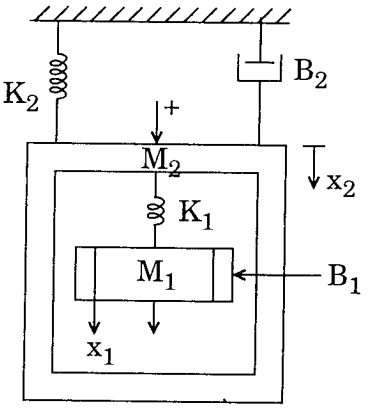
Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Use of semilog/log graph paper is permitted. Assume missing data if any with suitable justification.*

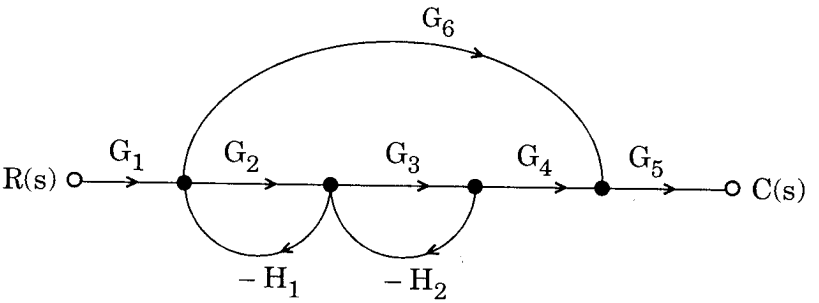
1. (a) Using block diagram reduction technique, find the closed loop transfer function of a system given below. State the advantages and features of the transfer function. 7



(b) For mass, spring and damper system, in the figure below, find the differential equation governing the system. *7*



2. (a) Derive the closed loop transfer function for signal flow graph shown below : *4*



(b) A servo mechanism is used to control the angular position θ_o of a mass through a command signal θ_i. The moment of inertia of load is 200 kg-m^2 and motor torque at load is $6{\cdot}88 \times 10^4$ N/m/rad of error. The damping torque coefficient is 5×10^3 N/m/rad/sec. Find the time response for step input of 1 radian. Given $G(s) = \frac{K_T}{\sqrt{s^2 + fs}}$, $H(s) = 1$. *10*

3. (a) Derive an expression for the time/response of second order system subjected to a unit impulse input for $\xi < 1$, $\xi > 1$, where ξ : damping ratio. *10*

(b) Draw the response characteristics curves of the P, I, D and PID controlling actions. Discuss the salient features. *4*

4. (a) State and explain Routh's stability criterion. *6*

(b) Explain the terms (any ***two***) : *8*

(i) AC and DC tachometer

(ii) Mason's Gain formula

(iii) Servo motor

5. (a) Sketch the complete Root Locus for the system having

$$G(s)\,H(s) = \frac{k(s+5)}{(s^2+4s+20)}$$ *10*

(b) Obtain the state space representation of armature controlled DC motor. *4*

6. (a) A system exhibits 50% overshoot in its step response and the time to peak is 3 seconds. Determine transfer function, rise time, settling time, oscillator time, number of oscillations, resonance peak and frequency. Sketch frequency response. *10*

(b) Explain the steps to design lag compensator. *4*

7. (a) Addition of poles to loop transfer function reduces the closed loop stability. Justify by Nyquist plots. *4*

(b) Sketch the Bode Plot for transfer function

$$G(s) = \frac{ks^2}{(1+0{\cdot}2s)\,(1+0{\cdot}02s)}$$

Determine the value of k for the gain crossover frequency to be 5 rad/sec. *10*