SANT GADGE BABA MARAVATI UNIVERCITY, AMRAVATI
Summer Examination 202 Credit Point0
HVPM's College of Engineering and Technology, Amravati
Department of Electronics & Tele Communication Engineering
Bachelor of Engineering Sem:-VI

Subject:-CONTROL SYSTEM **Code:-** 6ET2

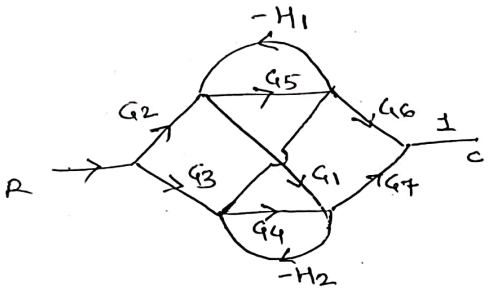
Instructions:-

1) Solve any two questions

2) All question carry equal marks

Q1.

a) Determine the overall transfer function form the signal flow graph shown below. **2 Credit Point**

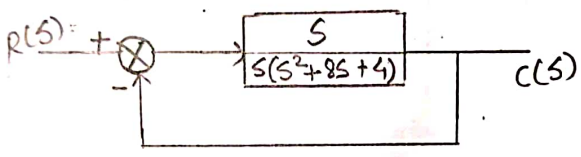


b) Explain the following terms: **2 Credit Point**
i) Linear time invariant control system
ii) Linear time-varying control system
iii) Open loop control system
iv) Closed loop control system

c) Define the response specifications: **2 Credit Point**
i) Delay Time ii) Rise Time iii) Peak Time
iv) Settling Time v) Peak over shoot

d) Define static error constant and show how the steady state errors are related to these constants. Indicate the significance of these constants in control system. **2 Credit Point**

e) For a system as shown in figure. **1 Credit Point**



Determine the range of K, for which system to be stable and also find frequency of oscillations.

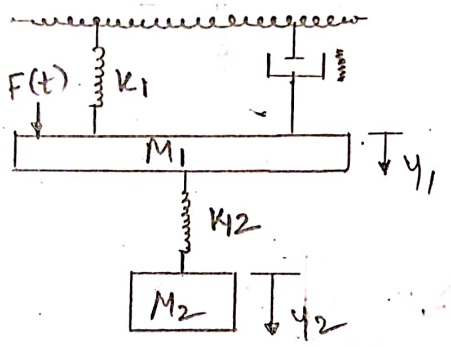
f) Sketch the root locus for the system having open loop transfer function

$$G(S)\,H(S) = \frac{K}{s(s+4)(s^2+4s+20)}$$ **1 Credit Point**

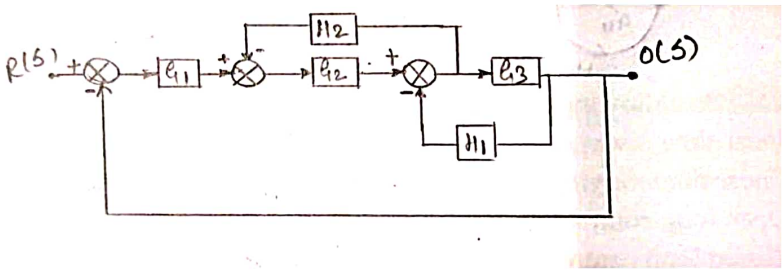
Also comment on stability of system.

Q2.

a) Write the differential equations governing the behavior of the mechanical system shown in figure. Also obtain an analogue electrical circuit based on Force-Voltage analogy. **2 Credit Point**



b) Simplify the block diagram given below and obtain the closed loop transfer function. **2 Credit Point**



c) A unity feedback system is characterized by an open loop transfer function.

$$G(s) = \frac{K}{s(s+10)}$$ **2 Credit Point**

Determine the gain k, So that the system will have a damping ratio, ξ=0.5. For this value of k, Determine settling time, peak overshoot and time to peak overshoot for a unit step input.

d) The open loop transfer function of servo system with unity feedback is

$$G(s) = \frac{10}{s(0.5s2+1s+1)}$$ **2 Credit Point**

Evaluate the static error constants k_p, k_v, and k_a. Obtain the steady state error of the system when subjected of an input $r(t) = \frac{q^2}{2}t^2$

e) The characteristics equation of control system is **1 Credit Point**

$3s^4 + 10s^3 + 5s^2 + 5S + 2 = 0$

Using RH criteria, Determine whether system is stable or not.

f) Define the gain margin and phase margin. Show how these could be determined from. **1 Credit Point**

i) Polar Plot ii) Bode Plot

Q3.

a) Draw the Bode plot for the system having open loop transfer function

$$G(s).H(s) = \frac{12}{s(s+0.2)+(s+1)}$$ **2 Credit Point**

On the plot specify

i) Gain Crossover frequency

ii) Phase crossover frequency

iii) Gain margin

iv) Phase margin

b) Explain the condition of controllability and observability. **2 Credit Point**

c) What are the advantages of stat variable approach over the transfer function approach for a control system? **2 Credit Point**

d) Draw the block diagram of digital control system. Also explain sampling and quantization. **2 Credit Point**

e) Solve the difference equation. **1 Credit Point**

$X_{(k+2)}+3X_{(k+1)}+2X_{(k)}=4_{(k)}$

With initial conditions $x_{(0)} = 0$ and $X_{(1)}=1$ for $k<0.7$

f) Sketch the polar plot for the system having **1 Credit Point**

$$G(s).H(s) = \frac{12}{s(s+1)+(s+2)}$$

Determine: i) Phase crossover frequency ii) Gain margin

Q4.

a) For a given transfer function. **2 Credit Point**

$$\frac{y(s)}{u(s)} = \frac{s^2+3s+3}{s^3+2s^3+3s+1}$$

Draw a suitable signal flow graph and construct stat model of the system.

b) If state model of the system is as **2 Credit Point**

$$X(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X(t) + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u(t) \text{ and } X(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Determine the stat transition matrix.

c) Explain Jury's Stability Criterion. **2 Credit Point**

d) Find inverse z-transform for **2 Credit Point**

$$X(z) = \frac{4z^2-2z}{z^3-5z^2+8z-4}$$

e) Explain the working of sampled data control system. **1 Credit Point**

f) Discuss Nyquist stability criterion for stability of control system in frequency domain. **1 Credit Point**