CBCS SCHEME

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18ME71

Seventh Semester B.E. Degree Examination, June/July 2023
Control Engineering

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define control system with block diagram. Explain open loop and closed loop control system. **(08 Marks)**

b. Explain the following controllers :
i) Proportional controllers
ii) Proportional plus integral controller. **(06 Marks)**

c. Obtain the differential equation and determine the transfer function of mechanical networks shown in Fig.Q1(c).

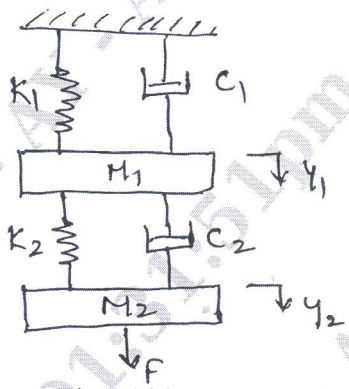

Fig.Q1(c) **(06 Marks)**

OR

2 a. What are the requirements of a Good Control System? Distinguish between open loop and closed loop control system. **(06 Marks)**

b. Explain the following controllers with block diagram :
i) Integral controller
ii) Derivative controller
iii) Proportional plus integral plus differential controllers. **(09 Marks)**

c. Derive an expression for transfer function of hydraulic system. **(05 Marks)**

Module-2

3 a. What are standard test signals? Derive an expression for transient response of first order system subjected to step input I/P. **(05 Marks)**

b. Derive an expression for steady state error and explain error constants. **(05 Marks)**

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

$$G(s) = \frac{K}{s(s+10)}$$

Determine the gain K so that, the system will have a damping ratio of 0.5. For this value of K determine the settling time, peak overshoot and time of peak overshoot for unit step input I/P. **(10 Marks)**

OR

4 a. Explain with the help of neat sketch transient response specifications of second order under damped system. **(06 Marks)**

b. An undrerdamed second order system is subjected to a step input of 4 units. If the first peak overshoot of 25% occurs at a time equal to 0.8 seconds. Then determine rise time, settling time, damping co-efficient (factor) and natural frequency. **(08 Marks)**

c. A unity feedback system has $G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$. Determine : i) Type of system ii) All error co-efficient iii) Steady state error for ramp input with magnitude 4. **(06 Marks)**

Module-3

5 a. What is block diagram? Obtain the transfer function C(s)/R(s) for the following Fig.Q5(a) using block diagram reduction rules.

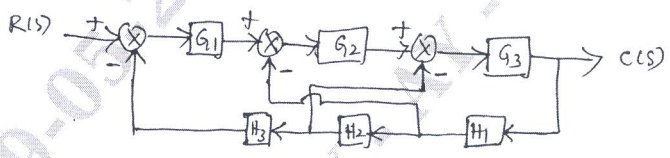

Fig.Q5(a) **(10 Marks)**

b. Define the terms : Node, Branch, Transmittance, Loop gain, Forward path, Source, Non-touching loops and also explain Masson's Gain Formulae. **(10 Marks)**

OR

6 a. Construct the signal flow graph for the following set of system equations and find the transfer function :
$Y_2 = G_1Y_1 + G_3Y_3$; $Y_3 = G_4Y_1 + G_2Y_2 + G_5y_3$ and $Y_4 = G_6Y_2 + G_7Y_3$. **(10 Marks)**

b. Draw the signal flow graph for the system shown in Fig.Q6(b) and determine. The transfer function using Masson's gain formulae.

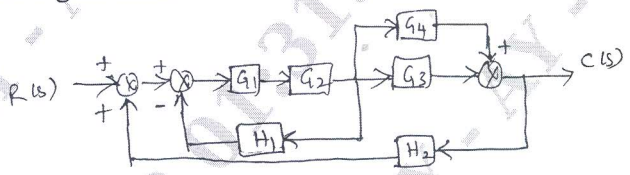

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. State and explain the Routh's stability criterion. The characteristic equation of a system is given by $s^4 + 6s^3 + 23s^2 + 40s + 50 = 0$. Determine the stability using R–H criterion. **(06 Marks)**

b. The characteristics equation of a system is given by $s^4 + 6s^3 + 11s^2 + K = 0$. Determine the range of K for the system to be stable. Use R – H criterion, **(06 Marks)**

c. Sketch the root locus plot of a unity feedback system with an open loop transfer function : $G(s) = \frac{K}{s(s+2)(s+4)}$. What is the greatest value of K which can be used before continuous oscillations occurs. Also determine the frequency of continuous oscillations. **(08 Marks)**

OR

8 a. Investigate the stability of the system using Routh Henvitz criterion having the following characteristics in $s^5 + 4s^4 + 12s^3 + 20s^2 + 30s + 100 = 0$. **(08 Marks)**

b. Sketch the root locus plot for the transfer function : $G(s)H(s) = \frac{K}{s(s^2+2s+2)}$. For what value of K will the system be unstable? Find the frequency at which the locus crosses the imaginary axis. **(12 Marks)**

Module-5

9 a. Explain Nyquist Stability Criterion. **(04 Marks)**

b. Sketch the polar plot for $GH(s) = \dfrac{12}{s(s+2)(s+4)}$ and ascertain the nature of stability. **(06 Marks)**

c. Sketch the bode plot and determine the gain crossover and phase crossover frequency,

$GH(s) = \dfrac{10}{s(1+0.55)(1+0.1s)}$. **(10 Marks)**

OR

10 a. For a system with an open loop transformation,

$GH(s) = \dfrac{1}{s(1+2s)(1+s)}$ Comment on stability of the system by Nyquist plot. **(08 Marks)**

b. Draw the bode plot for a system having $G(s)H(s) = \dfrac{100}{s(s+1)(s+2)}$. Find, Gain Margin, Phase margin, Gain crossover frequency and phase crossover frequency. **(12 Marks)**

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