A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 55B03

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2019

Fifth Semester

Biomedical Engineering

15UBM503 - BIO CONTROL SYSTEM

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

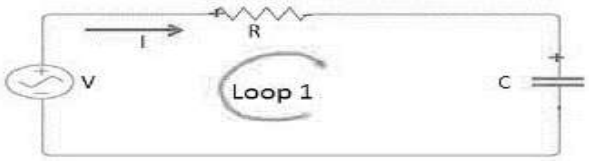
Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Force acting on a mass M causing displacement x is given by CO1- R

(a) $F = M\frac{dx}{dt}$ (b) $F = M\frac{d^2x}{dt^2}$ (c) $F = Mx$ (d) $F = Mx^2$

2. What is the equation pertaining to Kirchoff's voltage law around loop 1 in given figure. CO1- U



(a)$V = \frac{I}{R} + C\int Idt$ (b) $V = IR + C\frac{dI}{dt}$ (c)$V = \frac{I}{R} + \frac{1}{C}\int Idt$ (d) $V = IR + \frac{1}{C}\int Idt$

3. What should be the value of K in the transfer function $\frac{C(S)}{R(S)} = \frac{16}{S^2+KS+16}$ given that the response of the system is critically damped. CO2- R

(a) 2 (b) 4 (c) 6 (d) 8

4. For type 1 system, the steady state error due to ramp input is equal to CO2- R

(a) $1/K_P$ (b) $1/K_V$ (c) 1/Ka (d) $1/(1+ K_P)$

5. _____ is defined as the value of gain to be added to system in order to bring the system to verge of instability. CO3- R

(a) Phase Margin (b) Phase cross over frequency

(c) Gain Margin (d) Gain cross over frequency

6. _____ indicates the additional phase lag that can be provided to the system without affecting stability. CO3 R

(a) Phase Margin (b) Phase cross over frequency

(c) Gain Margin (d) Gain cross over frequency

7. System output is stable for limited range of variation of its parameters is CO4- R

(a) Absolutely Stable (b) Conditionally Stable (c) Limitedly Stable (d) Unstable

8. The Nyquist plot of a open loop transfer function G(jw)H(jw) of a system encloses the (-1,j0) point. The gain margin of the system is CO4- R

(a) Greater than Zero (b) Less than Zero (c) Equal to Zero (d) Equal to One

9. _____ feedback is highly common in physiological systems. CO5- R

(a) Embedded (b) Segregated (c) Positive (d) Negative

10. Pulse oximeter in physiological control system,receives physiological signals from the patient and processes them to produce CO5- R

(a) Heart Rate (b) SpO_2 (c) Heart Rate & SpO_2 (d) BP

PART – B (5 x 2= 10Marks)

11. Compare open loop and closed loop system. CO1- U

12. Differentiate transient response and steady state response. CO2- U

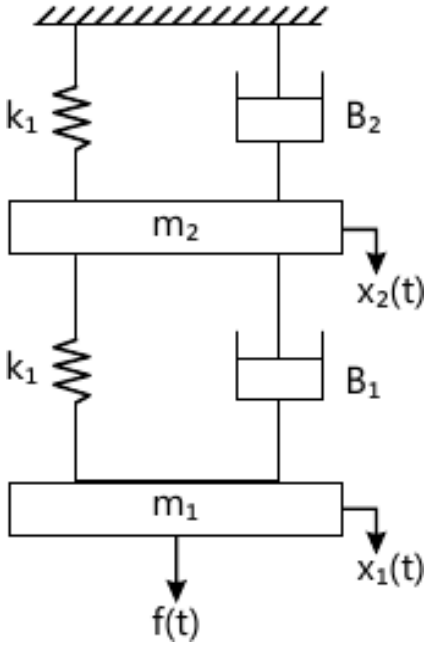
13. State the advantages of frequency response. CO3- U

14. Comment on the stability of the following characteristic equation. CO4- App
$S^3+3S^2+S+15=0$

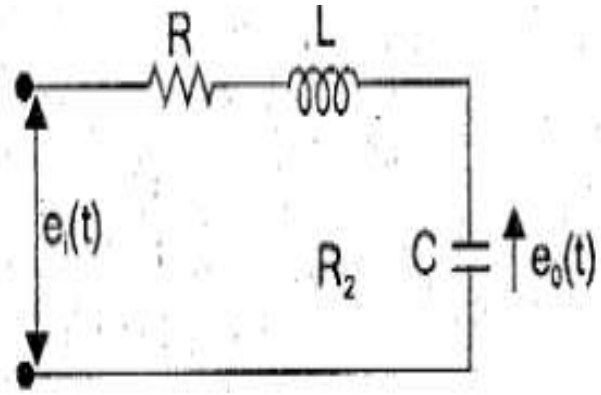
15. State the need for modeling in physiological system. CO5- Ana

PART – C (5 x 16= 80Marks)

16. (a) (i) Write the differential equation governing the mechanical system shown in figure. Draw the F-V and F-I electrical analogous circuits and verify by writing mesh and node equation. CO1- App (10)

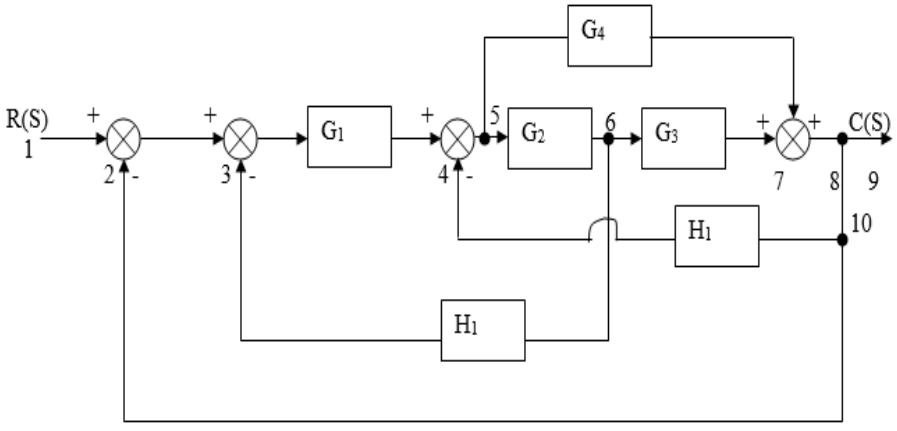


(ii) Determine the transfer function of the network in Fig. CO1- App (6)

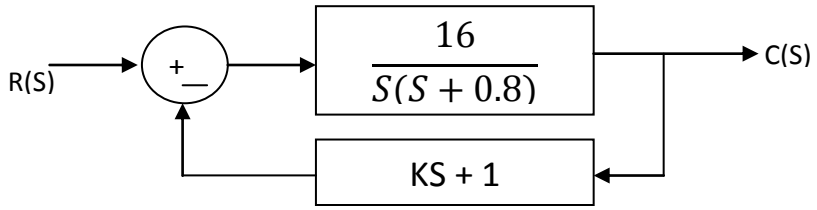


Or

(b) Convert the block diagram to signal flow graph and determine the transfer function using mason's gain formula. CO1- App (16)



17. (a) A positional control system with velocity feedback is shown in figure. What is the response c(t) to the unit step input. Given that ζ=0.5. Also calculate rise time, peak time, Peak overshoot and settling time. CO2- App (16)



Or

(b) The open loop transfer function of a feedback control system is given by $G(S)H(S) = \frac{100}{S(S+4)}$. Determine the static error coefficients and dynamic error coefficients for the input $r(t)=2t^2+5t+10$. CO2- App (16)

18. (a) Draw the Bode plot for $G(S)H(S) = \frac{S+3}{(S+2)(S^2+2S+25)}$ .Also find Gain crossover and phase cross over frequency. CO3- App (16)

Or

(b) The open loop transfer function of a system is given by $G(S)H(S) = \frac{10}{S(S+2)(S+5)}$ Sketch the polar plot and determine gain margin and phase margin. CO3- App (16)

19. (a) A unity feedback closed loop system has an open loop transfer function $G(S)H(S) = \frac{K(S+1.5)}{S(S+1)(S+5)}$. Sketch the Root locus and determine the range of K for which the system is stable. CO4- Ana (16)

Or

(b) Sketch a Nyquist plot for a system in open loop transfer function $G(S)H(S) = \frac{K(1+0.5S)(1+S)}{(1+10S)(S-1)}$. Determine the range of K for which the system is stable. CO4- Ana (16)

20. (a) Illustrate physiological control system with suitable examples. CO5- U (16)

Or

(b) Explain the linear model of Cardiovascular System. CO5- U (16)