Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – VI EXAMINATION – WINTER 2015

Subject Code:160304 **Date:14/12/ 2015**

Subject Name: Biomedical - Control Theory

Time:2:30pm to 5:00pm **Total Marks: 70**

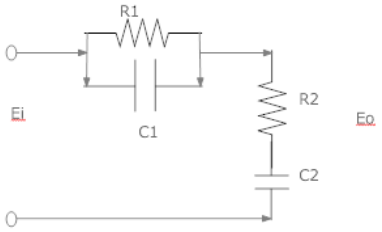
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

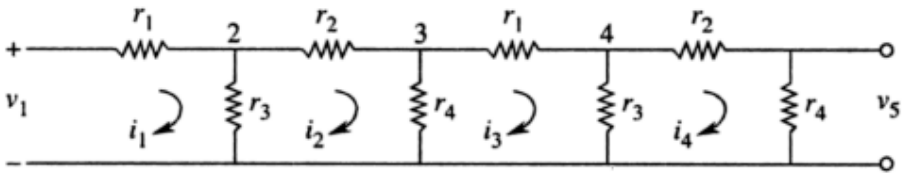
Q.1 (a) Explain the following terms: (1) Sensitivity, (2) Stability, (3) damping factor, (4) Bandwidth, (5) Oscillation, (6) Accuracy, (7) Settling time Ts **07**

(b) How do you improve the system dynamics by feedback? Explain positive and negative feedback system with an example. **07**

Q.2 (a) Describe the Laplace transform for three basic inputs with necessary diagrams and equation. Determine transfer function of the circuit given in figure. **07**

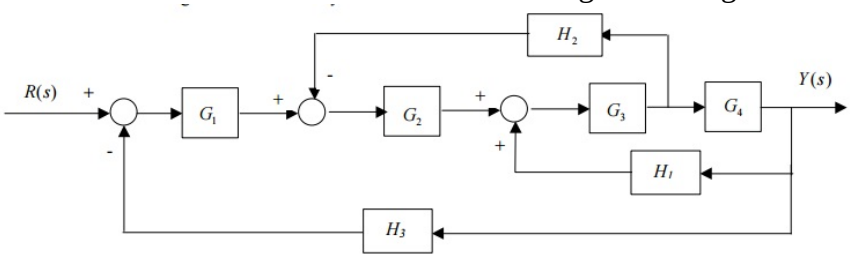


(b) What is signal flow graph? Derive transfer function v5/v1 for the circuit given using SFG technique. **07**



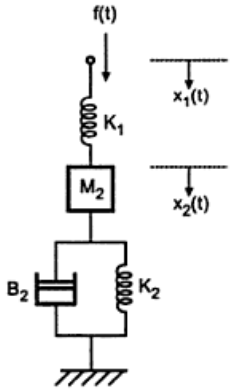
OR

(b) Determine the transfer function of the following block diagram. **07**



Q.3 (a) Define 'ξ'. Describe role of ξ in second order system. **07**

(b) Explain force-voltage analogy. Draw the equivalent mechanical system and analogous system based on F-V and F-I methods for the given system. **07**



OR

Q.3 **(a)** Explain underdamped, overdamped and critically damped systems. **07**

(b) Find the steady state error due to unit step, unit ramp and a parabolic input $(\frac{t^2}{2})$ u(t) for G(s) = $\frac{1}{s^2+s+2}$, H(s) = $\frac{1}{s+1}$ **07**

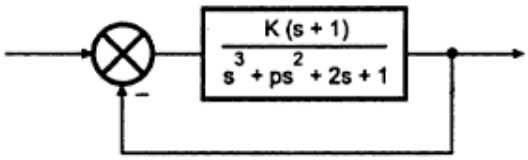
Q.4 **(a)** What is the relation between type of the system and steady state error of the system? **07**

(b) For a system with characteristic equation F(s) = $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$, examine stability. **07**

OR

Q.4 **(a)** Derive performance indices of the time domain system. **07**

(b) Given system oscillates with frequency 2 rad/sec. Find values of 'K_{mar}' and 'p'. No poles are in R.H.S. **07**



OR

Q.5 **(a)** The open loop transfer function of a feedback system is G(s) H(s) =$\frac{k}{s(s+4)(s^2+4s+20)}$. Draw the root locus plot and state about the stability of the system. **07**

(b) A unity feedback system has G = $\frac{k}{(s+4)(s+6)(s+10)}$. Find range of k so that system is stable. **07**

OR

Q.5 **(a)** For the system having the open loop transfer function G(s) H(s) = $\frac{10}{s(s+1)(s+10)}$. Determine the stability of the system by plotting the bode plot of the system. **07**

(b) Derive an expression for the time response of a second order system subjected to a unit impulse for $\xi<1$, $\xi>1$. **07**