*Seat No.: _____* *Enrolment No._____*

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- VI$^{th}$ SEMESTER–EXAMINATION – MAY- 2012**

**Subject code: 160304** **Date: 17/05/2012**

**Subject Name: Biomedical Control Theory**

**Time: 10:30 am – 01:00 pm** **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)** Differentiate between closed loop and open loop control system in respect of merits. **07**

**(b)** Explain missile guidance and launching system with neat sketch and related explanation. **07**

**Q.2** **(a)** Explain the force current analogy. **07**

**(b)** Obtain the transfer function for the electromechanical system shown in figure 1. Assume back emf $e_b$ and force produced on mass M by coil current $i_2$. **07**

**OR**

**(b)** Consider the liquid level system shown in figure 2. The inflow and outflow rate are Q at steady state and flow rate between the tanks is zero. The heads of both tanks are at H. At t = 0, the inflow rate is slightly changed to Q + q. The resulting changes in the heads $h_1$ and $h_2$ as well as flow rates $q_1$ and $q_2$ are assumed to be small. The capacitance of tank 1 & 2 are $C_1$ and $C_2$ respectively. The $R_1$ is the resistance of the valve between both tanks while $R_2$ is the resistance of the outflow valve. Design the mathematical model for q input and $h_2$ output. **07**

**Q.3** **(a)** Find the transfer function of the system shown figure 3 by block diagram reduction technique. **07**

**(b)** Draw Nyquist plot and comment on stability of the system with open loop transfer function $G(s)H(s) = 1/\{s(s+1)(2s+1)\}$ **07**

**OR**

**Q.3** **(a)** Derive unit step time response of second order system for damped case. **07**

**(b)** Design the polar plot of transfer function $G(s) = k/[s^2(1+T_1s)(1+T_2s)]$ **07**

**Q.4** **(a)** Narrate the rules governing the root locus technique. **07**

**(b)** Using routh's criteria, determine the possible range of K for system characteristic equation $s^4 + 20Ks^3 + 5s^2 + 10s + 15 = 0$ to be stable. **07**

**OR**

**Q.4** Design a root locus for a feedback system with the characteristic equation $1 + \frac{k}{s(s+3)(s^2+2s+2)} = 0$, k is positive only. **14**

**Q.5** Sketch the bode plot and determine the gain crossover and phase crossover frequencies for T.F. $G(s) = 10/ s(1+0.5s)(1+0.1s)$ **14**

**OR**

**Q.5** **(a)** Explain steady state errors in unity feedback control system **07**

**(b)** Derive the time response of second order system subjected to unit impulse input for critically damped system. **07**

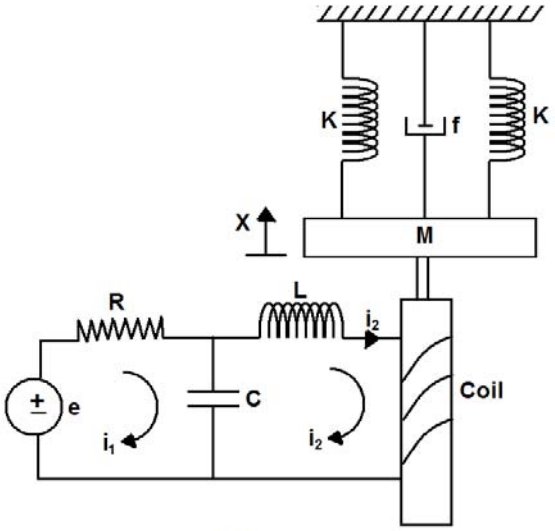


Figure-1-(Q-2b)

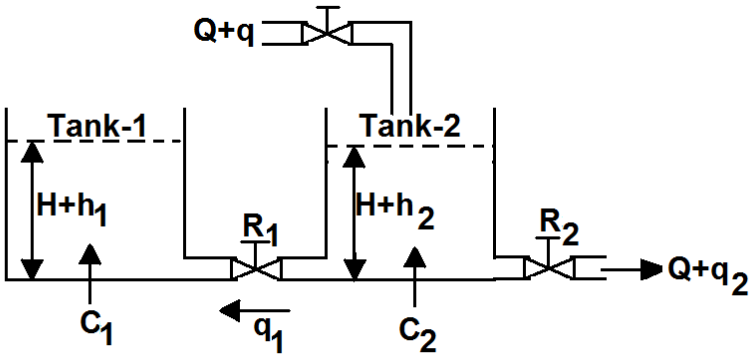


Figure-2-(Q-2b-OR)

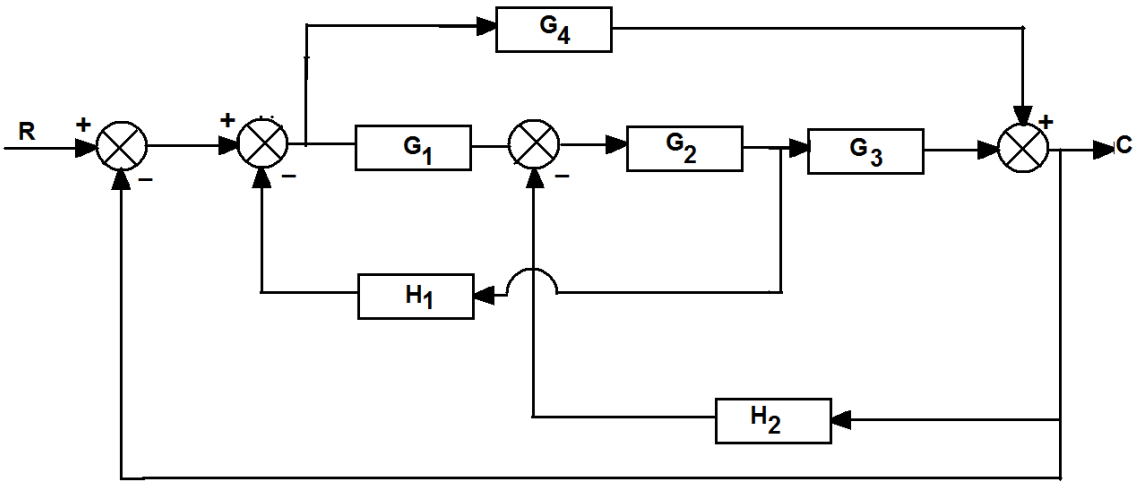


Figure-3-(Q-3a)

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