Seventh Semester B.E. Degree Examination, July/August 2021
## Control Engineering

Time: 3 hrs. Max. Marks: 100

### Note: Answer any FIVE full questions.

1 a. Define Control System. Explain with a schematic diagram working of manually operated closed loop control system. **(10 Marks)**

   b. Mention the compansons of open loop and closed loop control system, with an example for each. **(10 Marks)**

2 a. Explain with a general block diagram the working of automatic control system. **(10 Marks)**

   b. What are controllers? Explain with block diagram PI and PID controllers. **(10 Marks)**

3 a. Draw the equivalent mechanical system and write the set of equilibrium equations and obtain force voltage analogy for the system shown in the Fig.Q.3(a). **(12 Marks)**
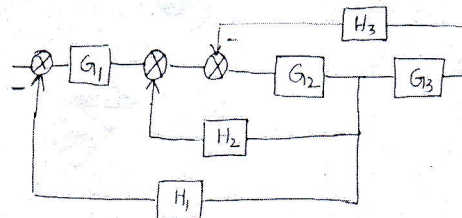
   Fig.Q.3(a)
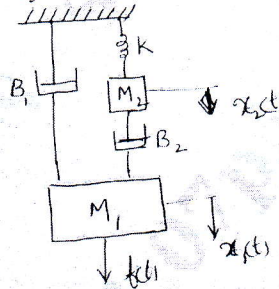
   b. Obtain the transfer function of liquid level control system shown in the Fig.Q.3(b). **(08 Marks)**
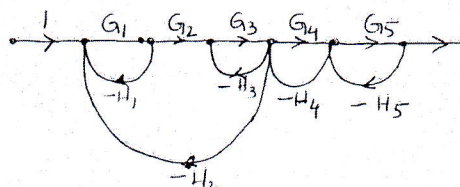
   Fig.Q.3(b)
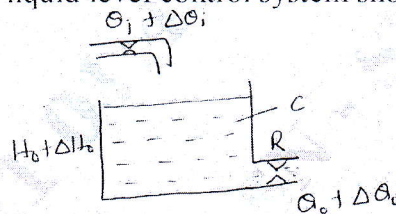
4 a. Derive the transfer function of the system shown in Fig.Q.4(a) using block diagram reduction technique. **(10 Marks)**

   Fig.Q.4(a)

   b. Determine the overall transfer function of the signal flow graph shown in the Fig.Q.4(b) using Masons gain formula. **(10 Marks)**

   Fig.Q.4(b)

5 a. A unity feedback control system is characterized by an open loop transfer function.

$G(S) = \dfrac{10}{s^2 + 2s + 6}$, determine the following, when the system is subjected to a unit step input   i) Undamped natural frequency   ii) Damping ratio   iii) Peak time   iv) Settling time   v) Peak overshoot.   **(10 Marks)**

b. By applying Routh's criterion discuss the stability of the closed loop system whose characteristic equation is
$s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$ **(10 Marks)**

6   Sketch the complete Root locus for the system having

$G(s)H(s) = \dfrac{K}{s(s+3)(s^2 + 3s + 11.25)}$ and comment on stability.   **(20 Marks)**

7   Draw the Bode plot for a system having $G(s)H(s) = \dfrac{100}{s(s+1)(s+2)}$. Find: i) Gain margin

ii) Phase margin   iii) Gain cross over frequency   iv) Phase cross over frequency, and comment on stability.   **(20 Marks)**

8 a. Draw the polar plot and ascertain the nature of stability for system with open loop transfer

function $G(s)H(s) = \dfrac{12}{(s+1)(s+2)(s+3)}$.   **(10 Marks)**

b. Draw the Nyquist plot for a system with open loop transfer function

$G(s)H(s) = \dfrac{1}{s(1+2s)(1+s)}$ and comment on stability.   **(10 Marks)**

9 a. Explain series and feedback compensation with block diagrams.   **(12 Marks)**
  b. Explain controllability and observability with reference to control system.   **(08 Marks)**

10 a. Explain the following terms:
   i) State   ii) State variable   iii) State vector   iv) State space   v) State equation.   **(10 Marks)**

  b. Discuss lag compensator, sketch the bode plot of a lag compensator.   **(05 Marks)**
  c. Discuss lead compensator, sketch the bode plot of lead compensator.   **(05 Marks)**

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