



**P.E.S. College of Engineering, Mandya - 571 401**

*(An Autonomous Institution affiliated to VTU, Belgaum)*

**Seventh Semester, B.E. - Mechanical Engineering**

**Semester End Examination; Dec - 2016/Jan - 2017**

**Automatic Control Engineering**

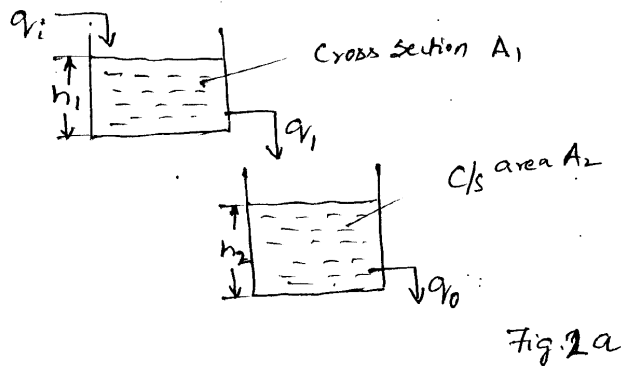
Time: 3 hrs

Max. Marks: 100

**Note:** i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.  
 ii) Assume suitably missing data if any.

**UNIT - I**

- 1 a. What are the basic requirements of an ideal control system? 5
- b. With block diagram explain : 8
  - i) Regulator system
  - ii) Follow up system.
- c. With suitable sketch explain automatic tank level control system and also identify system parameter and system components. 7
- 2 a. Determine the differential equation of the hydraulic system shown in Fig. 1
  - i) Relate head of the II tank with inflow of I tank
  - ii) Relate inflow of the I tank with outflow of II tank.



- b. Obtain the differential equation for RLC electrical circuit. 8

**UNIT - II**

- 3 a. Write a note on Summing junction. 4
- b. Reduce the given block diagram into canonical form shown in Fig.3 and determine closed loop transfer function. Also represent in open loop form.

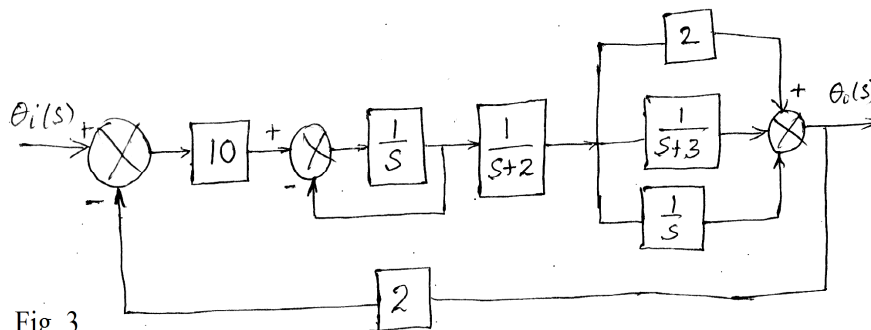


Fig. 3

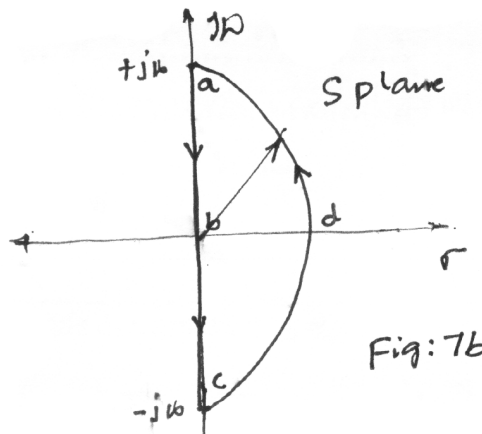
- 4 a. Differentiate between block diagram and signal flow graph. 4
- b. The equations describing the dynamic behavior of a control system are given below:
- $$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4 + a_{52}x_5$$
- $$x_3 = a_{23}x_2$$
- $$x_4 = a_{34}x_3 + a_{44}x_4$$
- $$x_5 = a_{35}x_3 + a_{45}x_4$$
- 16
- Where  $x_1$  &  $x_5$  are the input and output? Construct the signal flow graph and find its overall gain.

**UNIT - III**

5. Obtain an expression for response of a second order mechanical system subjected to a step input for under damped case and also draw the response curve. 20
- 6 a. The system has characteristic equation  $S^4 + 3S^3 + 4S^2 + 3S + K = 0$ . Determine the value of K, so that characteristic equation has two complex conjugate roots with zero real part. Find out those roots by Routh Hurwitz criterion method. 10
- b. Write a note on :
- i) Static velocity error constant      ii) Static acceleration error constant. 10

**UNIT - IV**

- 7 a. What are polar plots? Sketch the polar plot of the system having open loop transfer function, 8
- $$G(S)H(S) = \frac{10S}{(1+4S)}$$
- b. Obtain the Nyquist diagram for the system shown in Fig. 7b and ascertain its stability and its open loop transfer function is  $G(S)H(S) = \frac{100}{(1+2S)}$



8. Construct the Bode plot on a semi log graph paper for a unity feedback system, whose open loop transfer function is given by  $G(S)H(S) = \frac{10}{S(1+S)(1+0.02S)}$ . 20

From the Bode plot determine;

- a) Gain and phase cross over frequencies
- b) Gain and phase margin
- c) Stability of the closed loop system.

#### UNIT - V

9. Draw the complete root locus plot for the system with open loop transfer function

$$G(S)H(S) = \frac{K}{S(S^2 + 4S + 7)}. \text{ Hence determine the range of values of } K \text{ over which the system remain stable and what is the range of damping factor for the dominant poles?} \quad 20$$

10. Write note on :

- a) System state and state variable 20
- b) Transformation matrix.

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