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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.

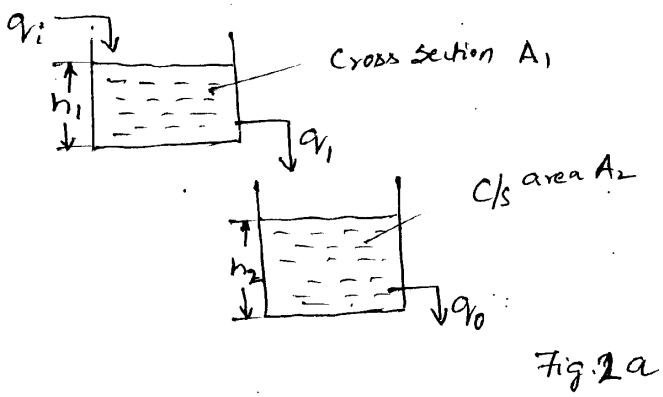

Fig. 1a

12

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.

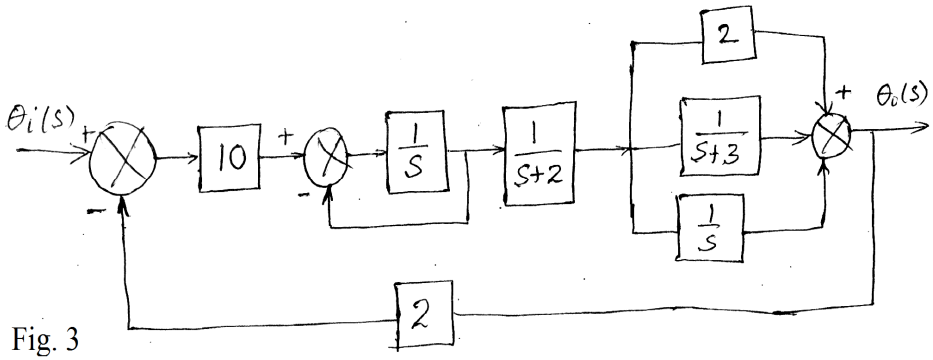

Fig. 3

16

Contd….2

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:

$$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4 + a_{52}x_5$$
$$x_3 = a_{23}x_2$$
$$x_4 = a_{34}x_3 + a_{44}x_4$$
$$x_5 = a_{35}x_3 + a_{45}x_4$$

Where x_1 & x_5 are the input and output? Construct the signal flow graph and find its overall gain. 16

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 : 10

i) Static velocity error constant ii) Static acceleration error constant.

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 $G(S)H(S) = \frac{100}{(1+2S)}$ 12

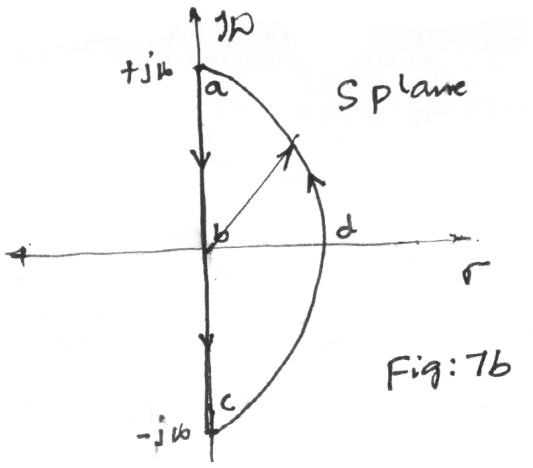

Fig: 7b

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

Contd….3

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

10. Write note on :

a) System state and state variable 20

b) Transformation matrix.

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