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

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec - 2017/Jan - 2018

Control Engineering and Machine Tool Technology

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. With the help of block diagrams, explain the regulator and follow-up closed loop system. 10

b. Explain the various requirements from a control system clearly mentioning their importance for the system. 10

2 a. Derive the transfer function $\frac{E_0(s)}{E_i(s)}$ for the electrical system shown in Fig. Q. 2(a). 10

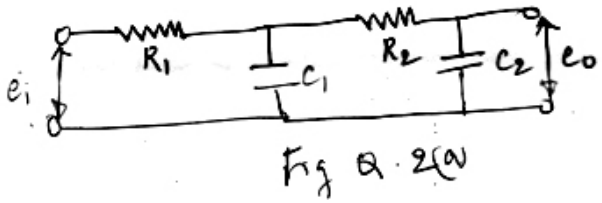

Fig Q. 2(a)

b. Draw the electrical analog based on force-voltage analogy for the mechanical system shown in Fig. Q. 2(b). 10

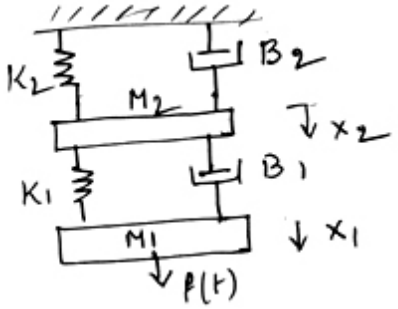

Fig 2(b)

UNIT - II

3 a. A feedback control system is described as $G(s) = \frac{50}{s(s+2)(s+5)}$ and $H(s) = \frac{1}{s}$. For a unit step input, determine the steady state error constants and errors. 10

b. Derive steady state error for an unity feedback control system shown in Fig. Q. 3(b). 10

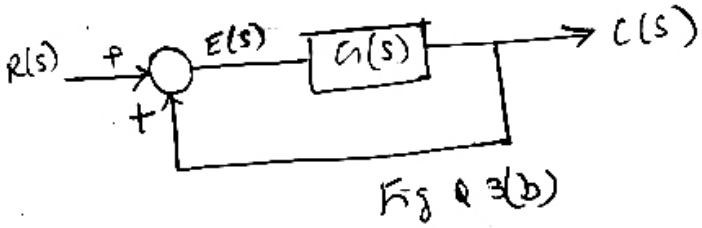

Fig Q 3(b)

4 a. Explain the standard test signals. 8

Contd…2

b. Evaluate the error series for a unit's feedback system having a forward path transfer function $G(s) = \frac{50}{s(s+10)}$. Estimate the steady state errors of the system for the input *r(t)* given by, *r(t) = 1 + 2t + t²*. 12

UNIT - III

5 a. Illustrate how,

i) Take off point is moved ahead of summing point

ii) Take off point is moved behind a summing point with the help of block diagram. 6

b. Reduce the block diagram shown in the Fig. Q. 5(b) to canonical form and determine the closed loop transfer function.

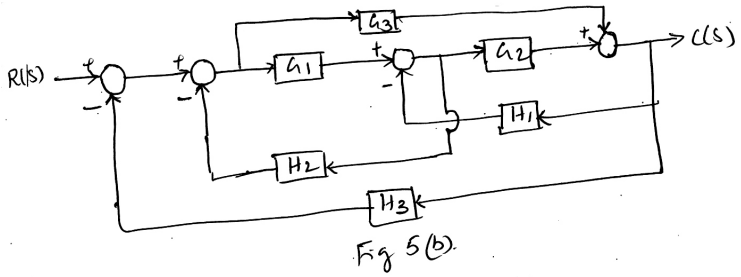

Fig 5(b). 14

6 a. Construct the signal flow graph of a system describe by the following equations :

$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4 \quad x_3 = a_{23}x_2 \quad x_4 = a_{34}x_3$ 8

Also obtain the overall system gain using Mason's gain formula.

b. Draw signal flow graph for the block diagram shown in Fig. Q. 5(b) and obtain overall system gain. 12

UNIT - IV

7 a. Explain the characteristics of a good machine tool. 10

b. Explain the method of classifying machine tool. 10

8 a. Describe how machine tool is designed based on static and dynamic rigidity? 10

b. Describe with neat sketch a selective control system in machine tool. 10

UNIT - V

9 a. Distinguish between stepped and stepless drive. 4

b. A gear box of a lathe has 9 spindle speeds ranging from 250 to 1600 rpm. A 10 HP motor at 1450 rpm is used;

i) Draw the speed ray diagram of gear box ii) Find the number of teeth on any 3 sets of gear

iii) Show the gear box layout iv) Find the diameter of any one shaft of the gear box. 16

10. Design a 12 speed gear box incorporating Ruppert drive with minimum speed 30 rpm and 1400 rpm maximum speed. The combination being 1×4×3. The speed variation is according to geometric progression. The motor runs at 1400 rpm. HP of motor = 7.35 kW.

i) Determine the progression ratio ii) Calculate all the spindle speeds

iii) Draw the speed diagram iv) Find the number of teethes on all the gears

v) Show the gear box layout

vi) Calculate the diameter of the intermediate shaft in the gear box. 20

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