# CBCS SCHEME

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C.M.R. INSTITUTE OF TECHNOLOGY, CMR, BANGALORE - 37

## Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
## Control Systems

Time: 3 hrs.                                                  Max. Marks: 80

***Note: Answer any FIVE full questions, choosing one full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

### Module-1

1 a. Distinguish between open loop and closed loop systems with examples. **(08 Marks)**

b. Write the differential equations for the mechanical system shown in Fig.Q1(b). Obtain F-V and F-I analogous electrical networks. **(08 Marks)**

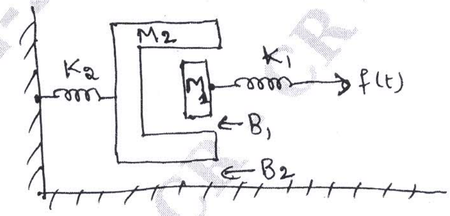


Fig.Q1(b)

**OR**

2 a. List the requirements of an ideal control system. **(04 Marks)**

b. Obtain the equivalent spring constant for the system shown in Fig.Q2(b). **(06 Marks)**

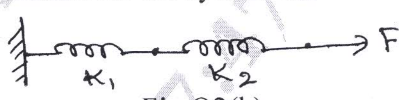


Fig.Q2(b)

c. Derive the transfer function of armature controlled dc motor. **(06 Marks)**

### Module-2

3 a. Determine C(s)/R(s) using block diagram reduction rules for Fig.Q3(a). **(06 Marks)**

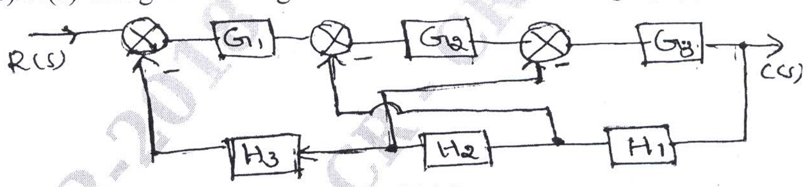


Fig.Q3(a)

b. Explain Mason's gain formula indicating each term. **(04 Marks)**

c. For the signal flow graph shown in Fig.Q3(c), determine the T.F C(s)/R(s) using Mason's gain formula. **(06 Marks)**

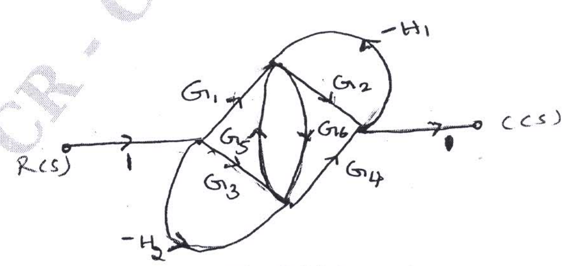


Fig.Q3(c)

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**OR**

4 a. For the network shown in Fig.Q4(a), draw the SFG and obtain the T.F using Mason's rule.

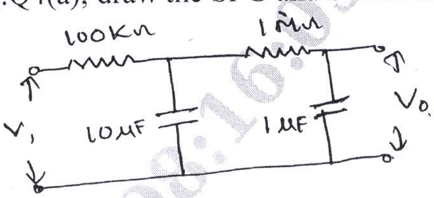


Fig.Q4(a) **(08 Marks)**

b. Draw the signal flow graph for the block diagram show in Fig.Q4(b) and determine C(s)/R(s). **(08 Marks)**

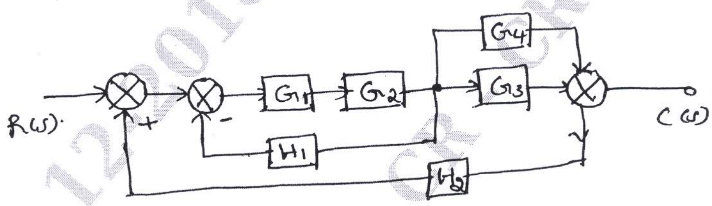


Fig.Q4(b)

## Module-3

5 a. For a control system shown in Fig.Q5(a), find the values of $K_1$ and $K_2$ so that $M_P = 25\%$ and $T_P = 4$ sec. Assume unit step input. **(08 Marks)**

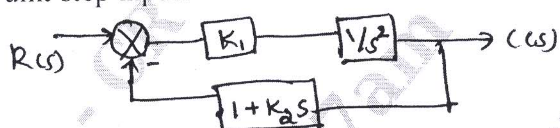


Fig.Q5(a)

b. Check the stability of the given characteristic equation using Routh's method.

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$ **(08 Marks)**

**OR**

6 a. Obtain an expression for time response of the first order system subjected to unit step input. **(04 Marks)**

b. Determine the location of roots with respect to s = –2, given that the characteristic equation is $s^4 + 10s^3 + 36s^2 + 70s + 75 = 0$ **(06 Marks)**

c. By applying Routh's criterion, discuss the stability of the closed loop system as a function of k for the following open loop transfer function

$$G(s)H(s) = \frac{k(s+1)}{s(s-1)(s^2+4s+16)}$$ **(06 Marks)**

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## Module-4

7 a. The open loop transfer function of a control system is given by

$$G(s) = \frac{k}{s(s+2)(s^2+6s+25)}$$

Sketch the complete root locus as K is varied from 0 to infinity. **(10 Marks)**

b. Write a note on frequency domain specifications. **(06 Marks)**

**OR**

8 a. The open loop transfer function of a unity feedback system is

$$G(s)=\frac{k}{s(1+0.2s)(1+0.05s)}$$

Draw the Bode plot. From the graph

(i) Determine the value of k for a gain margin of 10 dB. What is the corresponding phase margin?

(ii) Determine the value of k for a phase margin of 40°. What is the corresponding gain margin? **(12 Marks)**

b. List the advantages of root locus method. **(04 Marks)**

**Module-5**

9 a. The open loop transfer function of a control system is

$$G(s)H(s)=\frac{1}{s^2(s+2)}$$

Sketch the Nyquist plot. Ascertain the stability. **(10 Marks)**

b. Explain giving equations, the function of integral control. **(06 Marks)**

**OR**

10 a. Explain PID controller and discuss the effect on the behaviour of the system. **(10 Marks)**

b. Discuss the advantages of Nyquist plot. **(06 Marks)**

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