

# CBCS SCHEME

15EE61

## Sixth Semester B.E. Degree Examination, June/July 2019 Control Systems

Time: 3 hrs.

Max. Marks: 80

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

### Module-1

- 1 a. What is control system? Compare open loop with closed loop control systems. (04 Marks)
- b. For the mechanical system shown in Fig.Q.1(b). Draw the mechanical network and obtain the f-v analogous electrical systems. (07 Marks)

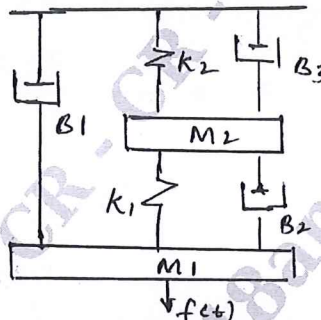


Fig.Q.1(b)

- c. Explain the A.C. servo motor. (05 Marks)

OR

- 2 a. Obtain the transfer function of electrical system shown in Fig.Q.2(a). (05 Marks)

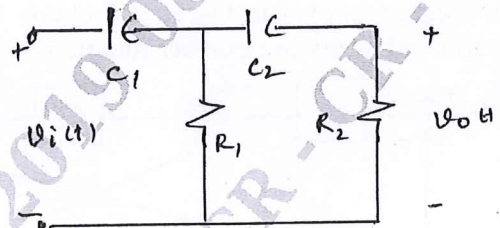


Fig.Q.2(a)

- b. Explain the synchros as on error detector. (04 Marks)
- c. For the mechanical network shown in Fig.Q.2(c), draw the F-i analogous electrical system. (07 Marks)

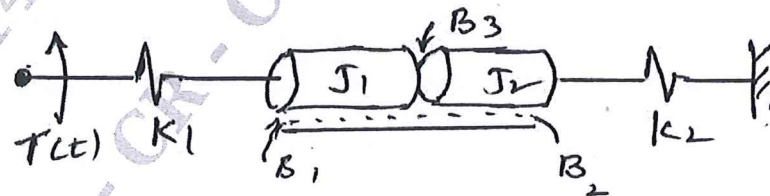


Fig.Q.2(c)

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-2**

- 3 a. What is transfer function? List the limitations of transfer function. (04 Marks)  
 b. For the block diagram shown in Fig.Q.3(b). Determine overall transfer function. (06 Marks)

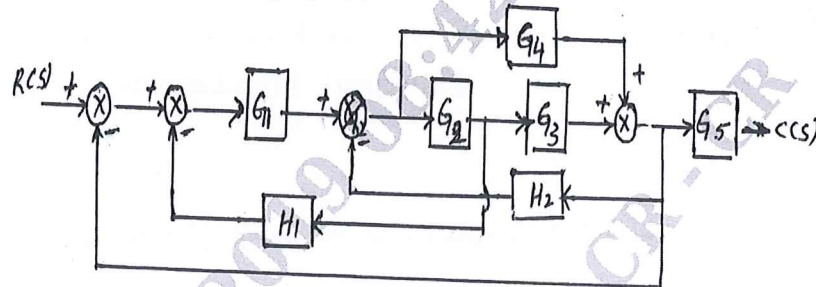


Fig.Q.3(b)

- c. Determine transfer function  $X_6(S)/X_1(S)$  using Mason's gain formula for the signal flow graph shown in Fig.Q3(c). (06 Marks)

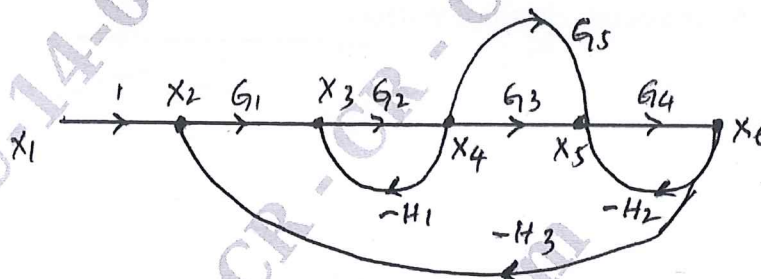


Fig.Q3(c)

OR

- 4 a. Define:  
 i) Source and sink node  
 ii) Loop and forward path  
 iii) Error signal and primary feed back signal. (06 Marks)  
 b. For the block diagram shown in Fig.Q.4(b) obtain the overall transfer functions. Draw the signal flow graph and verify the transfer functions using Mason's gain formula. (10 Marks)

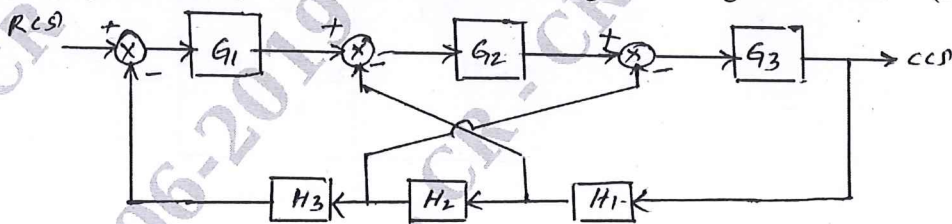


Fig.Q.4(b)

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**Module-3**

- 5 a. Derive an expression for response of second order under damped system for unit step input. (06 Marks)  
 b. An unity FBCS has  $G(S) = \frac{20(s+1)}{s(s^3 6s^2 + 8s)}$  calculate steady state error when the input  $r(t) = 40 + 2t + 5t^2$ . (05 Marks)  
 c. Check the stability of the give characteristic equation using R-H criterion  $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ . (05 Marks)

OR

- 6 a. State R-H Criterion. Explain the difficulties of R-H criterion and remedy. (06 Marks)
- b. A unity FBCS has  $G(S) = \frac{K(s+13)}{s(s+5)(s+7)}$ . Using R-H criterion, calculate the range of 'K' for which the system is stable. (05 Marks)
- c. A second order system is given by  $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$ . Find Rise time, peak time, peak overshoot and settling time for 2% tolerance. (05 Marks)

Module-4

- 7 a. Sketch the root locus for unity FBCS having  $G(s) = \frac{K(s+1)}{S(s+2)(s^2 + 2s + 2)}$ . Mark the salient points. (12 Marks)
- b. Derive an expression for resonant peak  $M_r$  and resonant frequency  $W_r$  for a standard second order system. (04 Marks)

OR

- 8 a. A unity FBCS with  $G(s) = \frac{10(s+10)}{s(s+2)(s+5)}$ . Find gain and phase Margin using bode plot. (12 Marks)
- b. Write note on: i) Break away point ii) Asymptotes. (04 Marks)

Module-5

- 9 a. Explain the Nyquist stability criterion. (06 Marks)
- b. What are the steps to design lead compensator? (05 Marks)
- c. Explain the P-I controller on a second order systems. (05 Marks)

OR

- 10 a. Sketch the Nyquist plot for the system with  $G(s)H(s) = \frac{4s+1}{s^2(s+1)(2s+1)}$  comment on stability. (10 Marks)
- b. What is Lead-Lag compensation? Explain the procedure to design lead-lag compensation in frequency domain. (06 Marks)

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