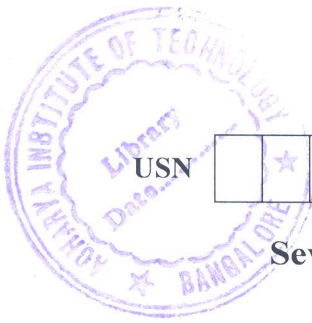


CBCS SCHEME



15ME73

Seventh Semester B.E. Degree Examination, Aug./Sept.2020 Control Engineering

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Define Control System. With block diagram and examples, explain open loop control system and closed loop control system. (10 Marks)
- b. What are the requirements of an Ideal Control System? (06 Marks)

OR

- 2 Explain the following controllers with block diagrams:
 - (i) Proportional Controller
 - (ii) Integral Controller
 - (iii) Proportional plus Integral Controller
 - (iv) Proportional plus integral plus differential controller (16 Marks)

Module-2

- 3 a. Write the Force – Voltage and Force current analogous circuit for the mechanical system shown in Fig.Q3(a). (10 Marks)

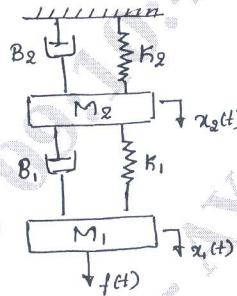


Fig.Q3(a)

- b. Derive an expression for the transfer function of armature controlled D.C motor. (06 Marks)

OR

- 4 Reduce the block diagram shown in Fig.Q4. Also verify the answer using signal flow graph and Mason's gain formula. (16 Marks)

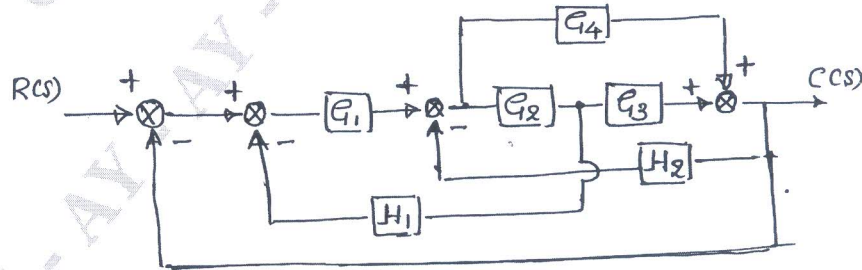


Fig.Q4

(16 Marks)

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-3

- 5 a. Using RH criterion investigate the stability of the control system with characteristic equation $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$ (05 Marks)
- b. Obtain an expression for time response of a first order control system subject to unit step input. (05 Marks)
- c. A unity feedback control system is characterized by an OLTF

$$G(s) = \frac{10}{s^2 + 5s + 6}$$

Determine the following when system is subjected to an unit step input

- (i) Undamped Natural Frequency
 (ii) Damping ratio
 (iii) Peak overshoot
 (iv) Peak time
 (v) Settling time

(06 Marks)

OR

- 6 Draw root locus plot for the system with OLTF

$$G(s)H(s) = \frac{k}{s(s+3)(s^2 + 3s + 4.5)}$$

Also comment on stability of the control system.

(16 Marks)

Module-4

- 7 Sketch the Bode plot for the system whose OLTF is given by

$$G(s)H(s) = \frac{ke^{-0.2s}}{s(s+1)(1+0.1s)}$$

Determine the value of System Gain k for a gain crossover frequency of 5 rad/s. (16 Marks)

OR

- 8 a. Explain Nyquist stability criteria. (04 Marks)
- b. For a control system

$$G(s)H(s) = \frac{k}{s(s+2)(s+10)}$$

draw the Nyquist plot and hence calculate the range of values of 'k' for stability. (12 Marks)

Module-5

- 9 a. What is System Compensation? Explain (i) Series compensation (ii) Feedback compensation. (07 Marks)
- b. Explain phase lag, phase lead and lag lead compensation circuits with sketches. (09 Marks)

OR

- 10 a. Explain the following terms :

(i) Controllability (ii) Observability (06 Marks)

- b. Find the controllability and observability of the system described by the state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = [1 \ 0]x$$

(10 Marks)
