

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2017

Subject Code: 2151908

Date: 23/11/2017

Subject Name: Control Engineering

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1*** (a) Define Controlled variable and Manipulated variable. State requirements of a good control system. **03**
- (b) What does a block diagram represent? List its salient characteristics. **04**
- (c) Briefly classify control systems. Write comparison between Open loop system and Closed loop system. **07**

- Q.2** (a) What is Transfer function? Write down Advantages and disadvantages of Transfer function. **03**
- (b) Using Force-Voltage analogy, draw electrical analogous circuit of the mechanical system shown in Figure I and write the differential equations governing the system shown in figure. **04**
- (c) What do you mean by Signal Flow graph? The block diagram representation of a control system is shown in Figure II. Draw the signal flow graph and determine overall transfer function using Mason's gain formula. **07**

OR

- (c) What is Modern control theory? Compare Modern control theory with conventional control theory. **07**
- Q.3** (a) Define the following terms: **03**
(1) Resonant peak (2) Gain Margin
- (b) Obtain the transfer function of a mechanical network shown in Figure III. **04**
- (c) For Unity feedback control system has **07**

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

Sketch the root locus. Also determine the value of K so that the damping ratio, ξ , of a pair of complex conjugate closed loop poles is 0.5.

OR

- Q.3** (a) What is meant by Step input, Impulse input and Ramp input? **03**
- (b) Explain Pneumatic PID controller with a schematic diagram. **04**
- (c) Find the frequency domain specifications with a unity feedback having, **07**

$$G(s) = \frac{20s}{s^2(s+4)}$$

- Q.4** (a) Explain PI controller and its effect on the system performance. **03**
- (b) The closed loop transfer functions of certain second order unity feedback control systems are given below. Determine the type of damping in the systems. **04**

$$\frac{C(s)}{R(s)} = \frac{8}{s^2 + 1.25s + 8}$$

$$\frac{C(s)}{R(s)} = \frac{2}{s^2 + 4.5s + 2}$$

- (c) Reduce block diagram as shown in Figure IV and obtain overall transfer function
- 07

OR

- Q.4

(a) Write note on “ Significance of Control Engineering”

03
- (b) State advantages and limitations of Frequency Response Analysis.

04
- (c) Unity feedback control system has,

07

$$\frac{C(s)}{R(s)} = \frac{K}{s(s+2)(s+3)(s+4)}$$

Find the range of K for the stability of the system using Routh’s stability criterion.

- Q.5

(a) Write short note on pneumatic nozzle-flapper amplifier with diagram.

03
- (b) Enlist basic elements of Hydraulic circuit and Pneumatic circuit.

04
- (c) Write comparison between

07
- (1) Hydraulic and Electrical control system
- (2) Pneumatic and Hydraulic control system

OR

- Q.5

(a) State the advantages of state-space approach for analysis and design of Control systems.

03
- (b) Explain Hydraulic PID controller with neat sketch.

04
- (c) Define State vector in the context of state-space approach.

07
- Obtain state model for the transfer function:
- $$\frac{C(s)}{R(s)} = \frac{(s+2)}{(s+1)(s+3)}$$
-
- Figure I
-
- 2
- http://www.gujaratstudy.com

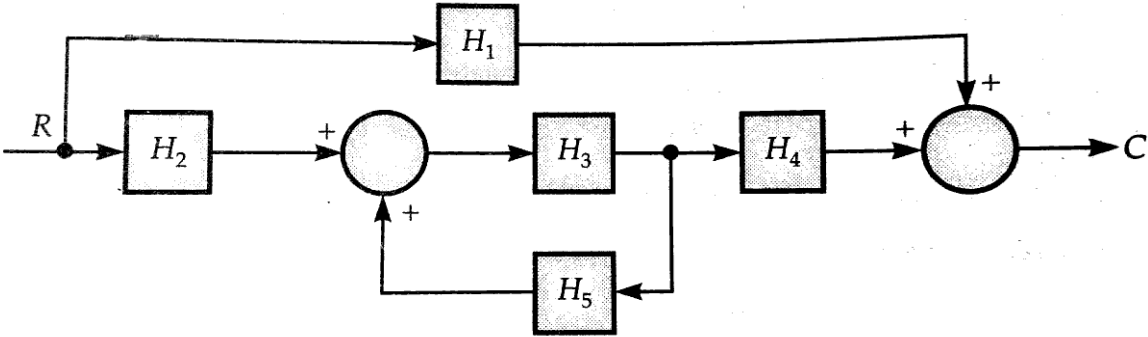


Figure II

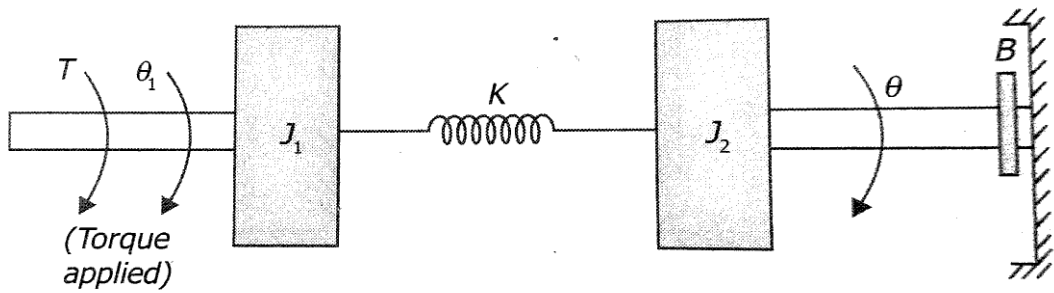


Figure III

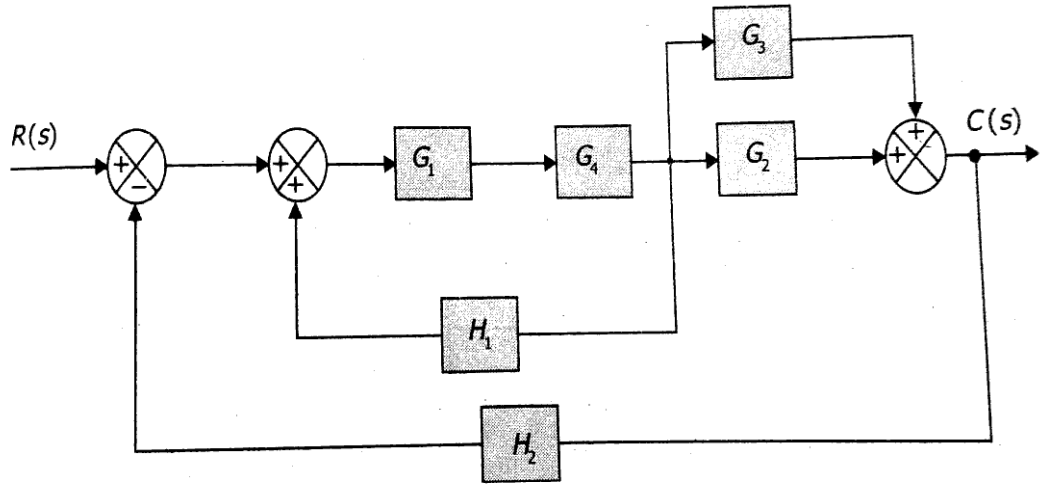


Figure IV