

2122
B.E. (Mechanical Engineering)
Seventh Semester
MEC-702: Automatic Controls

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part.

x-x-x

1. Attempt the following
 - (a) Define the static and dynamic systems, give example for each type.
 - (b) Draw block diagram for diaphragm type pneumatic control valve. Also write its transfer function equation.
 - (c) What are the advantage of having signal flow graph using Mason's gain formula?
 - (d) Define:
 - i) Stability, ii) Relative stability
 - (e) Calculate error at corner frequency to the term $(1 + j\omega T) \pm N$.

5*2

Part-A

2. (a) Figure 1, shows a gas pressure system. Volume of the vessel = 1.2 m^3 , Gas temp. = 257°C , Gas resistance $R_1 = 1.8 \times 10^5 \text{ NS/Kgm}^2$, Find the transfer function of the system relating 'p' and 'm', 'p' being the pressure in the vessel and 'm', the inflow mass flow rate. Gas constant $\bar{R} = 297 \text{ J/Kgk}$.

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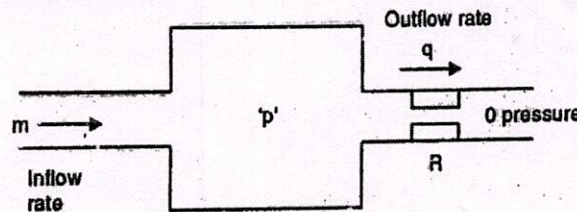


Fig. 1

- (b) What is feedback? What type of feedback is preferred for control system?
3. (a) Determine the transfer function C / R from the block diagram as shown in Fig. 2

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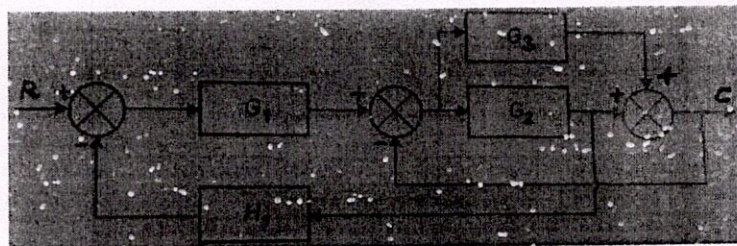


Fig. 2

- (b) What are the basic elements of mechanical rotational systems? Write its force balance equation.
4. (a) The transfer function, $G(s) = \frac{(s^2 + 4)(1 + 2.5s)}{2(s^2 + 2)(1 + 0.5s)}$, Plot the poles and zeros in s-plane and determine the value of the transfer function at $s = 2$.
- (b) Represent the following set of equations by a signal flow graph and determine the overall gain relating x_5 and x_1 .

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5

$$x_2 = ax_1 + fx_2; x_3 = bx_2 + ex_4; x_4 = cx_3 + hx_5; x_5 = dx_4 + gx_2.$$

(2)

Part-B

5. (a) Apply Routh criterion to determine the stability of the system having the characteristic equation as 5
$$s^3 + 4 \times 10^2 s^2 + 5 \times 10^4 s + 2 \times 10^6 = 0.$$
- (b) Explain stability in terms of characteristic equation of a control system. 5
6. (a) Write the state-space equations, using partial fraction method for the system with transfer function 5
$$Y(s) / U(s) = 8 / [(s + 1)(s + 2)(s + 4)]$$
- (b) What do you mean by virtual instrumentation? Why is Virtual Instrumentation necessary? 5
7. (a) Write the Steps to Create a Sub-VI. 5
- (b) Explain potentiometer error detector with circuit diagram. 5

x-x-x