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Total No. of Pages : 03

Total No. of Questions : 09

B.Tech. (Aerospace Engineering) (2012 Onwards) (Sem.–5)

CONTROL ENGINEERING

Subject Code : ASPE-304

M.Code : 71838

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) State the properties of transfer function.

b) What is servomechanism?

c) State Nyquist stability criterion.

d) Name and define types of controllers.

e) Write down Mason's gain formula and explain its various terms.

f) What is Force-voltage analog?

g) Explain the terms phase margin and gain margin.

h) Name the physical devices for system compensation.

i) What is Bode plot?

j) State Routh's Hurwitz criterion.

SECTION-B

2. A system for controlling the position of a robot is shown in fig. 1. Use a proportional plus integral controller to design a system whose characteristic equation has a damping ratio $g = 1.0$ and a natural frequency $\omega_n = 4$. Determine K_p.

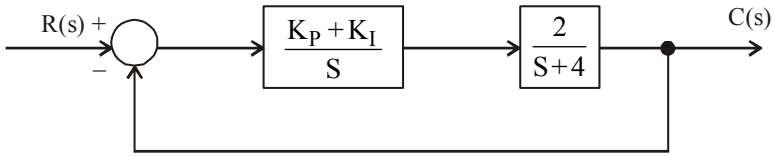

Fig.1

3. For the mechanical system shown in Fig. 2.

   a) Determine the differential equation relating f and x.

   b) Construct the force voltage analog.

   c) Construct the force current analog.

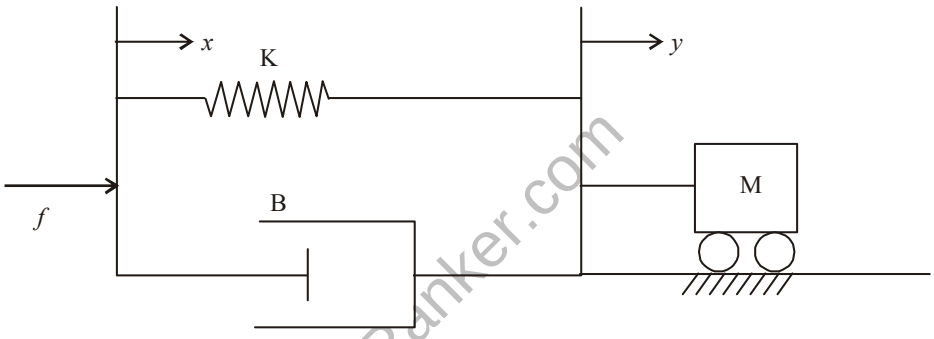

Fig.2

4. Draw the complete signal flow graph for the following simultaneous equations :

   $x_1 = a_{11}x_1 + a_{12}x_2 + b_1u_1$

   $x_2 = a_{21}x_1 + a_{22}x_2 + b_2u_2$

5. The block diagram representation for a servomechanism is shown in fig. 3.

   Determine the differential equation relating the output y to the input x. Determine the value of the steady state gain k and the time constant τ.

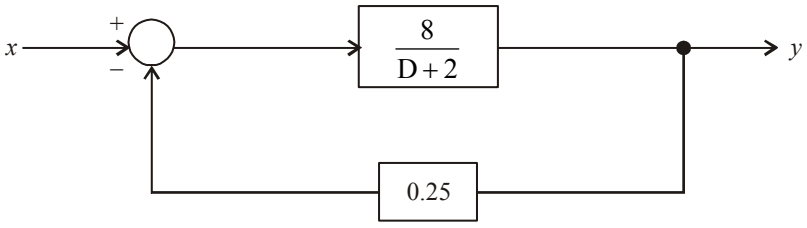

Fig. 3

6. Illustrate the use of a phase-lead component placed in series with the feedback portion of a control system to improve the stability.

SECTION-C

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

$$G(s)\,H(s) = \frac{K(S+3)}{S^2-2S+10}$$

Determine the value of $G(j\omega)\,H(j\omega)/K$ for $\omega = 0, 1, 2, 3, 4, 5$ and 6

Construct the entire Nyquist plot and then determine the range of values of K such that the system is stable.

8. The block diagram for the autopilot for a large commercial airliner is shown in fig. 4. The system is to be designed such that the percentage of overshoot to a step change in the input does not exceed 10 percent, and the 5 percent settling time should be less than 1s. Determine the required values of K and *a*.

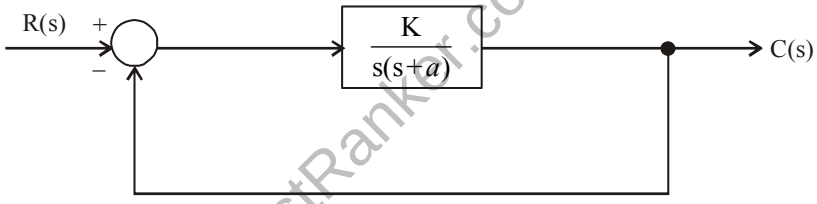

Fig.4

9. A system for controlling the output torque from an engine is shown in fig. 5. Apply Routh's criterion to determine the range of values of a such that the system is stable.

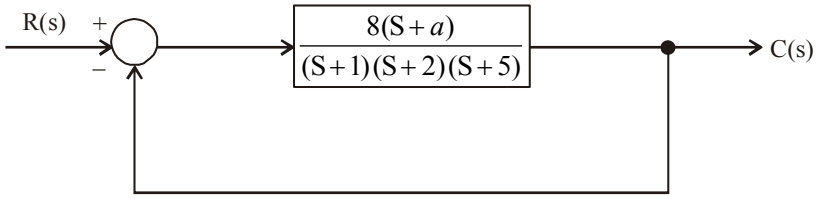

Fig.5

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.