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Total No. of Questions : 9]

[Total No. of Printed Pages : 7

IC–204

Linear Control System

(B.Tech., 4th Semester, 2063)

Time : 3 Hours] [Maximum Marks : 60

Note :– This paper consists of Three Sections. Section A is compulsory. Answer any *Four* questions from Section B and any *Two* questions from Section C.

Section–A

Marks : 2 Each

1. Answer the following short questions :

   (a) How is a servo-mechanism different from a regulating system ? Give examples.

   (b) Differentiate between the order and the type of control systems with illustrative examples.

(c) How are sensitivity and stability of an open loop control system modified, if it is incorporated a negative feedback ?

(d) How is state variable modelling superior to differential equation modelling ? Explain.

(e) Draw the block diagram of a non-unity feedback control system and distinguish between loop TF and closed loop TF if feedback is negative.

(f) Explain necessary and sufficient conditions of Routh-Hurwitz criterion and mention its limitations.

(g) Obtain TF of the two-phase a.c. servomotor and explain briefly its applications.

(h) Explain briefly the use of M-circles and N-circles for stability study of a feedback system.

(i) Explain how will you obtain Transfer Function of the system if its db-plot vs frequency is given.

(j) A unity f.b. system is described by its open loop TF, G (*s*) :

$$G(s) = \frac{4}{s(s+5)}$$

Obtain unit-step response of above system.

Section–B Marks : 5 Each

What do you mean by Mason's gain formula in signal flow graph ? Obtain the expression for overall gain of a system whose signal flow graph is given in Fig.–1.

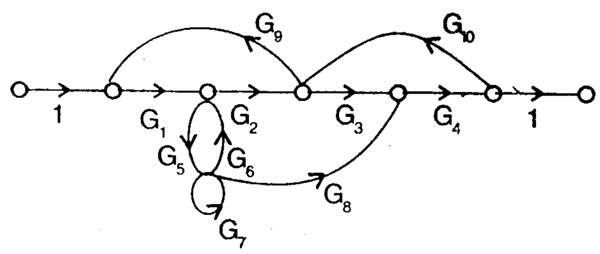

Fig.–1 : SFG of a system

3. What do you mean by TF of a linear system ? Derive TF of an armature-controlled d.c. motor as shown in Fig.–2 with armature voltage (e_a) as input and $\theta(t)$, the load position as output.

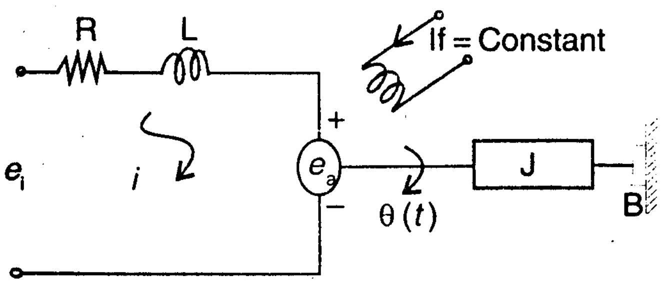

Fig.–2 : An arm. controlled d.c. motor

4. Enumerate typical test signals used as input for obtaining transient response of a system. Show

that the TF of the system shown in Fig.–3, $\frac{C(s)}{R(s)}$ has a zero lying in right half of s-plane. Obtain $C(t)$ when $r(t)$ is a unit step for the system.

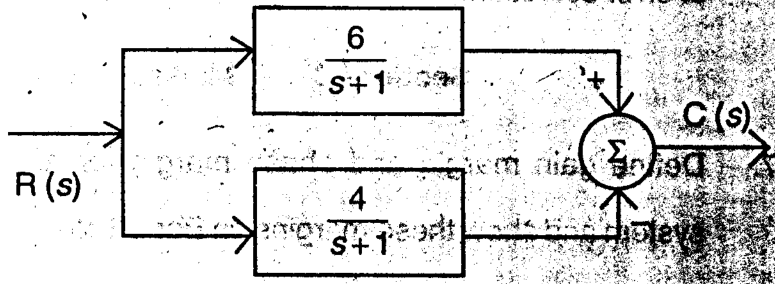

Fig.–3

5. What are the limitations of Routh-Hurwitz criterion ? A u.f.b. system is characterised by its open loop TF

$$G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$$

Obtain the range of K for the system to be stable. Use R-H criterion.

6. Discuss various schemes for error detection using (i) Potentiometers and (ii) Synchros. Describe merits and demerits of above schemes of error detection.

Section–C Marks : 10 Each

7. Define gain margin and phase margin for a system and show these margins on Bode' Plots and Nyquist Plot.

A system is described by its loop TF

$$G(s) = \frac{10}{s(1+0.5s)(1+0.25s)}$$

Obtain GM and PM from Bode' Plots and varify your results using the Nyquist Plot.

8. State and explain the rules for sketching the root loci for a feedback control system.

The open loop TF of an unity feedback control systemjis G (s)

$$G(s) = \frac{K}{s(s+1)(s+5)}$$

Sketch the root loan diagram for the system and obtain K for which the system is critically stable.

9. Write short notes on the following

(a) Importance of state-variable modelling

(b) On compensating network

(c) Applications of magnetic amplifiers. 3,3,4