Hall Ticket No | | | | | | | | | | Question Paper Code:AEEC12

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022

Regulation:UG20

CONTROL SYSTEMS

Time: 3 Hours **(ELECTRCAL AND ELECTRONICS ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

(NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

1. (a) Interpret the analogous electrical elements in force- current analogy for the elements of mechanical tranlational system. [BL: Understand| CO: 1|Marks: 7]

   (b) Solve the differential equations governing the mechanical system shown in Figure 1 and determine the transfer function $\frac{X_1(s)}{F(s)}$ and $\frac{X_2(s)}{F(s)}$ for the system [BL: Apply| CO: 1|Marks: 7]

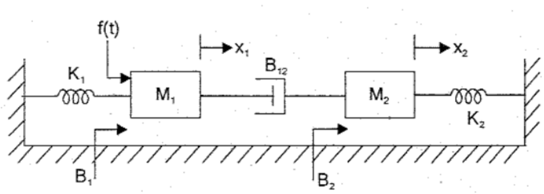

Figure 1

MODULE – II

2. (a) Illustrate in detail about P, PD, PI and PID controllers. Give an example of electronic PID controller with a neat sketch [BL: Apply| CO: 2|Marks: 7]

   (b) Construct the block diagram shown in Figure 2 to signal flow graph and find the transfer function of the system using Mason gain formula. [BL: Apply| CO: 2|Marks: 7]

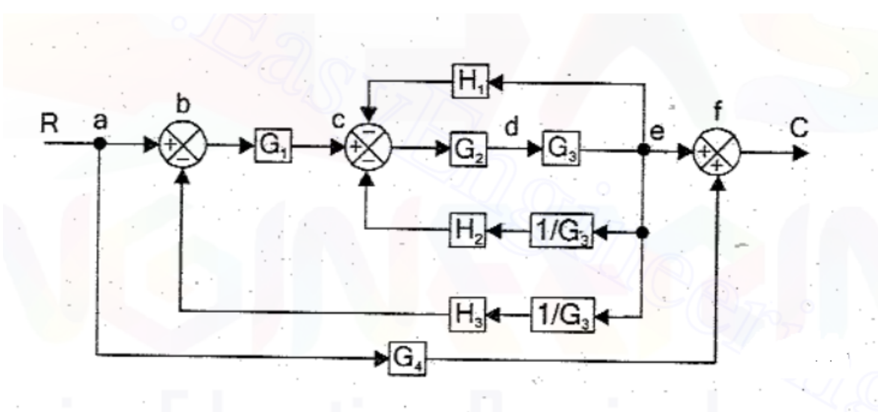

Figure 2

MODULE – III

3. (a) Describe the two special cases of Routh Hurwitz criterion and their remedies to find the stability analysis of a system. [BL: Understand| CO: 3|Marks: 7]

   (b) All elements in a row of Routh array are zero. What this indicates? How to overcome this situation? For a negative feedback control system, $G(s) = \dfrac{k-2}{s(s^2+s+1)}$ and $H(s) = \dfrac{1}{s+5}$. By applying RH criterion, determine the range of gain K over which the closed loop system is absolutely stable. Also investigate the stability and number of roots in RHS of s-plane when K=10 and K=0.5

   [BL: Apply| CO: 3|Marks: 7]

4. (a) Briefly infer the angle criterion of root locus technique. With an example, list the rules to construct the root locus diagram. [BL: Understand| CO: 4|Marks: 7]

   (b) Sketch the root locus of the system whose open loop transfer function is $G(s) = \dfrac{k}{s(s+2)(s+4)}$ Find the value of K so that damping ratio of the closed loop system is 0.5.

   [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Outline Nyquist stability criteria?. Explain various steps involved in plotting Nyquist plot.

   [BL: Understand| CO: 5|Marks: 7]

   (b) Using Nyquist stability criterion, investigate the stability of a closed-loop system whose open-loop transfer function is given by $G(s) = \dfrac{10}{(s+2)(s+1)}$ [BL: Apply| CO: 5|Marks: 7]

6. (a) Summarize the correlation between the time and frequency response. Describe in detail about frequency domain specifications. [BL: Understand| CO: 5|Marks: 7]

   (b) Given, $G(s) = \dfrac{ke^{-0.2s}}{s(s+2)(s+8)}$. Find K so that the system is stable with

   i) Gain marigin eqial to 2db

   ii) Phase marigin equal to 45^0 [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Demonstrate state transition matrix. List its advantages. Describe any two methods to obtain state transition matrix. [BL: Understand| CO: 6|Marks: 7]

   (b) A state variable description of a system is given by matrix equation

   $$\dot{X} = \begin{bmatrix} -1 & 0 \\ 1 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u \text{ and } Y = \begin{bmatrix} 1 & 1 \end{bmatrix} X$$

   Solve i) Transfer function ii) State transition matrix iii) State diagram

   [BL: Apply| CO: 6|Marks: 7]

8. (a) Derive the expression for the calculation of the transfer function from the state variables for the analysis of system. [BL: Understand| CO: 6|Marks: 7]

   (b) Develop a state model of RLC series circuit by choosing the current flowing through the circuit i(t) has one state variable and voltage across the capacitance as other variable. The input to the circuit is V_i(t) and out put across capacitor as V_0(t). [BL: Apply| CO: 6|Marks: 7]

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