Total number of printed pages–6

53 (IE 503) CNSY

2021

CONTROL SYSTEMS

Paper : IE 503

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Define the various test waveforms used in control systems alongwith mathematical descriptions and its application. 5

   (b) Discuss the effect of feedback on overall gain, stability and sensitivity. 5

   (c) Explain with an example Linear Time Invariant and Time Variant System. 4

   (d) Define Pole, Zero, Analytic function. 6

2. *(a)* Explain the Force-Voltage Analogous system. 4

Contd.

(b) A motor drives two loads. Find the system equations of Rotational motion in *Figure* 1. 6

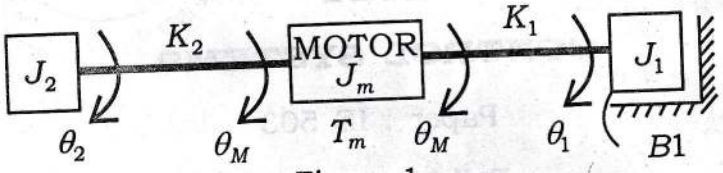
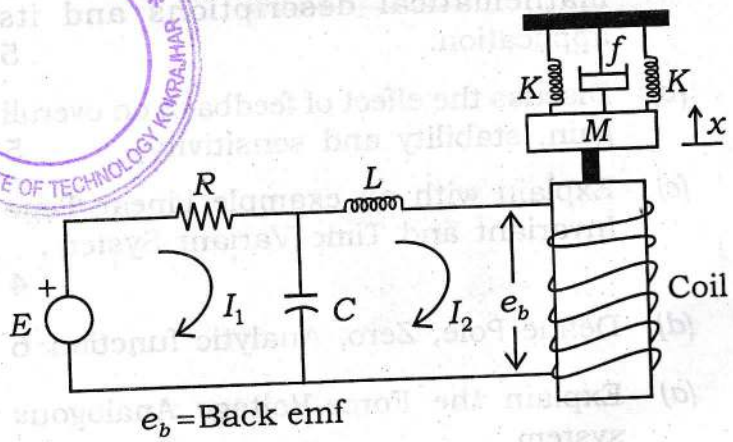


Figure 1

(c) Find the transfer function $\frac{X(s)}{E(s)}$ for the electromechanical system shown in *Figure* 2. 10

(i) Assume the back emf is proportional to derivative of movement '*x*' and

(ii) Force on Mass '*M*' is proportional to current in coil.



e_b = Back emf

Figure 2

3. *(a)* Consider a unity feedback control system with closed-loop transfer function

$$\frac{C(s)}{R(s)} = \frac{(Ks+b)}{(s^2+as+b)}$$

(i) Determine the open-loop transfer function 5

(ii) Determine the steady state error for unit Ramp Input response given by 5

$$e_{ss} = \frac{(a-K)}{(b)}$$

(b) Derive the static error coefficients K_p, K_v, K_a for a Type 1 system subjected to STEP and RAMP Inputs. 10

4. *(a)* Determine the Transfer function. Refer *Figure* 3 using Masons Gain formula. 10

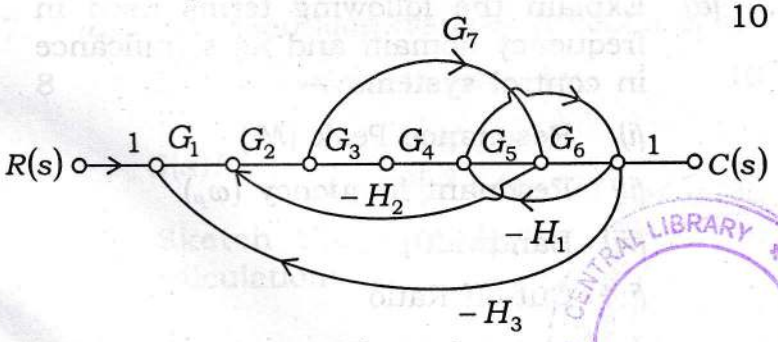


Figure 3

(b) Explain minimum phase and non-minimum phase system. Discuss the characteristics of Transportation Lag Element. 10