Reg.No.

Question Paper Code : X10037

B.E./B.Tech.DEGREE EXAMINATIONS NOVEMBER / DECEMBER 2020

Fifth Semester

Aeronautical Engineering

AE8505 - Control Engineering

(Regulations 2017)

Time:3Hours Answer ALL Questions Max. Marks100

PART- A (10 x 2 = 20Marks)

1. Define Thermal resistance.
2. Enlist the Electrical analogies of Mechanical Rotational Systems.
3. State the block diagram algebra for two blocks connected in parallel and feedback.
4. Describe path and loop in a signal Flow graph.
5. Define Rise time.
6. Differentiate the type number and order of the system.
7. Differentiate between stable and unstable systems.
8. Determine whether any of the roots of the polynomial are in RHP:

   $D(s) = s^6 + 4s^5 + 3s^4 + 2s^3 + 4s + 4.$
9. Find the Z –transform of the causal sequence

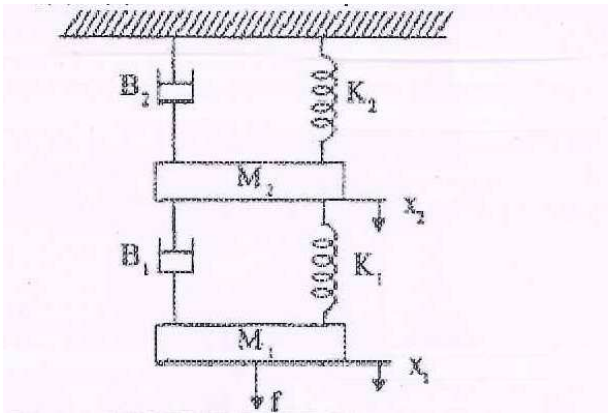
   $$f(k) = \begin{cases} 4, k = 2, 3..... \\ 0, otherwise \end{cases}$$
10. Describe the forward differencing property of Z-transform.

PART- B (5 x 13 = 65Marks)

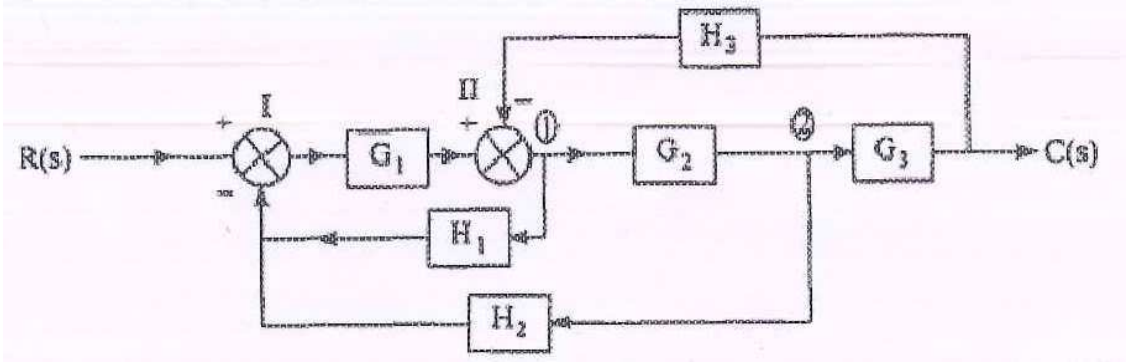
11. a) Derive the transfer function of heat exchanger thermal system with suitable illustrations **13**

OR

b) Write the equations describing the motion of Mechanical Translational system and find the transfer function $X_1(s)/F(s)$ and draw the equivalent Force-Voltage circuit. **13**

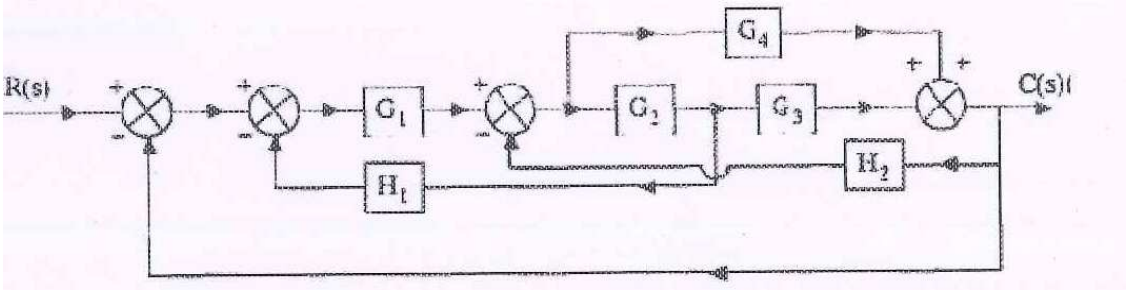


12. a) Obtain the overall transfer function by reducing the block diagram. **13**



OR

b) Obtain the transfer function using Signal Flow graph. **13**



13. a) Derive an expression for evaluating the peak time and peak overshoot by using step response of under damped second order system. **13**

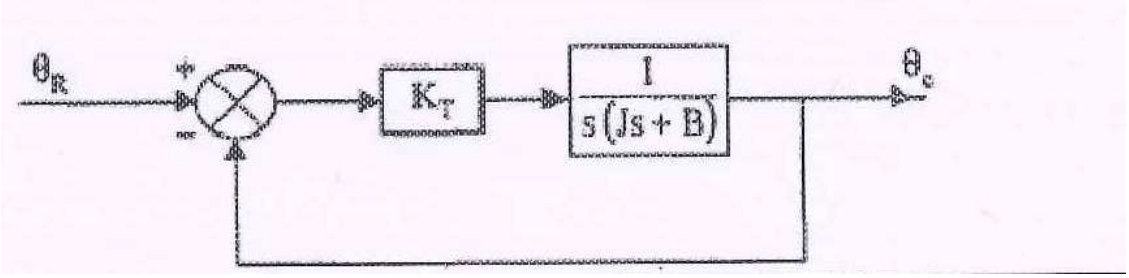
OR

b) The angular position θ_C of a mass is controlled by servo system through a reference signal θ_R. The moment of inertia of moving parts referred to the load shaft, J, is 150kgm^2 and damping torque coefficient referred to the load shaft, B, is 4.5×10^3 Nwm/rad/sec. the torque developed by the motor at the load is 7.2×10^4Nw-m per radian of error. **13**

i. Obtain the response of the system to a step input of 1 rad and determine the peak time, peak overshoot and frequency of transient oscillations. Also find the steady state error for a constant angular velocity of 1 revolution/minute.

ii. If a steady torque of 1000 Nwm is applied at the load shaft, determine the steady error.

The block diagram of the system may be considered as below.



14. a) Obtain the magnitude and phase angle plot for the system **13**

$$G(s)=\frac{20(0.1s+1)}{s^2(0.2s+1)(0.02s+1)}$$

OR

b) Sketch the root locus for $G(s)=\frac{K}{s(s+2)(s^2+2s+4)}$. Assume the damping factor to be 0.6. **13**

15. a) Find the z-domain transfer function of an armature controlled DC motor. **13**

OR

b) Design a digital PID controller for analog plant $G(s)=\frac{1}{(s+1)^4}e^{-0.2s}$ with sampling time T=0.1, process gain =1, time constant=3 and time delay=1.55 for an equivalent first-order dead time model and the apparent time delay for digital control be 1.6. **13**

PART- C (1 x 15 = 15 Marks)

16 a) Determine the stability of the closed-loop transfer function **15**

(i) $T(s)=\frac{10}{s^5+2s^4+3s^3+6s^2+5s+3}$

(ii) $T(s)=\frac{10}{s^5+7s^4+6s^3+42s^2+8s+56}$

OR

b) Find the system type, the appropriate error constant associated with the system type and the steady-state error for a unit step input. Assume input and output units are same. **15**