UESTC3001 - Dynamics & Control

Tutorial

Q1 (a) Using block diagram reduction techniques, reduce the block diagram shown in figure Q1 to a single block. [18 marks]

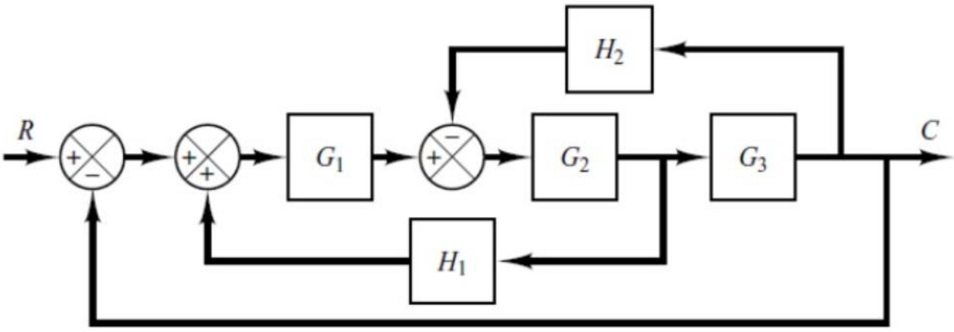

Figure Q1

(b) Use Routh's Criterion to determine whether the system stable:

$$s^4 + 2s^3 + 3s^2 + 4s + 5 = 0$$

[7 marks]

Q2 A cooling fan's angular speed ω can be related to the applied torque $T_A(t)$ by the relationship:

$$J\dot{\omega} = T_A(t)$$

where J is the moment of inertia of the fan. The applied torque $T_A(t)$ is the difference between the driving torque T(t), supplied by a motor, and a disturbance torque N(t), due to changes in the local airstream. It is desirable to keep the fan running at a constant speed ω_r and so a feedback control system is used to counter the disturbances N(t). The controller has transfer function $G_c(s)$ which operates on the error between the actual fan speed ω and the required speed ω_r. The controller (via an electric servo motor) supplies the driving torque T(t).

(a) Draw the block diagram of this system. [8 marks]

(b) If proportional control with gain K_p is used, derive an expression for the steady state error due to a unit step in the disturbance. [8 marks]

(c) Show that is integral action of gain Ki is added to the proportional action then the steady state error can be removed. [9 marks]