INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM 695 547

B.Tech (Electronics and Communication Engg)-Quiz 2, March 2023

AV224 – Control Systems
(Answer all questions)

Time: 1 Hour **Date: 28/03/2023** **Max. Marks: 50**

1. (a) State Nyquist stability Criterion with the help of appropriate diagram for an LTI system having no open loop poles on the $j\omega$ axis in $s-$plane.

   (b) Draw the generic shape of Nyquist plot for an LTI system with open loop transfer function, $G(s)H(s)$ based on its frequency response while $s \to j0$ and $s \to j\infty$. Assume different values for the type number of $G(s)H(s)$ like, $\lambda = 0, 1, 2, 3$ and different values for the relative order (excess of poles over zeros) like, $r = 1, 2, 3$.

   (c) Define the terms, gain margin and phase margin based on the Nyquist frequency response plot of a transfer function, $G(s)H(s)$. Assume that $G(s)H(s)$ is strictly proper and has no poles in the right half of s-plane.

   (d) Sketch the Nyquist plot and derive the expression for gain margin for the open loop system transfer function,

$$G(s)H(s) = \frac{K}{s(1+s\tau_1)(1+s\tau_2)}$$

   with $K > 0, \tau_1 > 0$ and $\tau_2 > 0$.

(5+5+5+15 marks)

2. Using Routh array, find the value of K such that

$$s^5 + s^4 + 6s^3 + 6s^2 + 25s + K = 0$$

has four complex roots symmetrically distributed w.r.t. both real and imaginary axes of s-plane.

(10 marks)

3. Draw the bode plot of the transfer function,

$$G(s) = \frac{s(s+100)}{(s+1)(s+10)}$$

(10 marks)