M.E. ELECTRONICS & TELECOMMUNICATION ENGINEERING

First- YEAR FIRST SEMESTER. EXAM-2024

NONLINEAR CONTROL SYSTEM (CON)

Ref. No.: EX/PG/ETCE/I/113C/2024

Time: 3 Hours **Answer Q.1** & any ***Four*** from the rest **Full Marks:100**

1. Indicate True(**T**)/ False(**F**) : **10x2**

i In State-variable (SV) representation of control system , Choice of state is unique
ii. A proportional controller improves feedback-system stability
iii.. Controller in a servo-system operates as a gain adjusting element
iv. Zeigler recommendations are based on root-locus
v. A third-order closed-loop system is stable if its Phase-Margin (PM) >> 180^o
vi. A limit-cycle phase-Isocline represents a stable system
vii. Integral controller improves system stability
viii. A 2^{nd}.-Order system is unstable if its S-matrix is nonsingular
ix. Eigen values of a state-defined system are essentially the poles of system
x. State-space Re-presentation & choice of states for control system is unique

2. (a) Define Gain-margin (GM) and Phase-margin (PM) **8+12**
(b) Skectch the Bode-plot and find GM & PM ; given a transfer function
H(s) = 1000/ [(1+0.1s)(1+0.001s)]

3. (a) Define State Variable (SV) **8+12**

(b) Derive the SV-representation for a system with Transfer Function
$H(s) = 1/ (s^4 + 3s^3 + 3s^2 + 2s + 1)$

4. **(a)** Define the features of PID controller 8+12
(b) A unity feedback system is given by **H(s) = 20/{(s+1)(10s+1)(20s+1)}**
Using a Bode-plot, obtain the parameter settings of a PID controller as per Ziegler

5. (a) What is Describing Function (DF) ? **10+10**
(b) A relay with dead-zone element is cascaded to a linear system of transfer function H(s) in closed-loop. Determine the stability conditions of the looped-system using DF. Given H(s) = 2/ [s(s+2)(s+3)].
Assume: **E=1, D=2, T_m=2** for nonlinear block.

6. (a) Explain the principles of *a* Servomechanism
(b) Given transfer function of a servo-system G(s)= **10A/|s^2+35s + 4A|;** If forward gain A=**300**
Calculate : Damping factor (δ) and Settling time (T_s); Sketch transient response **8+12**

7. Write Short Notes (Any Two) : **10x2**
(*a*) Controllability / Observability
(b) Phase Variable
(c) Servo-mechanism Characteristics
(d) Lyapunov Stabilty conditions