R18 Regulation *Subject code:2O7BA*

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous, Accredited by NAAC with 'A' Grade)

B.Tech VII Semester Supplementary Examinations, July 2022

ADVANCED CONTROL SYSTEMS

(ELECTRICAL AND ELECTRONICS ENGINEERING)

Maximum Marks: 70 Date:06.07.2022 Duration: 3 hours

Note: 1.This question paper contains two parts A and B.
2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
3. Part B consists of 5 Units. Answer any one full question from each unit which carries 10M.
4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks **(10x2M=20 Marks)**

1 What is a polar plot?
2 Discuss Nyquist Stability Criterion.
3 Define Lyapunov Stability Criteria
4 State direct method of Lyapunov stability
5 State different types of singularity points
6 What is stable node. Draw the phase portrait of a stable node?
7 State different types of non-linearities.
8 What is the behaviour of a nonlinear systems?
9 Define Observability.
10 State any four properties of state transition matrix.

Part-B

Answer All the following questions. **(10MX 5=50Marks)**

11 The open loop transfer function of unity feedback system is G(s) = 1 / S(S+1)(S+2). Draw the Nyquist plot to test the stability. (10M)

OR

12 Explain the procedure of Lag – Lead design of controllers in frequency domain. Explain how its performance can be assessed. (10M)

13 a) Explain the sufficient conditions of stability of non-linear autonomous system (4M)
b) Observe whether the following quadratic form is positive definite (6M)
$Q= x_1^2 + 2\,x_2^2 + x_3^2 + 4\,x_1x_2 - 8\,x_2\,x_3 - 2x_1x_3$

OR

14 Explain the procedure to formulate a Lyapunov function and to investigate the stability of a linear system. (10M)

15 a) Explain the Isocline method for construction of trajectories. (5M)
b) Obtain a phase-plane portrait of the following system (5M)
$\ddot{x} + 0.5\dot{x} + 2x + x^2 = 0$

OR

16 a)Explain various singularity points with neat diagrams (5M)
b) Discuss the procedure Phase phase analysis for non linear systems (5M)

17 Explain the describing function for saturation non-linearity. (10M)

OR

18 a) Explain how to study the stability of the system through describing function analysis. (5M)
(b) Determine the describing function for the nonlinear element described by, $y=x^3$ where x= input to the nonlinear element and y=output of the nonlinear element. (5M)

19 a) Define Controllability (2M)
b) Determine controllability and observability of the following systems (8M)

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u$$

$$y(t)=\begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

OR

20 a) Describe the concept of State and State Variable. (5M)
b) State and prove the properties of state transition matrix (5M)