R18 Regulation *Subject code:2O7BA*

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

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

B.Tech VII Semester Regular/Supplementary Examinations, November 2022

ADVANCED CONTROL SYSTEMS

(Open Elective)

(Electrical and Electronics Engineering)

Maximum Marks: 70 Date:07.12.2022 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 If the Nyquist plot cuts the negative real axis at a distance of 0.8, then what is the gain margin of the system?

2 What is the main disadvantage of lag controllers?

3 State Stability Theorem in the Lyapunov Sense.

4 Define Lyapunov stability.

5 What are the Advantages of Phase Plane Analysis?

6 Write short notes on Saddle Point.

7 What are the types of non-linearities in a control system?

8 Define a describing function.

9 What are the Advantages of state variable analysis?

10 For a single input system

$\dot{X} = AX + BU$

$Y = CX$

$A=\begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$:$B=\begin{bmatrix} 0 \\ 1 \end{bmatrix}$; $C=[1 \quad 1]$

Check the controllability & observability of the system.

Part-B

Answer All the following questions. (5X10M=50Marks)

11 The open loop transfer function of a negative unity feedback system is given by, $\frac{k}{s(s^2+2s+2)}$. 10M

Find the range of k for closed — loop stability by using plor-plot.

OR

12 Design a Phase Lead Controller for the following system:

$G(s) = \frac{s+3}{s(s+1)(s+8)}$ 10M

To satisfy the following specifications:

(a) $T_s = 80$ milliseconds (b) $\xi = 0.4$

13 A. Explain Lyapunov direct method. 5M

B. Investigate the stability of following non-linear system using Liapunov direct method. 5M

$\dot{x_1}=x_2$

$\dot{x_2}=-x_1-x_1^2x_2$

OR

14 A second order system is represented by 10M

$\dot{x}=Ax$ where $A=\begin{bmatrix}0 & 1\\ -1 & -1\end{bmatrix}$

Assuming matrix Q to be identity matrix, solve for matrix P in the equation $A^TP+PA=-Q$. Use Liapunov theorem and determine the stability of the origin of the system. Write the Liapunov function V(x).

15 Draw the phase-plane trajectory for the following equation using isocline method: 10M

$\ddot{x}+2\xi\omega\dot{x}+\omega^2x=0$ Given, $\xi=0.5$, $\omega=1$, Initial point (0,6).

OR

16 Determine the kind of singularity for each of the following differential equations. 10M

(a) $\ddot{y}+3\dot{y}+2y=0$

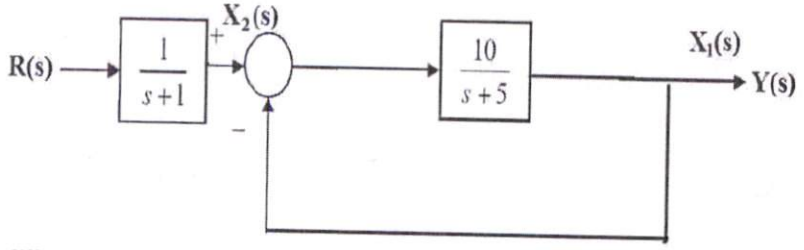
(b) $\ddot{y}-8\dot{y}+17y=34$

17 Estimate the describing function of Dead-zone nonlinearity. 10M

OR

18 Estimate the describing function of saturation nonlinearity. 10M

19 Find the state space representation in phase variable form for the block diagram shown. 10M



OR

20 Find the state transition matrix for the following system. 10M

$$\dot{X}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -2 & -5 & -4\end{bmatrix}X$$