Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2022

EE5CO05 / EE5CP05 Advance Control Systems

Programme: M.Tech. Branch/Specialisation: EE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. Which compensator improves the steady state response? **1**

(a) Lead Compensator (b) Lag Compensator

(c) Both (a) and (b) (d) None of these

ii. Which compensator increases the system bandwidth? **1**

(a) Lead Compensator (b) Lag Compensator

(c) Proportional Controller (d) None of these

iii. Controller design is possible for systems which are- **1**

(a) Controllable

(b) Observable

(c) Neither controllable nor observable

(d) None of these

iv. Number of state variables is equal to- **1**

(a) System order

(b) Number of energy storing elements in the system

(c) Number of integrators in the system

(d) All of these

v. Designing of state feedback controller requires- **1**

(a) All state variables to be measurable

(b) System to be controllable

(c) Both (a) and (b)

(d) None of these

vi. Full order observer is designed when- **1**

(a) Only output is measurable

(b) Half of the state variables are measurable

(c) All the state variables are measurable

(d) The system is controllable

P.T.O.

vii. Finite capability of actuator to transmit the control input is known as- **1**
(a) Saturation (b) Hysteresis
(c) Dead zone (d) Backlesh

viii. If the Lyapunov function is globally positive definite and radially unbounded, and the time derivative of the Lyapunov function is globally negative definite then the equilibrium is- **1**
(a) Globally asymptotically stable
(b) Locally asymptotically stable
(c) Regionally asymptotically stable
(d) Unstable

ix. An algorithm that provides estimates of some unknown variables given the measurements observed over time is known as- **1**
(a) Controller (b) Lyapunov function
(c) Kalman Filter (d) None of these

x. Algebraic Riccati equation is encountered in the designing of- **1**
(a) Infinite-horizon, continuous-time LQR
(b) Finite-horizon, continuous-time LQR
(c) Both (a) and (b)
(d) None of these

Q.2 i. Draw Bode plot of Lag compensator. **2**

ii. What are the characteristics of lead compensator? **3**

iii. For the system with transfer function **5**

$$G(s)=\frac{4}{s(s+2)}$$

Design a lead network to meet the following performance requirements
(a) Velocity error coefficient = 20
(b) Phase margin > 50

OR iv. Explain the designing of RC based Lag Compensator. **5**

Q.3 i. Determine the Eigen values of the following system matrix and comment on stability- **2**

$$A=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}$$

ii. Define Controllability. Check the controllability of the system with- **8**

$$A=\begin{bmatrix}0 & 1\\ -1 & -2\end{bmatrix};B=\begin{bmatrix}0\\ 1\end{bmatrix}$$

OR iii. Define Observability. Check the observability of the system with- **8**

$$A=\begin{bmatrix}-2 & 0\\ 0 & -3\end{bmatrix};C=\begin{bmatrix}0 & 1\end{bmatrix}$$

Q.4 i. What is the difference between state regulator problem and servo problem **3**

ii. For the linear system with following dynamics: **7**

$$A=\begin{bmatrix}1 & 1\\ 1 & 2\end{bmatrix};B=\begin{bmatrix}1\\ 0\end{bmatrix}$$

Design a state feedback controller to relocate the closed loop poles at -5 and -6.

OR iii. Explain the designing of full order observer. **7**

Q5. i Explain saturation nonlinearity and its effects on system performance. **3**

ii Explain Lyapunov stability method and analyze the stability of following system using Lyapunov method: **7**

$$A=\begin{bmatrix}0 & 1\\ -3 & -4\end{bmatrix}$$

iii Explain Popov criterion. **7**

Q6. Attempt any two:

i State and explain the principle of optimality. **5**

ii Explain the working of Kalman filter. **5**

iii Explain the designing of infinite horizon, continuous time linear quadratic regulator. **5**

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Marking Scheme
EE5CP05 Advance Control Systems

Q.1

i) B

ii) A

iii) A

iv) D

v) C

vi) A

vii) A

viii) A

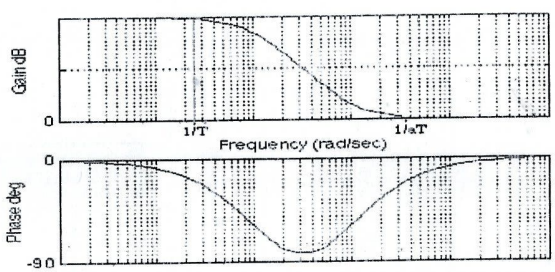
ix) C

x) A

Q.2

i) Diagram **2 Marks**

$$C(s) = \frac{1}{a}\left(\frac{1+aTs}{1+Ts}\right) \qquad [a < 1]$$



ii) Characteristics. **1*3=3 Marks**

iii) 1 Marks for K calculation 2 Marks for existing phase margin calculation and 2 marks for phase lead network transfer function.

iv) Diagram **2 Marks**

Designing procedure. **3 Marks**

Q3

i)	Eigen Value is -1 and -2	**1 Marks**
	System is stable	**1 Marks**
ii)	Definition	**4 Marks**
	Rank is Full system is controllable	**4 Marks**
iii)	Definition	**4 Marks**
	Rank is not Full system is Unobservable	**4 Marks**

Q.4

i)	Difference Between State problem and servo problem	**3 Marks**
ii)	Calculations	**5 Marks**
	Controller Gain K1=14 , K2=57	**2 Marks**
iii)	Designing procedure	**7 Marks**

Q.5

i)	Explanation	**2 Marks**
	Effects on system performance	**1 Marks**
ii)	Explanation of Lyapunov Stability	**4 Marks**
	Analysis system stability (System is Stable)	**3 Marks**
iii)	Explanation Popov Criterion	**7 Marks**

Q.6

i)	Statement of optimality	**3 Marks**
	Explanation	**2 Marks**
ii)	Explanation of Working	**5 Marks**
iii)	Explanation of designing	**5 Marks**