



ANDHRA UNIVERSITY

TRANS-DISCIPLINARY RESEARCH HUB

ADVANCED CONTROL SYSTEMS

Unit I

Control System Design by the root locus method-lead, lag and lag-lead compensation, PI, PD, PID Controllers design procedures and examples.

Control System Design by frequency response approach-lead, lag lag-lead compensation, PI, PD, PID Controllers – design procedures and examples.

Unit II: Eigen value and Eigen vector sensitivities in linear systems theory:

Continuous time systems: Introduction, first – order Eigen value sensitivities, first – order Eigen vector sensitivities, second order Eigen value sensitivities, second – order Eigenvector sensitivities

Unit III: Mode – Controllability matrix:

Distinct Eigen values, confluent Eigen values associated with a single Jordan block, confluent Eigen values associated with a number of distinct Jordan blocks, confluent Eigen values associated with a number of non- distinct Jordan blocks

Mode – Controllability structure of multivariable linear systems:

Introduction, Distinct eigen values, confluent eigen values associated with single Jordan block, confluent eigen values associated with a number of distinct Jordan blocks

Unit IV: Mode –observability matrices:

Distinct Eigen values, confluent Eigen values, mode observability structure of multi variable linear system: Introduction, Distinct Eigen values, confluent Eigen values

Non linear systems:

Common physical non-linearities; the phase-plane method-basic concepts, singular points, construction of phase trajectories-Isocline and Delta methods. Describing function-basic concept-derivation of describing functions-stability analysis by describing function method.

Unit V: Lyapunov stability analysis:

Second method of Lyapunov, stability in the sense of Lyapunov, construction of Lyapunov function- Krasovskii's and variable gradient methods. Lyapunov stability analysis of linear time-invariant systems.

REFERENCE BOOKS:

1. Modern Control Engineering - K.Ogata – PHI - 3rd edition.
2. Control Systems Engineering – I.J.Nagrath, M.Gopal – New Age International - 3rd edition.
3. Control Systems – N.K.Sinha - New Age International - 3rd edition,
4. Automatic Control Systems – B.C.Kuo – PHI – 7th edition.
5. Modern Control Systems – HSU AND MEYER
6. Modal control theory and applications Brian porter AND Roger crossley



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MODEL QUESTION PAPER

ADVANCED CONTROL SYSTEMS.

Answer any five questions.

Each question carries 20 marks

Max. Marks:100

1. (a) Explain the design procedure of lead compensator.
(b) What is the need for lag compensator? Derive its transfer function
- 2.(a) Write about first-order Eigen value sensitivities.
(b) Write about second-order Eigen vector sensitivities.
- 3.(a) Explain about confluent Eigen values associated with a number of distinct Jordan blocks
(b) Explain distinct and confluent Eigen values.
4. (a) Explain about mode observability structure of multi variable linear system
(b) Design a PID controller
5. (a) Explain the classification of non-linearities and give the examples for each.
(b) Explain about construction of phase trajectories
6. (a) Test the stability of the following system by using variable gradient method

$$\dot{x}_1 = -2x_1 + 3x_1^2x_2$$

$$\dot{x}_2 = -4x_2$$

- (b) Obtain the expression for describing functions with diagram.
7. (a) Explain in detail about the Isocline and Delta methods.
(b) Explain stability analysis by describing function method.
8. (a) Explain the stability in the sense of Lyapunov.
(b) Test the stability of the system described by

$$\dot{x}_1 = -2x_1 + 5x_1^2x_2$$

$$\dot{x}_2 = -3x_2$$

Determine the region of asymptotic stability using Krasovskii method.