ADVANCED CONTROL SYSTEMS

Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AEE527	**Elective**	3	-	-	3	30	70	100

Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil	Total Classes: 45

OBJECTIVES:

The course should enable the students to:

I.   Apply phase plane analysis to linear and non linear control systems.
II. Analyze the stability of the systems using different techniques.
III. Illustrate the design of optimal controller.
IV. Demonstrate state variable analysis, non-linear systems and optimal control.

COURSE LEARNING OUTCOMES (CLOs):

At the end of the course, the student will have the ability to:

1 Define basic concepts of state, state variable and state model.
2 Explain the properties of linear and continues time systems such as controllability and observability.
3 Design of control systems with state observers.
4 Study the features of linear and non linear systems.
5 Demonstrate non-linear system behavior by phase plane, isoclines method.
6 Derive the describing function for common non-linearities.
7 Analyze the describing function methods for non -linear systems.
8 Observe the condition for stability and stability Oscillations.
9 Perform the stability analysis of nonlinear systems by Liapunov's' method
10 Develop and design skills in optimal control problems.

11 Learn the Lure's transformation, Aizerman's and Kalman's conjecture stability technique.
12 Study the concept of Popov's criterion, Circle criterion.
13 Discuss the concept of decoupling.
14 Design the linear quadratic regulator for optimal control.
15 Study the concept of steady state optimal control, optimal estimation
16 Design the multivariable control for optimal control
17 Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.

UNIT-I	STATE VARIABLE ANALYSIS	Classes: 09

Concept of state , state variable and state model, state models for linear and continuous time systems, solution of state and output equation, controllability and observability, pole placement, state observer design of control systems with observers.

UNIT -II	PHASE PLANE ANALYSIS	Classes: 09

Circuit analysis: Star to delta and delta to star transformation, mesh analysis and nodal analysis by Kirchhoff's laws, inspection method, super mesh, super node analysis; Network topology: definitions, incidence matrix, basic tie set and basic cut set matrices for planar networks, duality and dual networks.

UNIT-III	DESCRIBING FUNCTION ANALYSIS	Classes: 09

Basic concepts, derivation of describing functions for common non-linearities.

Describing function analysis of non-linear systems, Conditions for stability, Stability of oscillations.

UNIT -IV	STABILITY ANALYSIS	Classes: 09

Introduction, Liapunov's stability concept, Liapunov's direct method, Lure's transformation, Aizerman's and Kalman's conjecture, Popov's criterion, Circle criterion.

UNIT -V	OPTIMAL CONTROL	Classes: 09

Introduction, decoupling, time varying optimal control, linear quadratic regulator (LQR), steady state optimal control, optimal estimation, multivariable control design.

Text Books:

1. I J Nagrath and M Gopal, 'Control Systems Engineering', New Age International Publishers, 1st Edition , 2003.
2. Ashish Tewari, "Modern Control Design with MATlab and Simulink", John Wiley, 2nd Edition, 2002.

REFERENCE

1. George J Thaler, "Automatic Control Systems", Jaico Publishers, 1st Edition, 1993.
2. M Gopal, "Modern control system theory", New Age International Publishers, 1st Edition, 2002.
3. Gene F Franklin, J David Powell, Abbasemami-Naeini, "Feedback Control of Dynamic Systems", Pearson Education, 1st Edition 2002.

Web References:

1. https://www.nptel.ac.in/courses/108103007/
2. https://www.textofvideo.nptel.iitm.ac.in/108103007/lec1.pdf
3. https://www.file:///C:/Users/Administrator/Downloads/lecture_note_382311150307220.pdf

E-Text Books:

1. https://www.file:///C:/Users/Administrator/Downloads/adv_control_eng.pdf
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