Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NEEC501	Advanced Control System	3	1	0	4

Course Objective
• To impart knowledge on advanced aspects in control system in a compact way.
Learning Outcomes
• Acquaintance of modern control systems in terms of state-space analysis, controller design and understanding of non-linear systems suitable for all specializations in Electrical Engineering and a basis for specialization subjects under Control Systems specialization.

Unit No.	Topics to be Covered	Lecture +Tutorial Hours	Learning Outcome
1	**Introductory mathematical background**: Introductory matrix algebra and linear vector space, Linearization, State space representation, Similarity transformation and invariance of system properties due to similarity transformations, Caley-Hamilton theorem. Minimal realization of transfer function.	10L+2T	Linear algebra and mathematics required for analysis of modern control systems are discussed here.
2	**Analysis of modern control systems:** Solution of state equations, Evaluation of state transition matrix. Controllability and controllable canonical form, Observability and observable canonical form. Discretization of continuous-time state space model, discrete-time models.	10L+2T	Discussion on analysis of the modern control systems with discretization of state models.
3	**Design of Controller:** Pole placement technique using state feedback and Ackermann's formula.	4L+4T	Discussion on design of state-space controllers, consideration of observers.
4	**Design of Observer:** Full order observer and design of full order observer using Ackermann's formula, Duality, Observer based controller design, reduced order observer, Combined controller-estimator compensator, Linear quadratic regulator problem and algebraic Riccati equation.	10L+2T	Discussion on design of observers and introduction to optimal control.
5	**Introduction of non-linear systems:** Non-linear phenomena and characteristics, Linearization, introduction to describing function and phase plane analysis. Stability in the sense of Lyapunov, Lyapunov stability theorem, Lyapunov function for linear systems.	8L+4T	Discussion on non-linear systems in terms of behavior, analysis and stability analysis using Lyapunov function.
	Total Contact Hours	42L+14T	

Text Books:

1. K. Ogata, Modern control engineering, Pearson Prentice Hall
2. M. GopaL, Digital control and state variable methods, TMH

Reference Books:

1. R. T. Stefani, B Shahian, C J Savant Jr., G H Hostetter, Design of Feedback Systems, Oxford University Press
2. S. H. Zak, Systems and Control, Oxford University Press.