

EE 650	Linear Systems Theory	3-0-0	6
--------	-----------------------	-------	---

**Course Contents:**

Essentials of linear algebra: vector spaces, subspaces, singular value decomposition; state variable modeling of linear dynamical systems; transfer function matrices; Stability theory: Lyapunov theorems; controllability and observability; realization theory: balanced realization, Kalman canonical decomposition; linear state feedback and estimation. Introduction to linear robust control: model uncertainty, model reduction and co-prime factorization; robust stability and robust performance.

**Texts / References:**

1. S. Lang, *Introduction to Linear Algebra*, Springer-Verlag, 2/e, 1997.
2. L. A. Zadeh and C. A. Desoer, *Linear System Theory: The State Space Approach*, Springer-Verlag, 2008.
3. C.T. Chen, *Linear System Theory and Design*, Oxford University Press, 3/e, 1999.
4. W. Rugh, *Linear System Theory*, Prentice Hall, 2/e, 1995.

EE 581	Modern Power Systems	3-0-0	6
--------	----------------------	-------	---

**Course Contents:**

Introduction to modern power system: interconnected power system, main objective in operation of power system, structure of Indian power system; Power Component static and dynamic modeling: static modeling of transmission lines, transformer, and capability curve of generator ; Power flow analysis: Gauss-Seidel, Newton-Raphson (polar and rectangular form), decoupled load flow, fast decoupled power flow, DC load flow, Distribution system power flow ; Contingency analysis: contingency ranking, DC and AC sensitivity analysis ; Power system stability: equal area criteria, rotor angle and voltage stability, energy function approach towards transient stability prediction; Power system Operation and Control: Economic load dispatch, load frequency control.

**Texts / References:**

1. J. J. Grainger and W D. Stevenson, *Power System Analysis*, Tata McGraw-Hill, 2003.
2. A. J. Wood and B. F. Wollenberg, *Power Generation Operation and Control*, John Wiley and Sons, 2nd Edition, 2005.
3. N. G. Hingorani and L. Gyugyi, *Understanding FACTS*, Wiley-IEEE Press, 1999.
4. J. Arrillaga, *High voltage direct current transmission*, IEE Power Engineering Series, 2nd Edn., 1998.
5. P. Kundur, *Power System Stability and Control*, McGraw-Hill, 1995.

EE 683	Advanced Power Electronics	3-0-0	6
--------	----------------------------	-------	---

**Course Contents:**

Introduction to power electronics converters, Harmonic distortion, Modulation of one invert phase leg, Modulation of single phase voltage source inverter, Zero space vector placement modulation strategies, Modulation of current source inverters, Overmodulation of inverters, Programmed modulation strategies, Programmed modulation of multilevel converters, Carrier based modulation strategies, Space vector PWM, Implementation of modulation controllers.

**Texts / References:**

1. D. Grahame Holmes, Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, Wiley-IEEE Press, 1<sup>st</sup> Edition, 2003.
2. Ned Mohan, Power Electronics: Converters, Applications, and Design, Wiley, 3<sup>rd</sup> Edition, 2002.

EE 558	Applied Control Lab	0-0-3	3
--------	---------------------	-------	---

**Course Contents:**

1. DC Motor Speed Control: Using PLC to control the speed of DC Motor to understand the principles of feedback control, PWM and PLC programming. The objective is to study the following:

- a. Open loop speed control
- b. Close loop speed control
- c. Use of PLC for the speed control
- d. Acceleration and deceleration ramps programming in PLC
- e. To Monitor the duty cycle of the motor

2. AC Machine Control: The objective will be to study:

- a. Open loop speed control
- b. Close loop speed control
- c. Frequency converter and its control
- d. Acceleration and deceleration ramps programming in the controller
- e. PWM programming

3. Process Measurement and Control: The objective of this experiment is to understand:

- a. Industrial measurements
- b. The control systems used in industry
- c. The programming techniques of the controller to achieve specific purpose
- d. Process supervision through PC
- e. Various transducers and sensors used in the industry.

EE 551	Optimal and Adaptive Control	3-0-0	6
--------	------------------------------	-------	---

**Course Contents:**

Basic mathematical concepts, Conditions for optimality, Calculus of variations, Pontryagin's maximum principle, Hamilton Jacobi-Bellman theory, dynamic programming, structures and properties of optimal systems, various types of constraints, singular solutions, minimum time problems, optimal tracking control problem

Model reference adaptive control, gain scheduling, adaptive internal model control, adaptive variable structure control, adaptive back-stepping design, introduction to system identification, direct and indirect adaptive control.

**Texts / References:**

1. D. E. Kirk, Optimal Control Theory: An Introduction, Prentice-Hall, 2004.
2. B.D.O. Anderson and J.B. Moore, Optimal Control: Linear Quadratic Methods, 2007.
3. M. Krstic, P. V. Kokotovic, I. Kanellakopoulos, Nonlinear and Adaptive Control Design, John Wiley and Sons, 1995.
4. K. J. Astrom and B. Wittenmark, Adaptive Control, 2/e, 2008.
5. G. Feng and R. Lozano, Adaptive Control Systems, Oxford University Press, 1999..

EE 652	Digital Control	3-0-0	6
--------	-----------------	-------	---

**Course Contents:**

Discrete-time system representations: modeling discrete-time systems by linear difference equations and pulse transfer functions, time responses of discrete systems; discrete state-space models, stability of discrete-time systems. Finite settling-time control design: deadbeat systems, inter sample behavior, time-domain approach to ripple-free controllers, limitations and extensions of the deadbeat controller. State-feedback design techniques: linear system properties, state feedback using Ackermann's formula, tracking of known reference inputs. Output-feedback design techniques: observer design , observer-based output feedback design.

**Texts / References:**

1. B. C. Kuo, Digital Control Systems; Oxford University Press, 2/e, Indian Edition, 2007.
2. K. Ogata, Discrete Time Control Systems; Prentice Hall, 2/e, 1995.
3. M. Gopal, Digital Control and State Variable Methods; Tata Mcgraw Hill, 2/e, 2003.
4. G. F. Franklin, J. D. Powell and M. L. Workman; Digital Control of Dynamic Systems; Addison Wesley, 1998, Pearson Education, Asia, 3/e, 2000.
5. K. J. Astroms and B. Wittenmark, Computer Controlled Systems - Theory and Design; Prentice Hall, 3/e, 1997.

EE 580	Control of Electrical Drives	3-0-0	6
--------	------------------------------	-------	---

**Course Contents:**

Modeling of DC Machines, Phase Controlled DC Motor Drives, Chopper Controlled DC Motor Drives, Modeling of Polyphase Induction Machines, Phase Controlled Motor Drives, Frequency Controlled Induction Motor Drives, Vector Controlled Induction Motor Drives, Permanent Magnet Synchronous and Brushless DC Motor Drive Modeling and Control.

**Texts / References:**

1. R. Krishnan, *Electric Motor Drives: Modeling, Analysis and Control*, Prentice Hall, 2002.
2. Mohamed El-Sharkawi, *Fundamentals of Electric Drive*, CL-Engineering, 1st Edition, 2000.

EE 654	Advanced Power and Control Lab	0-0-3	3
--------	--------------------------------	-------	---

**Course Contents:**

Study of 3-phase inverter, Study of 3-phase rectifier, Control of buck-boost converter, Position control of servo-motor, Speed control of 3-phase AC motor, Speed and position control of stepper motor, Load flow analysis with power flow control using series compensation, Control of power flow using back-to-back converter, Effect of SVC (Static Var Compensator) in controlling the bus voltage, Synchronization of alternators.

**Texts / References:**

1. C. S. Indulkar, Laboratory Experiments in Electrical Power Engineering, Khanna Publishers, 1/e, 2003.
2. G. K Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2/e, 2002.
3. O. P. Arora, Power Electronics Laboratory: Theory, Practice & Organization, Narosa Publishing House, 1/e, 2007.
4. P. Kundur, Power System Stability and Control, McGraw-Hill, 1/e, 1994.