Syllabus for M.Tech in Electrical Engineering
Semester I

J11010	Advanced Mathematics

LINEAR PROGRAMMING: Formulation, Graphical method, Simplex method, Two-Phase simplex method, Duality, Primal-dual relationship, Dual-simplex method.

MATRICES AND LINEAR SYSTEM OF EQUATIONS:
Solution of linear system of equation by Gaussian elimination method and its modification, Crout's method, Iterative methods – Jacobian method, Gauss-Siedel method.

SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS:
Matrix Theory, Solution of linear system of differential equations, Eigenvalues and Eigenvectors, Unitary, Hermitian and Normal matrices.

Z-TRANSFORM:
Definition of Z-transform, Linear property of Z-transform, Z-transform of elementary functions, Shifting theorem, Initial and final value theorem, Convolution theorems, Inverse of Z-transform.

FOURIER TRANSFORM:
Introduction, Fourier integral theorem, Fourier sine and cosine integral, Complex form of Fourier integrals, Fourier transform, Inverse Fourier transform, Properties, Modulation theorem, Convolution theorem for Fourier transform.

REFERENCES:

1. S. S. Rao – Engineering Optimization: Theory and Practice, NewAge Int. Pub.
2. Bazaraa, Jarvis and Sherali - Linear Programming and Network Flows, Wiley India.
3. Andrews and Shivamoggi - Integral Transform, PHI.
4. S. Ross - Ordinary Differential Equations, Wiley India.
5. R. Bronson – Matrix Methods: An Introduction, Elsevier.

EBB210	Advanced Control System

REVIEW OF MODELING AND ANALYSIS OF LTI SYSTEMS:

Modelling of physical Systems. Design specifications and performance indices, Motion control systems, Transportation lags. Approximation of time-delay functions, Sensitivity of control systems to parameter variations. Effects of disturbance of signals. Disturbance rejection.

ANALYSIS IN STATE-SPACE:

A perspective on state-space design, State variables, State models for physical systems, SISO and MIMO systems, Solution of state equations. Transfer function, Eigenvalues and eigenvectors, Jacobian linearization technique, State transformations and diagonalisation, Transformation to phase-variable canonical form, Controllability and observability, Duality property, Stability.

INTRODUCTION TO DISCRETE-TIME SYSTEMS:

Basic elements of discrete-time control system, Z-transform and properties, Inverse Z-transform, Difference equation and its solution by Z-transform method, Z-transfer function, State diagram of digital systems, Time delay, Direct, cascade and parallel decomposition of Z-transfer functions.

FEEDBACK CONTROL DESIGN:

Continuous control design, Proportional, derivative and integral control action, PID controller tuning rules, Ziegler-Nichols method, Two degree of freedom control systems, Compensator design using Bode diagram in frequency response approach, Lag, Lead, Lag-lead compensator, Control law design for full state feedback by pole placement, Full order observer system, Observer based state feedback, Separation principal.

NON LINEAR SYSTEM:

Classification and types of non-linearity, Phenomena peculiar to non-linear systems, Methods of analysis, Linearization based on Taylor's series expansion, Jacobian Linearization, Phase trajectory and its construction, Phase-plane analysis of linear and non-linear systems, Existence of limit cycles, Describing function of typical non-linearities, Stability analysis by DF method, Introduction to DIDF, Popov's circle criterion, Stability analysis by Lyapunov's indirect and direct methods, Lyapunov's theorem.

REFERENCE BOOKS:

1. Ogata, K – Modern Control Engineering, PHI Learning
2. Kuo, B.C. – Automation Control Systems, Prentice Hall
3. Roy Choudhury, D – Modern Control Engineering, Prentice Hall
4. Nagrath, J. J. Gopal, M – Control System Engineering, New Age Pub.
5. Schulz, D.G. and Melsa, L. – State Functions and Linear Control Systems, McGraw-Hill.
6. Stepheni, Shahian, Savant, Hostetler – Design of feedback control systems, Oxford University Press.
7. Vidyasagar- Nonlinear system analysis, Prentice-Hall.
8. Gibson, J.E. - Non linear system , Mc. Grawhill.
9. Gopal. M, Digital Control and State Variable Methods, TMH

EBB010	Advanced Power Electronics

REVIEW OF POWER SEMICONDUCTOR DEVICES:
Review of Semiconductor devices like Power BJT, SCR, MOSFET, IGBT, GTO, MCT; Static and dynamic characteristics of these devices; Single quadrant, Two quadrant and bid-directional switches.

SWITCHING VOLTAGE REGULATORS:
Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations like Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Cuck convert, design criteria for SMPS; Multi-output switch mode regulator.

INVERTERS:
Classification; Review of line commutated inverters; Bridge inverters with 120°,180°,and 150° modes of operation; Harmonic reduction techniques; Sine-triangular PWM; Space Vector Pulse Width Modulation; Current Source Inverters.

GATE AND BASE DRIVE CIRCUITS:
Preliminary design considerations; DC coupled drive circuits with unipolar and bipolar outputs; Importance of isolation in driver circuits; Electrically isolated drive circuits; Some commonly available driver chips (based on boot-strap capacitor); Cascade connected drive circuits; Thyristor drive circuits; Protection in driver circuits; Blanking circuits for bridge inverters.

MULTI-LEVEL CONVERTERS:
Bridge inverters, Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded multi-level configurations; Features and relative comparison of these configurations; Switching device currents; DC link capacitor voltage balancing, features of multi-level converters, Applications. 4 quadrant operation of dc-dc converters.

REFERENCE BOOKS:
1. Rashid, M. H., “Power Electronics Circuits, Devices, and Applications”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2nd edition, 1999.
2. Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics Converters, Applications, and Design”, John Wiley & Sons, Inc., 2nd Edition, 1995.
3. B. K. Bose, “Modern Power Electronics and AC drives”, Pearson Education Asia, 2003.
4. Rashid, M. H., “Power Electronics Handbook”, Elsevier Academic Press, 2001.