BTech Electrical Engineering (EE) Curriculum - 2019 Intake Onward

Programme Core Curriculum

Semester 1

Course code	L-T-P-C	Course Name
EE 100	1-0-0-1	Introduction to Profession

Total Credits 23
Refer to Institute Core Course List for semester-1 for the remaining courses in semester-1.

Semester 2

Course code	L-T-P-C	Course Name
EE 102	3-0-0-3	Circuit Theory

Total Credits 21
Refer to Institute Core Course List for semester-2 for the remaining courses in semester-2.

Semester 3

Course code	L-T-P-C	Course Name
MTH 3151	3-1-0-2	Complex Analysis
MTH 3142	3-1-0-2	Differential Equations II
EE 231	2-1-3-4	Electronic Devices and Lab
EE 232	2-1-3-4	Digital Circuits and Lab
EE 201	2-1-0-3	Signals and Systems
EE 221	2-1-0-3	Probability and Random Processes
	3-0-0-3	Open Elective

Total Credits 21

Semester 4

Course code	L-T-P-C	Course Name
EE 222	2-1-0-3	Electromagnetic Waves
EE 223	2-1-0-3	Analog Communication Systems
EE 233	2-1-3-4	Analog Circuits and Lab
EE 211	2-1-3-4	Electrical Machines and Lab
	3-0-0-3	Open Elective

Total Credits 17

Semester 5

Course code	L-T-P-C	Course Name
EE 321	2-1-3-4	Digital Communication Techniques and Lab
EE 301	2-1-2-4	Control Systems and Lab
EE 322	2-1-3-4	Digital Signal Processing and Lab
EE 311	2-1-3-4	Power Electronics and Lab
	3-0-0-3	Open Elective

Total Credits 19

Semester 6

Course code	L-T-P-C	Course Name
EE 312	2-1-0-3	Power Systems
EE 313	2-1-0-3	Electric Drives
EE XXX	3-0-0-3	Program Elective
EE XXX	3-0-0-3	Program Elective
	3-0-0-3	Open Elective

Total Credits 15

Semester 7

Course code	L-T-P-C	Course Name
EE XXX	12-0-0-12	Internship
		OR
EE XXX	0-0-6-6	BTP I
	3-0-0-3	Program Elective
	3-0-0-3	Program Elective/Open Elective

Total Credits 12

Semester 8

Course code	L-T-P-C	Course Name
	3-0-0-3	Program Elective /BTP II
	3-0-0-3	Program Elective
	3-0-0-3	Program Elective/Open Elective
	3-0-0-3	Open Elective

Total Credits 12

Program Total Credits 140

- Track 1: A student doing industrial internship will have to earn 12 credits through program electives.
- Track 2: A student who is not doing 6 months' industrial internship will have to earn 6 BTP I credits in 7th semester, and program electives equivalent to 18 credits of which 3 credits can be for BTP-II.
- A student has to earn a minimum of 9 credits from the courses offered by HSS department under open elective category. The minimum number of credits to be earned from HSS courses including the foundation course is 12.
- A minimum of 9 credits are to be acquired from open elective courses other than HSS courses.

EE - Electrical Engineering Core Course
MTH - Core Courses in Mathematics
HSS - Humanities and Social Sciences course

Course numbering

EE XYZ denotes a course offered in the year X of undergraduate studies, of category Y. The number Z linearly orders courses with the same X and Y components.

Course categories	Code
Circuits and Systems	0
Power Engineering	1
Communication & Signal Processing	2
VLSI and Microsystems	3

Course Description

EE 100 Introduction to Profession 1-0-0-1

Objective: This course aims to acquaint the fresher students with the broad areas of electrical engineering and career opportunities.

Contents:

- Introduction to electrical engineering and it’s various areas such as machines, power electronics and power systems.
- Introduction to electronics and communication engineering, semiconductor technology and fabrication details.
- Future prospects of career in electrical, electronics and communication engineering.
- Introduction to technical report writing, LaTex and plagiarism.
- Introduction to professional bodies of electrical engineering such as IEEE, IET and INAE.
- Acquaintance with various BEE standards and grid codes.

EE 102 Circuit Analysis 3-0-0-3

Objective: This course intends to train the students to analyse of circuits in Electrical and Electronics Engineering applications using various analytical tools and methods. By the end of the course, the student is expected to:

- Acquire proficiency in using various techniques and theorems for the analysis of circuits in DC and AC steady states as well as in transient conditions.
- Learn Graph Theoretical approach to solving networks and circuits.
- Model and analyse two-port network models.
- Acquire proficiency in computer aided analysis and simulation of electrical circuits.

Prerequisites: None

Contents:

- Conventions for Describing Networks.
- Active Element Conventions, The Dot Convention for Coupled Circuits, Reference directions for Current and Voltage.
- Differential Equation approach to Circuit Analysis.
- Initial Conditions in Networks, Geometrical Interpretation of Derivatives, Procedure for evaluating Initial Conditions, Higher-Order Equations; Internal Excitation.
- Laplace Transform Method of Analysis of Circuits: Basic Theorems for the Laplace Transformation, Partial Fraction Expansion.
- Frequency response plots, Fourier series and Fourier transform approach to Circuit Analysis
- Graphs: Basic Notions, Graphs and Subgraphs, Connectedness, Circuits and Cutsets.
- Trees and Forests, Strongly Directedness, Fundamental Circuits and Cutsets.
- Orientation, Isomorphism and Cyclically Connectedness.
- Graphs and Vector Spaces: The Circuit and Crossing Edge Vectors, Voltage and Current Vectors.
- Dimension of Voltage and Current Vector Spaces, Fundamental Cutset Matrix of a forest f.
- Multi-Port Networks with particular emphasis on 2-Port Networks – Z-parameters, Y-parameters, h-parameters, t-parameters and inverse transmission parameters of 2-Port networks, network functions, complex frequency.

Suggested Textbooks:

1. M. E. Van Valkenburg, Network Analysis, PHI Publishers, Third Edition, 2004

Reference Textbooks:

1. Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, McGraw-Hill Higher Education, 2007.
2. William H. Hayt Jr., J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, McGraw Hill Education, 2013.
3. N. Balabanian and T. A. Bickart, Linear Network Theory: Analysis, Properties, Design and Synthesis, Matrix Publishers Inc. 1981.
4. L. O. Chua, C. A. Desoer, E. S. Kuh, Linear and Nonlinear Circuits, McGraw-Hill International Edition 1987.

MTH 3151 Complex Analysis I 3-1-0-2

Contents:

- Complex numbers: algebraic properties, graphical representation, Riemann Sphere, limits and continuity, Differentiability, CR equations,
- Analytic functions. Elementary functions, integration on contours, Cauchy's theorem, Cauchy's integral formula and its applications, Morera's theorem. Series of complex numbers, Taylor's theorem, Sequence of analytic functions, Schwarz reflection principle, Runge's approximation theorem, Identity theorem, Maximum modulus principle, Laurent series, Cauchy's Residue theorem.

Suggested Textbooks:

1. Churchill, Brown, Complex variables and Applications. (2009)
2. Stein and Shakarchi, Complex analysis. (2013).
3. Ahlfors, Complex Analysis.

4. Serge Lang, Complex Analysis.
5. Conway, Functions of One Complex Variable.
6. W. Rudin, Real and complex analysis

MTH 3142 Differential Equations II 3-1-0-2

Contents:

- Sturm-Liouville problems, Power series solution, Second-order PDEs, and their classification. Laplace, Heat and Wave equations- Fourier series, Method of separation of variables

Suggested Textbooks:

1. Walter A. Strauss, Partial Differential Equations: An Introduction.
2. Mark A. Pinsky, Partial Differential Equations and Boundary value Problems with Applications.
3. Sandro Salsa. Partial Differential Equations in Action: From Modelling to Theory, 2015.
4. Lawrence C. Evans Partial Differential Equations , 2nd edition, 2010.

EE 201 Signals and Systems 2-1-0-3

Objective:

- To explore the fundamentals of signals, systems,
- To understand the classification of various signals and system properties,
- To introduce the transform techniques in continuous and discrete time signal processing.

Prerequisites: None

Contents:

- Elements of signal space theory: Different types of signals; Linearity, time invariance and causality; Impulse sequence, impulse functions and other singularity functions.
- Convolution: Convolution sum, convolution integral and their evaluation; Time-domain representation and analysis of LTI systems based on convolution and differential equations.
- Multi input-multi output discrete and continuous systems: state model representation, solution of state equations, state transition matrix.
- Transform domain considerations: Laplace transforms and Z-transforms; Applications of transforms to discrete and continuous systems-analysis; Transfer function, block diagram representation, DTFT.
- DT Fourier Series and Discrete Fourier Transform. Fundamentals of sampling.

Suggested Textbooks:

1. Signals and Systems - Continuous and Discrete, 4th Edn. Prentice Hall, 1998. A.V. Oppenheim, A.S. Willsky.
2. Haykin: Signals and Systems, Wiley Edition, 2002.
3. B.P. Lathi : Communication Systems, John Wiley, 1987.

EE 211 Electrical Machines Theory and Lab 2-1-3-4

Objective:

- Understanding of the fundamental working principles of ac machinery such as transfrmers, induction and synchronous motors.
- Correlating the use of transformers and synchronous machines in power systems and inductions motors in majority of the industrial load applications.
- Understanding of the fundamental working principles of dc generators and motors, speed control of dc motors for practical applications (especially traction).
- Realizing the need for efficient motors, leading to the basic understanding of permanent magnet and reluctance machines.
- Understanding the basic design concepts of electrical machines for use in evolving applications such as electric and hybrid electric vehicles, renewables etc.

Prerequisites

- EE 101 Introduction to Electrical and Electronics Engineering
- EE 102 Circuit Analysis

Contents:
Theory Component

- Operating principles of transformers, dc, induction and synchronous machines.
- Operating characteristics and speed control of dc and ac machines.
- Constructional features of ac and dc machines, and introduction to their design.
- Introduction to permanent magnet and reluctance machine topologies.
- Dynamics of electric drives and electric braking.

Reference Textbooks:

1. Stephen J. Chapman, Electric Machinery Fundamentals, McGraw - Hill Education, 2017.
2. A. E. Fitzgerald, Charles Kingsley Jr. and Stephen D. Umans, Electric Machinery, McGraw Hill Education, 2017.
3. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, 2019.
4. M. G. Say, The Performance and Design of Alternating Current Machines, CBS, 2005.
5. Duane C. Hansleman, Brushless Permanent-Magnet Motor Design, McGraw – Hill Education, 1994.
6. S. K. Pillai, A first course on Electrical Drives, New Age International Publishers, 2012.

Laboratory Component
Same syllabus and references. Experiments and demos will be carried-out on transformers, dc, induction and synchronous machines to supplement the theory.

EE 221 Probability and Random Processes 2-1-0-3

Objective:

- To explore the students into the field of abstract probability theory, fundamental principles, axioms in the theory of probability.
- To introduce the concept of random variables, two dimensional random variables and transformation of random variables.

- To extend the ideas of random variables to random sequences, random process, ensemble and time characterization of random process.

Prerequisites: None

Contents:

- Sets and set operations; Probability space, Conditional probability and Bayes theorem, Combinatorial probability and sampling models, Discrete random variables, probability mass function, probability distribution function, example random variables and distributions, Continuous random variables, probability density function, probability distribution function, example distributions, Joint distributions, functions of one and two random variables, moments of random variables, Conditional distribution, densities and moments, Characteristic functions of a random variable, Markov, Chebyshev and Chernoff bounds;
- Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square), Limit theorems, Strong and weak laws of large numbers, central limit theorem.
- Random process.
- Stationary processes.
- Mean and covariance functions.
- Ergodicity.
- Transmission of random process through LTI.
- Power spectral density.

Reference Textbooks:

1. Pappoulis: Probability, Random Variables and Random process.
2. Stark and Woods: Probability and random process with applications to signal processing

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EE 222 Electromagnetic Waves 2-1-0-3

- Understanding the nature of electromagnetic waves through mathematics
- Understanding the application of electromagnetic waves.

Prerequisites

- EE 101 Introduction to Electrical and Electronics Engineering

Contents:

- Maxwell's equations, Transmission line equations.
- Impedance of loaded and unloaded transmission lines.
- Reflections and VSWR.
- Smith chart and its use in impedance matching and other transmission line problems.
- Propagation of electromagnetic waves in different media.
- Reflection and refraction at different boundaries.
- Total reflection and polarizing angle.
- Ground wave and sky wave propagation.
- Parallel plane and rectangular waveguides.
- Attenuation in wave guides.
- Radiation of electromagnetic waves.

- Dipole and array of dipoles for medium wave and short wave transmission.

Suggested Textbooks

1. R K Shevgaonkar, Electromagnetic Waves, McGraw Hill Education, India 2006.
2. D K Cheng, Fundamentals of Eleectromagnetics, Addison Wesley, MA 1993.
3. E.C. Jordon and E.G. Balmain, Electro-magnetic Waves and Radiation Systems, 2nd Ed.Prentice Hall India, 1986.

EE 223 Analog Communication Systems 2-1-0-3

Objective:

- To introduce the traditional communication system aspects
- To expose the students the pioneering analog communication techniques
- To enable the students to grasp the ideas behind the transition of traditional analog communication to recent communication techniques
- To extend the ideas of analog communication techniques into pulse modulation forms.

Prerequisites: None

Contents:

- Principles of analog modulation, modulation and demodulation of AM, DSBSC, SSB signals and their practical applications, FDM systems.
- Principles of angle modulation, frequency and phase modulation, narrow and wide band FM, generation and demodulation of FM signals, phase locked loops, application of FM. #
- Samplingand quantization of band limited signals. Sampling theorem, pulse-amplitude and pulse-time modulation, PCM, DPCM and Delta modulation.
- TDM systems.

Suggested Textbooks:

1. S.S. Haykin, An Introduction to Analog and Digital Communication Systems, Wiley Eastern, 1989.
2. R.B. Carlson : Communication Systems (3rd Intl. Ed.), McGraw Hill, 1986.
3. B.P. Lathi : Communication Systems, John Wiley, 1987.

EE 231 Electronic Devices and Lab 2-1-3-4

Objective: This is the fundamental course to understand semiconductor devices. It starts with the electron-hole transport phenomena inside the semiconductor. The working principle of the devices like Semiconductor Diode, Bipolar Junction Transistor and MOSFETs are also covered in this course which is the foundation of circuit analysis.

Prerequisites:

- EE 101 Introduction to Electrical and Electronics Engineering.

Contents:

- Semiconductor fundamentals, crystal structure, Fermi level, energy-band diagram, intrinsic and extrinsic semiconductor, carrier concentration, scattering and drift of electrons and holes, drift current, diffusion mechanism, generation and recombination and injection of carriers, transient response, basic governing equations in semiconductor, physical description of p-n junction, transport equations.
- Semiconductor Diodes: Barrier formation in metal-semiconductor junctions, PN homo- and hetero-junctions; CV characteristics and dopant profiling; IV characteristics; Small signal models of diodes; Some Applications of diodes.
- Bipolar transistors: IV characteristics and Ebers-Moll model; small signal models; Charge storage and transient response. Discrete transistor amplifiers: Common emitter and common source amplifiers; Emitter and source followers.
- Field Effect Devices: JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor and concept of accumulation, depletion and inversion; MOSFET characteristics and small signal models.

Suggested Textbooks/Reference Textbooks:

1. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago) 1997
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988
3. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995
4. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International, 1987.
5. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991
6. R.T. Howe and C.G. Sodini, Microelectronics : An integrated Approach, Prentice Hall International, 1997

EE 232 Digital Circuits and Lab 2-1-3-4

Objective:

- To build a thorough understanding of digital system fundamentals
- To develop skills to analyze and design real-life, complex digital circuits
- To familiarize with the digital system design flow using VHDL and CPLDs

Prerequisites:

- EE 101 Introduction to Electrical and Electronics Engineering

Course Contents:

- Review of basics of digital electronics: Number systems, Boolean algebra, logic gates and circuits, minimization of logic functions.
- Number representation and arithmetic circuits: Signed and unsigned numbers, binary codes, arithmetic operation of binary numbers-addition, subtraction and multiplication.
- Combinational circuit elements: Multiplexers and demultiplexers, decoders and encoders, code converters. Synthesis of combinational logic functions. Cyclic and acyclic logic circuits.
- Memory elements: latches and flipflops, applications-shift registers and counters. Sequential circuits and finite state machines: analysis and synthesis.
- Synchronous and asynchronous sequential circuits. Timing analysis of clocked circuits. Hazards in digital circuits.

- Transistor level implementation of digital circuit elements: CMOS digital family. Introduction to VHDL and programmable logic devices. Advanced digital system design topics and applications.

References Textbooks:

1. Stephen Brown and Zvonko Vranesic, "Fundamentals of Logic Design Logic with VHDL Design," Tata McGraw Hill
2. John F. Wakerly, "Digital Design: Principles and Practices," PearsonEducation
3. Charles H. Roth Jr. and Larry L. Kinney, "Fundamentals of Logic Design," CL-Engineering
4. Perry D. L., "VHDL: Programming by Example," McGraw Hill
5. Zvi Kohavi and Niraj K. Jha, "Switching and Finite Automata Theory," Cambridge University Press
6. M. Morris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL," Pearson Education

EE 233 Analog Circuits and Lab 2-1-3-4

Objective: The main objective of this course is to educate the students with semiconductor device real applications like amplifier, differential amplifier, operational amplifier. It deals with the design of how the individual semiconductor devices are connected to form a complete circuit and to get desired output from the circuit. Basic understanding of filter, waveform generator, analog to digital, and digital to analog converters are also covered in this course.

Prerequisites: EE 101 Introduction to Electrical and Electronics Engineering

Contents:

- Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short, Analysis of simple operational amplifier circuits, Frequency response of amplifiers, Bode plots.
- Feedback: Feedback topologies and analysis for discrete transistor amplifiers, stability of feedback circuits using Barkhausen criteria.
- Linear applications of operational amplifiers: Instrumentation and Isolation amplifiers, Current and voltage sources, Active filters.
- Non-linear applications of operational amplifiers: Comparators, clippers and clampers, Linearization amplifiers, Precision rectifiers, Logarithmic amplifiers.
- Waveform Generation: sinusoidal feedback oscillators, Relaxation oscillators, square-triangle oscillators
- Analog and Digital interface circuits: A/D, D/A Converters, S/H circuits and multiplexers.

Suggested Textbooks/Reference Textbooks:

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York, 1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S.Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition IV
5. Paul R.Gray & Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, Wiley, 3 rd Edition.
6. B. Razavi, Design of Analog CMOS Integrated Circuits, TATA McGRAW-HILL Edition.
7. S Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata McGraw-Hill, 3rd Edition.

EE 301 Control Systems and Lab 2-1-3-4

Objective:

- To learn developing models such as transfer function or state variable model of a physical system
- To understand time and frequency domain approaches for determination of stability of a system and designing a controller
- To derive model of a physical system from experiment
- To analyse transient and steady state behviour of a control system experimentally
- To design and implement a PID controller/Lead/Lag/Lag-Lead Compensators
- To design an error detector system using synchro pairs

Prerequisites: None

Contents:

- Introduction to Automatic Control: Concept of control system, Definition, Open Loop/Closed-loop, Basic elements of a servo mechanism, Types of servomechanism Development of Automatic Control Mathematical Model: Mathematical representation of physical system, Electrical mechanical systems, transfer function and impulse response of linear systems, Block diagram, signal flow graphs, Application of the signal flow graphs for gain formula to block diagrams. Mathematical modelling of dynamical systems.
- General Feedback Theory: Feedback, effect of feedback, Mathematical definition of feedback
- Control System Components: Potentiometer, Synchros, A.C. Servo motors
- Time Response of feedback control systems: Typical test signal for the transient analysis, time domain performance characteristics of feedback control systems, transient response, transient response of 2nd order systems, transient response of a positional servomechanism, effects of derivative and integral controls on the transient performance, PI, PD, PID controllers, Steady state response steady state error
- Stability linear control system: Routh-Hurwitz criterion. Frequency response method polar plots, Bodes plot, Magnitude versus phase plot frequency response of feedback control system, Frequency domain specifications, Polar Plot, Nyquist criterion and stability, Principle of argument the Nyquist path, Nyquist criterion, application of the Nyquist criterion, Relative stability, gain margin, Phase margin, M and N circles, Nichol's chart, Root Locus Technique: construction of the root loci, some other properties of the root locus
- Compensator Design: Lag/Lead/Lag-Lead Compensator Design using Root Locus & Bode Plot Methods
- State variable analysis: Introduction, Concept of state, state variable and state model, State equations of continuous data control system, Derivation of state Model from transfer functions and Vice versa. Diagonalisation, Solution of state equation.

Laboratory Component:

- Study the Transient and frequency response of a second order network.
- Study of a DC motor driven closed loop position control system
- Study of a Position Control System using Synchro
- Identification of a DC Motor transfer function, position and speed control of a DC motor using PD and PID Controller via Ziegler Nichol's tuning method
- Study the discrete-time version of the PID controller, and to implement classical tuning rules for the digital control system

- Modelling and control of oven for temperature control
- Study of PID controller performance on stabilisation of an Inverted Pendulum

Suggested Textbooks:

1. K. Ogata, *Modern Control Engineering,*, Pearson Higher Education, 2002
2. I.J. Nagrath, and M. Gopal, *Control System Engineering*, New Age, 2002

Reference Textbooks:

1. R.C. Dorf and R.H.Bishop, *Modern Control System*, Pearson, 2017
2. B.C. Kuo, *Automatic Control System*, Prentice Hall, Digitized Dec 5, 2007

EE 311 Power Electronics and Lab 2-1-3-4

Objective: The course aims at

- Understanding the considerations of formulating switching circuits.
- Understanding the switch realization in power electronic circuits using semiconductor devices.
- Analysis and design of Power converters operating in steady state

Prerequisites:

- EE 101 Introduction to Electrical and Electronics Engineering
- EE 102 Circuit Theory

Contents:

- Introduction to switched circuits, Non- sinusoidal steady state, Operating characteristics of power semi-conductor devices: Diodes, Thyristor, MOSFET, IGBT, Safe Operating Area, Switch realization using semiconductor devices.
- DC/DC converters: Buck, Boost, Buck-Boost, Čuk converter, Choppers for Motor drive applications, H-bridge converter, Isolated DC/DC converters: Forward converter, Flyback converters, AC/DC converters: Single phase uncontrolled rectifiers, 3- phase diode rectifiers, Line- commutated controlled rectifiers using thyristors, PWM rectifiers.
- DC/AC converters: Voltage source inverters,Single phase inverters in square wave modulation and PWM operation, 3-phase bridges, PWM operation.
- Introduction to AC/AC converters.
- Ancillary issues: Gate driver circuits, Snubber circuits and commutation circuits, Thermal aspects and heat sinks.
- Non- ideal components: capacitors, inductors and magnetic circuits for Power electronic applications.

Laboratory Component:

- Experiments on steady state operation of low voltage DC/DC converters
- Experiments on steady state operation of AC/DC line commutated rectifiers.
- Experiments on steady state operation of PWM rectifiers and inverter circuits.
- Experiments on gate driver design and operation for MOSFETs and IGBTs.

Suggested Textbooks:

1. John Kassakian, Martin F. Schlecht, George C. Verghese, Principles of Power Electronics, Pearson Education, 2010.
2. Robert.W. Erickson and Dragan Maksimovic, Fundamentals of Power Electronics, Springer, 2001, Second Edition.

Reference Textbooks:

3. N. Mohan, T. M. Undeland, and W. P. Robbins, Power Electronics: Converters, Applications, and Design, John Wiley & Sons Inc. 2012, third edition
4. Joseph Vithayathil, Power Electronics Principles and Applications, Tata McGraw-Hill, 2010, First Ed.
5. P.C. Sen, Principles of Electric Machines and Power Electronics, Second Edition, John Wiley & Sons-1996.
6. M.H. Rashid, Power Electronics Circuits, Devices and Applications, Third Edition, Prentice-Hall of India Private Limited, New Delhi-2004.

EE 313 Electric Drives 2-1-0-3

Objective:

- Understanding the fundamentals of IV-quadrant operation of electrical machines and various types of braking of machines.
- Appreciating the use of power electronic converters as a drive for ac and dc motors for precise torque and speed control.
- Understanding the basics of electric traction and various dc and ac motors used for traction.

Prerequisites:

- EE 211 Electrical Machines Theory and Laboratory

Contents:

- Dynamics of electrical drives, starting of motors, electric braking, rating and heating of motors, introduction to solid state controlled drives – dc motor systems, ac motor systems, brushless dc motors and switched-reluctance motor drives.
- Traction drives – nature of traction load, coefficient of adhesion, duty cycle of traction drives, main line and suburban train configurations, conventional dc and ac traction drives, semiconductor converter controlled drives, semiconductor converter controlled dc and polyphase ac motors for traction.

Suggested Textbooks/Reference Text books:

1. W. Leonhard, Control of Electric Drives, Springer Verlag, 1985.
2. P. Vas, Vector Control of ac Machines, Clarendon press, 1990.
3. S. K. Pillai, A first course on Electrical Drives, New Age International Publishers, 2012
4. G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publications, 1995.

EE 321 Digital Communication Techniques and Lab 2-1-3-4

Objective:

- To explore the ideals of communication in digital form and provide them the comprehensive analysis

of various advanced and effective communication techniques invented in the past two decades
- To motivate the students, the effectiveness of digital communication techniques and its application in various fields of terrestrial communication and bandwidth efficient long distance communication
- To facilitate the students to grasp the classical result of Shannon and techniques to achieve the limits on communication dictated by mathematical theory.

Prerequisites: EE 221 Probability and Random Processes

Contents:

- Review of Random Processes and Spectral analysis.
- Elements of Detection Theory.
- Optimum detection of signals in noise.
- Coherent communication with waveforms- Probability of Error evaluations.
- Baseband Pulse Tranmission- Intersymbol Interference and Nyquist criterion.
- Passband Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continous Phase Modulation and Minimum Shift Keying.
- Digital Modulation tradeoffs.
- Optimum demodulation of digital signals over bandlimited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques.
- Synchronization and Carrier Recovery for Digital modulation.

Laboratory Component:

- Generation of amplitude modulated signals and demodulation of the generated AM signal using envelope detector circuit
- Generation of DSB-SC amplitude modulated signals and demodulation
- Generation of FM signals using VCO, Demodulation of FM signals
- Generation and reconstruction/demodulation of the PAM signals
- Generation and reconstruction/demodulation of the PWM signals
- Generation of digitally modulated signals like ASK, BPSK, FSK, QAM etc. and their demodulation.
- Monte-Carlo simulation to compute the bit error rate for different modulation schemes, OFDM: transmitter and receiver implementation.

Suggested Textbooks:

1. Proakis; Digital Communications, Fifth Edition, McGraw Hill
2. Haykin; Digital Communicaitons, Wiley Edition, 2001.

EE 322 Digital Signal Processing and Lab 2-1-3-4

Objectives:

- To introduce and review the transform techniques in discrete time signal processing
- To deal with the treatment of DT-LTI systems, its time and frequency characterization in terms of impulse response, magnitude and phase response, special class of system
- To train the students in the application of sampling theory, its implications and the mathematical background behind the transition from analog to discrete time signal and then to digital signal forms
- Leveraging the ideas of digital signal processing with multi rate sampling techniques.

Prerequisites: EE 201 Signals and Systems

Contents:

- Review of Sampling continuous time signals, aliasing, band pass sampling.
- Discrete time Fourier transform, Z transform, Properties. Discrete time processing of continuous time signals, continuous time processing of discrete time signals, non integer delay, introduction to multi rate sampling.
- Transform analysis of LTI systems, Systems characterized by difference equations, Frequency response of rational transfer functions, relationship between magnitude and phase, all-pass and minimum phase systems.
- Generalized linear phase systems.
- DFT – DTFS, sampling the Fourier transform, properties, linear and circular convolution. Introduction to wavelet transform.

Laboratory Component:

- Experiments to supplement the theory topics will be performed

Suggested Textbooks:

1. Oppenheim, Shafer and Buck, Discrete Time Signal Processing, Pearson Edition, 2014.
2. Digital Signal Processing, Pearson Edition, 2007.
3. SK Mitra, Digital Signal Processing, A computer based approach, McGraw Hill, 2013.
