Effective From: **2018-19**

Electronic Devices and Circuits

Course No	**:**	**ELC2110**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELA1110 (Principle of Electronics Engineering)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the physics behind the semiconductor behaviour of materials
2. Understand the various diodes and their applications
3. Understand the working of Bipolar and Field-Effect Transistors
4. Analyze single transistor amplifier configurations

Syllabus

Unit I: Semiconductor Physics

Energy Bands in Silicon, Intrinsic and Extrinsic Silicon; Carrier Transport in Silicon: Diffusion Current, Drift Current, Mobility, and Resistivity; Generation and Recombination of Carriers, Hall Effect.

Unit II: Diodes

PN Junction: Barrier Potential, Energy Band Diagram, Diode Equation, Charge Storage, Recovery Time, Depletion and Diffusion Capacitances; Special Purpose Diodes: Schottky Diode, Tunnel Diode, LED, Photodiodes, P-I-N Diode.

Unit III: BJT and MOSFET

BJT: Minority Carrier Profile, Current Equation, Base Width Modulation, Temperature Effects; MOSFET: Current Equation, Channel Length Modulation, Oxide Capacitance, Biasing and Bias Stability.

Unit IV: Transistor Configurations

Classification of Amplifiers, Small signal models of BJT and MOSFET, Analysis of BJT Configurations: CE, CC, CB; Analysis of MOSFET Configurations: CS, CD, CG; High frequency models of BJT and MOSFET, Frequency Responses.

Books:

1. A. S. Sedra, K. C. Smith, *Microelectronic Circuits*, Oxford Univ Press, 2004.
2. J. Millman, C.Halkias and Chetan D. Parikh, *Integrated Electronics*, Tata McGraw Hill, 2010.
3. Donald A. Neamen, *Semiconductor Physics and Devices,* 3e, Tata McGraw Hill, 2007

Effective From: **2018-19**

Circuit Theory

Course No	**:**	**ELC2120**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Perform transient and steady state analysis of linear circuits in time domain.
2. Use transforms like Laplace and Phasors for circuit analysis, along with use of Network theorems, in frequency domain.
3. Understand and apply the fundamentals of graph theory for network analysis.
4. Analyse the network as a black box using the concepts of two port networks.

Syllabus

Unit I: Elementary Network Analysis

Circuit Elements: Models and Energy Consumed; Linear constant Coefficient Differential Equations; Time Domain Analysis of Simple RLC Circuits, Circuit Transients; State Equations for Networks, Order of Complexity; Methods of Network Analysis: Mesh and Node Variable Analysis.

Unit II: Network Theorems / Frequency Analysis and Network Theorems

Steady State Sinusoidal Analysis Using Phasors; Impedance Concept; Power Factor; Resonance Circuits, Bandwidth and Selectivity; Frequency Domain Analysis of RLC Circuits, Steady State Analysis with Non-Sinusoidal Inputs; Network Theorems: Superposition, Reciprocity, Thevenin's, Norton's, Millman's and Maximum Power Transfer Theorems; Wye-Delta Transformation.

Unit III: Graph Theory and Network Equations

Introduction to Graph Theory; Network Matrices: Incidence and Reduced Incidence matrix, Loop Matrix, Fundamental Loop Matrix, Cut Set and Fundamental Cut Set Matrix; Relationship Between Network Matrices; Formulation of Network Equations, Fundamental Loop Equations and Nodal Admittance Matrix; Tellegen's Theorem and Application.

Unit IV: Two Port Circuit Parameters

Introduction to Two Port Networks, Two Port Network Parameters: Z, Y, h Parameters, ABCD and g Parameters; Image Impedances; T and π Network; Relationship Between Different Two Port Network, Interconnection of Two-Port Network: Cascade, Series, Parallel, Series-Parallel and Parallel-Series Connections; Indefinite Admittance Matrix and Applications.

Books:

1. M. E. Valkenburg, *Network Analysis* , PHI,1995.
2. S. Ghosh, *Network Theory: Analysis and Synthesis*, PHI, 2005.
3. T. S. K. Iyear, *Circuit Theory*, Tata McGraw Hill, 1985.
4. Del Toro, *Principles of Electrical Engineering*, PHI, 1994.

Effective From: **2018-19**

Digital Electronics

Course No	**:**	**ELC2130**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2310 (Logic Circuits)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand and compare different logic families.
2. Differentiate and Design different types of digital and logic circuits using BJTs and MOSFETs.
3. Design different types of memories (ROM, EEPROM, RAM etc.) using MOS logic.
4. Understand the applications of ROM in practical scenario.
5. Understand different ADCs and DACs and use them in practical applications.

Syllabus

Unit I: Logic Families

Digital IC Terminology; TTL Logic Family; Analysis of TTL Gates; NAND, NOR, AOI Gates; Schottky TTL; Open Collector and Tri-State TTL; Emitter Coupled Logic; Basic ECL

Circuits; ECL OR/NOR Gate.

Unit II: MOS Based Circuits

MOS and CMOS Logic Circuits and Characteristics; CMOS Inverter, NAND, NOR, X-OR, X-NOR Gates; CMOS Complex Gates; CMOS Transmission Gate; CMOS Clocked S-R and D-Flip-Flops. Pseudo NMOS Logic Circuits; Pseudo NMOS Inverter and Other Gates; Pass Transistor Logic (PTL) and Complementary Pass Transistor Logic (CPTL); Realization of Different Gates in PTL and CPTL; Bi-CMOS Digital Circuits; Introduction to Bi-CMOS; Comparison of various Logic Families.

Unit III: Memory Devices

Memory Terminology, Semiconductor Memories; Types and Architecture; ROM-Architecture, Addressing and Timing; MOS ROM; PROM, EPROM, EEPROM (EAPROM), ROM Applications; Programmable Logic Device Arrays (PAL and PLA); ROM/PLD Based Combinational Design; Semiconductor RAM -- RAM Organization; Static RAM, Dynamic RAM; DRAM Structure and Operation; Read/Write Cycles; DRAM Refreshing; Expanding Word Size and Capacity; Concepts of CCD.

Unit IV: Data Converters

Principle of Operation of Digital-to-Analog Converters (DACs); Basic Circuits Using Binary Weighted Resistors and R/2R Ladder; DAC Specification; DAC Applications, Analog-to Digital Converters (ADCs); -Digital Ramp ADC, Up/Down Digital Ramp ADC, (Tracking ADC), Successive Approximation ADC; Flash ADC, Dual Slope Integrated ADC; Data Acquisition, Sample and Hold Circuits; Multiplexed ADC.

Books:

1. Ronald. J. Tocci, And Neal .S. Widmer, *Digital Systems - Principles And Applications*, Eighth Edition, Pearson Education, New Delhi, 2001
2. A.S. Sedra and K.C. Smith, *Microelectronic Circuits*, Oxford University Press, 5th Edition, 2004.
3. J. Millman and Grabel, *Microelectronics*, McGaw Hill, 1987.

Effective From: **2018-19**

Electronic Circuits

Course No	**:**	**ELC2140**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2110 (Electronic Devices and Circuits)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1 Understand the operation of amplifiers and oscillators
2 Analyze and design transistor based analog electronic circuits.
3 Apply transistor models for performance analysis of circuits
4 Use basic building blocks for design of Integrated circuits like Opamp.

Syllabus

Unit I: Feedback Amplifiers and Oscillators

Feedback Concept; Negative Feedback and Its Effects; Feedback Topologies; Positive Feedback; Principle of Oscillator Circuits; BJT and MOS Oscillators; Crystal Oscillators.

Unit II: Differential Amplifiers

Differential Pair, Small Signal Operation, Differential and Common Mode Gains, CMRR, Differential Amplifier with Active Load, Frequency Response of Differential Amplifier, Biasing of ICs: Bipolar and CMOS

Unit III: Multistage Amplifiers and Output Stages

Compound Transistor Pairs, Widebanding Techniques, Cascode Amplifier, Tuned Amplifiers. Classification of output stages, Class A, Class B, Class AB (Push-Pull): Transfer Characteristics, Signal Waveforms, Power Conversion Efficiency, Distortion Analysis.

Unit IV: Operational Amplifier

Bipolar Opamp: Biasing Circuit, Input Stage, Gain Stage, Level Shifting Stage, Output Stage. Small Signal Gain and Frequency Response of opamp. Non-ideal Opamp Parameters and Their Measurement.

Books:

1. S. Sedra, K. C. Smith, *'Microelectronic Circuits'*, Oxford Univ Press, 2011.
2. S. Soclof, '*Application of analog ICs'*, PHI, 2004.
3. J. Millman, A. Grabel, '*Microelectronics*', Mc Graw Hill, 1987.

Effective From: **2018-19**

Measurement and Instrumentation

Course No	**:**	**ELC2210**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2120 (Circuit Theory)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand construction and applications of Analog Measuring Instruments.
2. Understand different Digital Measuring Instruments.
3. Apply bridge methods for measurement of basic electrical components.
4. Demonstrate knowledge of transducers and oscilloscopes.

Syllabus

Unit I: Analog Measuring Instruments

Accuracy, Precision, Resolution; Sensitivity and Linearity; Classification of Measuring Instruments; PMMC Instruments: Theory, Construction and Applications; Measurement of DC, AC, RMS and Peak Values; Moving Iron Instruments; Electrodynamometer Type Instruments, Energy Meter.

Unit II: Digital Measuring Instruments

Digital Voltmeters: Dual-Slope Integrating Type; Integrated type; Successive Approximation Type; Continuous Balanced Type, 3½ Digit Display Type; Data Acquisition System: Objective, Multi-Channel Data Acquisition. Digital Multimeter, Digital Counter-Timer, Frequency Meter and Tachometer.

Unit III: Measurement of Passive Components

Measurement of Low, Medium and High Resistances; Sources of Errors in Bridge Circuits; Precautions and Techniques Used For Reducing Errors; Measurement of Inductance and Capacitance; Q-Meters: Working and Applications; Different Types of Ohmmeters and Their Applications.

Unit IV: Transducers and Oscilloscopes

Transducers; Types of Transducers and Selection Criterion; Resistive; Measurement of Linear Displacement, Strain, Temperature, Pressure and Fluid Flow, CRO: Single and Dual Trace, Digital Storage Oscilloscopes and Their Applications, Digital Displays

Books:

1. Albert D. Helfrick and William D. Cooper, "*Modern Electronic Instrumentation and Measurement Techniques"*, PHI, 1 Edition, 2011.
2. H. S. Kalsi, "*Electronic Instrumentation*", Tata McGraw-Hill, 3 Edition, 2010.
3. D. V. S, "*Transducers and Instrumentation*", PHI, 2 Edition, 2009.

Logic Circuits

Course No	**:**	**ELC2310**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELA1110 (Principle of Electronics Engineering)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Describe the Boolean algebraic structure and apply it for proving basic theorems and minimization of Logic functions.
2. Analyse and design combinational logic circuits.
3. Analyse and design sequential logic circuits.
4. Apply logic circuits for basic arithmetic operations like addition, subtraction and multiplication.

Syllabus

Unit I: Boolean Logic

Boolean Algebra - Huntington's Postulates, Basic Theorems; Switching Algebra; Logic Function Representation – Standard and Canonical Forms, Minterm and Maxterm, Universal Sets, Simplification of Function Expressions; Logic Gates – Extension to Multiple Inputs; Logic Function Minimization – Karnaugh Map, Prime Implicants, Minimization in SOP and POS Forms, Tabular Method of Minimization.

Unit II: Combinational Logic

Encoder and Priority Encoder, Decoder/Demultiplexer and Multiplexer; Variable Entered Maps (VEM); Function Implementation with Multiplexer and Decoder; Priority Encoder; Binary codes – BCD, Gray, Alphanumeric Codes, Code Converters, BCD-to-7-Segment Decoder/Driver; Implementation Using XOR and XNOR Gates -Parity Checker/Generator, BCD-Gray Code Converter.

Unit III: Sequential Logic

Finite State Machines: State Representation, Mealy and Moore Machines; Latch and Flip-Flop - RS, JK, D, T Flip-Flops and their Operation, Setup and hold Time, State Tables, Excitation Tables and Triggering, Asynchronous Edge Triggered FF circuit; Registers, Universal Shift Register; Synchronous Design; Asynchronous and Synchronous Counters - Design and Analysis, Ripple, Up/Down, Modulo-n, Johnson, Ring Counters; Ring Oscillator.

Unit IV: Arithmetic Logic Circuits

Binary Arithmetic – Addition, Subtraction, Multiplication; One's and Two's Complement – Signed Representation, Addition and Subtraction, Arithmetic circuits – Half and Full Adder, Ripple Carry Adder/Subtractor; Serial Adder; Look Ahead Carry Generator, Decimal Adder, Binary subtractor, Binary multiplier, Magnitude Comparator.

Books:

1. M. M. Mano and M. D. Ciletti, *Digital Design*, Vth ed., Pearson, 2013.
2. R. J. Tocci, N. S. Widmer and G. L. Moss, *Digital Systems: Principles and Applications*,9th ed., Pearson, 2004.
3. C. H. Roth,Jr. *Fundamentals of Logic Design*, 5th ed., Cengage Learning, 2004.
4. N. Balabanian and B. Carlson, *Digital Logic Design Principles*, Wiley, 2001.

Effective From: **2018-19**

Signals and Systems

Course No	**:**	**ELC2410**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Describe and characterize signals and systems.
2. Compute transforms for continuous and discrete time signals.
3. Analyse continuous and discrete time systems in time domain.
4. Analyse continuous and discrete time systems in frequency domain.

Syllabus

Unit I: Representation and Classification of Signals and Systems

Representation and Classifications of Continuous and Discrete Time Signals and Systems; Singularity Functions; Convolution Operation of Continuous and Discrete Time Signals; Impulse Response and Its Properties

Unit II: Fourier Analysis

Fourier Series; Fourier Transform and Its Properties; System Analysis Using Fourier Transform; Hilbert Transform; Representation and Analysis of Bandpass Signals and Systems

Unit III: Time and Frequency Domain Analysis of Continuous Time Systems

Review of Laplace Transform; Two Sided Laplace Transform; System Analysis of I and II Order Systems; Transfer Function; Frequency Response of I and II Order Systems; Feedback Systems

Unit IV: Analysis of Discrete Time Systems

Overview of Sampling; Z-Transform and Its Properties; Discrete Time Fourier Transform; Discrete Fourier Transforms; Discrete Time System Analysis Using Difference Equations and Z-Transform

Books:

1. Alan, V. Oppenheim & A.S. Wilsky, *Signals & Systems*, PHI, 1998
2. Simon Haykin, *Signals and Systems*, John Wiley, 1999
3. Simon Haykin, *Communication Systems*, John Wiley, 1995
4. Tarun Kumar Rawat, *Signals and Systems*, Oxford University Press, 2010

Effective From: **2018-19**

Principles of Communication Engineering I

Course No	**:**	**ELC2420**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2410 (Signals and Systems)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand random variables and random processes.
2. Analyse different amplitude modulation schemes.
3. Analyse different angle modulation schemes.
4. Explain sampling processes and reconstruction.
5. Analyse the behaviour of communication system in the presence of noise.

Syllabus

Unit I: Random Variables and Stochastic Processes

Review of Random Variables; Probability Distribution and Probability Density Functions; Uniform, Gaussian, Exponential and Poisson Random Variables; Statistical Averages; Random Processes; Correlation; Power Spectral Density; Analysis of Linear Time Invariant Systems With Random Input; Noise and Its Representations

Unit II: Amplitude Modulation

Introduction to Modulation; Amplitude Modulation Systems (AM, DSBSC, SSBSC, VSB Modulation/Demodulations); Frequency Division Multiplexing; Superhetrodyne Radio Receiver; Equivalent Receiver Model, Noise in CW Receivers Using Coherent Detection, Noise in CW Receivers Using Envelope Detector

Unit III: Angle Modulation

Angle Modulation: Frequency and Phase Modulation; Generation and Demodulation of Narrowband and Wideband FM; FM Broadcasting; Non-linear Effects in FM Systems; Noise in FM Receivers, FM Threshold Effect

Unit IV: Sampling and Pulse Modulation

Sampling Theorem; Various Sampling Techniques; Sampling of Low Pass and Bandpass Signals; Time Division Multiplexing; Generation and Recovery of PAM, PWM and PPM Signals

Books:

1. Simon Haykin, *Communication Systems*, 4th Edition, John Wiley & Sons, 2001
2. G R Cooper and C D McGillem, *Probabilistic Methods of Signals and Systems Analysis*, Oxford University Press, 1998
3. H Taub, D L Schilling & G Saha, *Principles of Communication Systems*, 3rd Edition, Tata McGraw Hill, 2008
4. A B Carlson, *Communication Systems*, McGraw Hills, 2002
5. J G Proakis & M Salehi, *Communication Systems Engineering*, 2nd Edition, Pearson Education, 2006

Effective From: **2018-19**

Electromagnetics

Course No	**:**	**ELA2510**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	AMS2520 (Higher Mathematics II)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Apply various electrostatic and magneto-static laws in various electromagnetic problems.
2. Analyse Maxwell's equations in various forms (differential and integral forms) and apply them in diverse engineering problems.
3. Examine the phenomena of wave propagation in different media and its interfaces.
4. Analyse various characteristics of transmission lines analytically as well as using Smith Chart.

Syllabus

Unit I: Electrostatics and Magnetostatics

Review of Vector Algebra and Coordinate Systems; Electrostatics: Electrostatic Fields, Gauss's Law and Its Applications, Electric Field and Potential due to a Dipole, Energy Density in an Electric Field, Electric Polarization; Magnetostatics: Biot-Savart's and Ampere's Circuital Laws and Applications; Magnetic Flux; Scalar and Vector Magnetic Potentials; Forces due to Magnetic Fields; Magnetic Energy; Magnetic Field and Circuits

Unit II: Maxwell's Equations and Electromagnetic Waves

Motion of Charged Particles in Electric And Magnetic Fields; Faraday's Law of Electromagnetic Induction; Displacement Current, Conservation of Charge, Equation of Continuity, Generalized Ampere's law, Maxwell's Equations in Various Forms; Time Varying Potential, Sinusoidal Variation of Fields; Wave Equations and Their Solutions.

Unit III: Electromagnetic Wave Propagation in Unbounded Media

Uniform Plane Wave in Lossless and Lossy Dielectrics; Plane Waves in Free Space and in Good Conductors; Poynting Theorem and Power Flow; Polarization; Depth of Penetration (Skin Depth); Reflection and Refraction. Radio-Wave Propagation

Unit IV: Transmission Lines

Transmission Line Theory; Transmission Line as Distributed Parameter Circuits; Transmission Line Equations and Their Solutions; Input Impedance, SWR and Power; Transmission Lines as Circuit Elements; Smith Chart and Its Applications; Impedance Matching: Quarter Wave Transformer, Single and Double Stub Matching.

Books:

1. Hayt, W. H. and Buck, J. A., "*Engineering Electromagnetics*", VII edition, Tata Mc Graw Hill, New Delhi, 2006
2. Sadiku, M. N. O, "*Elements of Electromagnetics*", Fourth Edition, Oxford Press, 2007.
3. Jordon, E. C and Balmain, K. G., "*Electromagnetic Waves and Radiating Systems*", Prentice Hall Ltd, New Delhi, 1997.
4. Kennedy, G and Davis, B., "*Electronics Communication Systems*", 4th Edition, McGraw Hills, New Delhi, 1995.

Effective From: **2019-20**

Analog Electronics

Course No	**:**	**ELC3110**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2140 (Electronic Circuits)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the working of ICs and analyze analog circuits.
2. Critically analyze and use analog ICs for real world problems.
3. Independently synthesize the filtering circuits for feasible solutions
4. Understand the applications of ICs for system design

Syllabus

Unit I: Basic Analog Circuits

Comparator, Peak Detectors, Voltage-to-Current and Current-to-Voltage Converters, Instrumentation Amplifier, Precision Rectifiers, Log and Exponential Converters, Schmitt Trigger and Applications as Monostable and Astable Multivibrators, Square/Triangular Wave Generators.

Unit II: Analog Signal Processing Circuits

Multivibrators Using Logic Gates, 555 Timer Circuit and Applications, Analog Multiplier/ Divider Using Log-Antilog Amplifier. Sinusoidal Oscillators. Voltage Controlled and Quadrature Oscillators, PLL and its applications, Power Supplies.

Unit III: Active Filter Topologies

Network Functions, Filters and Their Classification, Lossy and Lossless Integrators, Bilinear Transfer Functions, Biquad Topologies: Sallen-Key, KHN. Biquad Design Parameters and Their Significance.

Unit IV: Analog Filter Design Techniques

Approximation Methods: Butterworth, Chebyshev, and Elliptic. Cascade Approach. Ladder Networks: Element Substitution, Operation Simulation. Sensitivity Analysis.

Books:

1. S. Sedra, K. C. Smith, '*Microelectronic Circuits'*, Oxford Univ Press, 2011.
2. Rolf Schaumann, H. Xiao, and M. E. Van Valkenburg, *Design of Analog Filters*, 2nd Ed., 2009.
3. S. Soclof, '*Application of analog ICs'*, PHI, 2004.

Effective From: **2019-20**

Control Systems

Course No	**:**	**ELC3210**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2410 (Signals and Systems)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand basic concepts of control system
2. Determine the transfer function of a control system
3. Analyse the behaviour of control systems in time and frequency domain
4. Test the stability of linear and nonlinear systems
5. Model a control system using state space techniques

Syllabus

Unit I: Components and Transfer Function Representation

Introduction; Basic Components of Control System; Open Loop and Closed Loop Control Systems; Mathematical Modeling of Electromechanical Systems; Servo motors and Tachometers; Block Diagram and Signal Flow Graph Techniques

Unit II: System Analysis

Transient and Steady State Response; Steady State Error; Time Response of a Position Control System; Frequency Response of a Closed Loop System; Stability of Closed Loop Systems; Routh-Hurwitz Technique of Determining Stability

Unit III: Stability Analysis

Root-Locus Technique; Bode Plot; Stability Using Bode Plot; Nyquist Stability Criterion; Stability Using Nyquist Diagram; Gain Margin and Phase Margin; Design of P, I, D Controllers and Their Variants; Phase Lead and Phase Lag Compensation

Unit IV: State Variables and Nonlinear Systems

State Variable Representation; Analysis of Control System Using State Variables; Controllability and Observability; Introduction to Nonlinear Systems; Analysis of Nonlinear Systems and Their Stability

Books:

1. B C Kuo, *Automatic Control Systems*, PHI, 2004.
2. I J Nagrath & M Gopal, *Control System Engineering*, New Age Int, 2007.
3. K Ogata, *Modern Control Engineering*, PHI, 2002.

Effective From: **2019-20**

Microprocessor & Microcontrollers

Course No	**:**	**ELC3310**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2130 (Digital Electronics)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the difference between Microprocessors and Microcomputers along-with their architecture.
2. Use and program various interfacing devices.
3. Understand the instruction set and Write effective programs.
4. Apply the knowledge gained to Design Microprocessor /Microcomputer based system.

Syllabus

Unit I: 8085 Microprocessor

Introduction to Microcomputer Architecture. 8085 Microprocessor's Architecture, Instruction set and Addressing modes, some assembly Language programming examples, timing and control, Comparison of different Machine cycles. Different Data Transfer Schemes; Programmed Data Transfer, Interrupt Data Transfer.

Unit II: Interfacing Memory and I/O devices

Need for Interfacing; Address Space Partitioning- Memory mapped I/O and I/O mapped I/O. 8085 Minimal System. Interfacing Devices (Any three of these to be covered in class and rest for self-Study)- 8255(PPI), 8251 (USART), 8253 (Programmable Interval Timer), 8279 (Keyboard Controller), 8259 (PIC).

Unit III: Advanced Microprocessors

Introduction to 16 bit microprocessor, Overview of 8086 Family, 8086 Internal Architecture. Bus Interface Unit, Execution Unit, Pin diagram and function of various pins. Programmers model of 8086 Microprocessor. Difference between 8086 and 8088 Microprocessor. Addressing modes and Instruction formats. Important Instructions. Program Development Steps and writing programs. Overview of other microprocessors.

Unit IV: Microcontroller and its Applications

Introduction to Microcontroller- Criteria used to select a microcontroller. Architecture- Memory Organization, Signals, Special Function Registers, Port Operations, Memory Interfacing, Programming 8051, Programmers model of 8051, Operand types, Programming the on chip Timer/Counter, Serial Interface. Important Instructions, Interfacing with DAC/ADC.

Books

1. R.S. Gaonkar, *Microprocessor Architecture, Programming and Applications*, Wiley Eastern limited.
2. K.L. Short, *Microprocessor and Programmed Logic*, Prentice Hall of India.
3. Douglas V. Hall, *Microprocessor and Interfacing-Programming and Hardware*, Tata McGraw Hill.
4. M. Rafiquzzaman, *Microprocessor and Microcomputer Development System*, Cambridge Publications, Haper and Row
5. A.P. Malvino, *Digital Computer Electronics – An Indroduction to Microcomputer*, Tata McGraw Hill.

Effective From: **2019-20**

Principles of Communication Engineering II

Course No	**:**	**ELC3410**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2420 (Principles of Communication Engineering I)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand waveform coding techniques.
2. Design detectors for digital communication systems.
3. Understand baseband communication system design issues.
4. Understand different digital modulation schemes

Syllabus

Unit I: Waveform Coding

Introduction to PCM; Noise in PCM System: Transmission and Quantization Noise; Companding; Line Coding: Techniques and Power Spectra of Different Waveforms; DPCM; Delta Modulation; Digital Multiplexing; Time Slot Interchanging

Unit II: Introduction to Detection and Estimation

Geometric Representation of Signals; Gram Schmidt Orthogonalization Procedure; Detection of Known Signals in Noise; MAP and ML Criteria; Probability of Error; Correlation and Matched Filter Receivers; Estimation: Concepts and Criterion

Unit III: Baseband Communication

Introduction to Baseband Communication Systems; Matched Filter and Correlation Receivers, Error rate due to Noise, Inter-symbol Interference (ISI) and Eye Patterns; Nyquist Criterion of Distortion-less Baseband Transmission, Baseband Pulse Shaping, Correlative Coding, Equalization Techniques

Unit IV: Digital Modulation

Introduction to Passband Communication; Binary Modulation Techniques: ASK, PSK, DPSK and FSK; *M*-ary Modulation Techniques: MPAM, QPSK, OQPSK, $\pi/4$-DQPSK, QAM; MSK

Books:

1. B P Lathi, *Modem Digital and Analog Communication Systems*, 3rd Ed., Oxford Press, 2004
2. Tri T Ha, *Theory and Design of Digital Communication*, Cambridge Univ Press, 2010
3. Simon Haykin, *Communication Systems*, 5th Edition, John Wiley & Sons, 2009
4. J. G. Proakis & M. Salehi, *Communication Systems Engineering*, 2nd Edition, Pearson Education, 2006
5. G J Proakis, *Digital Communication*, 5th Edition, McGraw Hill, 2008
6. Van Trees, *Detection, Estimation and Modulation Theory, Vol 1 and 2*, John Wiley, 2004

Effective From: **2019-20**

Digital Communication

Course No	**:**	**ELC3420**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC3410 (Principles of Communication Engineering II)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Compare different digital modulation techniques.
2. Understand the concepts of information theory and source coding.
3. Apply the channel coding techniques.
4. Understand the basics of spread spectrum communication systems.

Syllabus

Unit I: Detection of Digitally Modulated Signals

Power Spectra of Baseband and Passband Signals; Synchronization; Coherent and Non-coherent Detection of Modulated Signals; Probability of Error in Detection; Comparison of Various Modulation Techniques

Unit II: Information Theory

Introduction to Information Theory; Discrete Memoryless Sources; Information Measures; Source Coding Theorem; Source Coding Techniques; Channel Capacity; Channel Coding and Channel Capacity Theorems

Unit III: Channel Coding

Introduction to Channel Coding; Error Detection and Correction; Linear Block Codes; Decoding of Linear Block Codes; Introduction to Cyclic Codes; Convolutional Codes; Viterbi Decoding Algorithm

Unit IV: Spread Spectrum Communication

Introduction to Spread Spectrum Communication; Spreading Sequences; Direct Sequence Spread Spectrum; Frequency and Time Hopping Spread Spectrum; Applications of Spread Spectrum; CDMA Techniques; OFDM

Books:

1. G J Proakis, *Digital Communication*, 5th Edition, McGraw Hill, 2008
2. J G Proakis & M Salehi, *Communication Systems Engineering*, 2nd Edition, Pearson Education, 2006
3. B P Lathi and Z Ding, *Modern Digital and Analog Communication Systems*, 4th Edition, Oxford Univ Press, 2010
4. R Bose, *Information Theory, Coding and Cryptography*, 2nd Ed, Tata McGraw Hill, 2008
5. G R Cooper and C D McGillem, *Modern Communication and Spread Spectrum*, McGraw Hill, 1986

Effective From: **2019-20**

Digital Signal Processing

Course No	**:**	**ELC3430**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2410 (Signals and Systems)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Describe and analyze discrete time signals and systems in the time and frequency domain.
2. Design and simulate digital filters.
3. Solve digital signal processing problems using MATLAB.
4. Analyze the errors in hardware realization of discrete time systems.

Syllabus

Unit I: Fourier Analysis of Discrete Signals

Review of DFT, Functional Operations with DFT; Efficient Computation of DFT; FFT Algorithm; Fourier Analysis of Signals using DFT

Unit II: Infinite Impulse Response Filters

Frequency Response for Rational System Functions; All Pass and Minimum Phase Systems; Basic Structure for IIR Filters; Design of IIR Filters from Continuous Time Filters; Frequency Transformations of IIR Low Pass Filters; Computer Aided Design of IIR Filters

Unit III: Finite Impulse Response Filters

Linear Systems with Generalized Linear Phase; Basic Network Structures for FIR Filters; Design of FIR Filters; Window Function Methods and Frequency Sampling Technique; Comparison of FIR and IIR Filters

Unit IV: Finite Word Length Effects in Digital Signal Processing

Overview of Finite Precision Numerical Effects; Effects of Round Off Noise in Digital Filters; Effect of Finite Register Length in DFT Computation; Introduction to Multirate Digital Signal Processing

Books:

1. A. V. Oppenheim and R. W. Schafer, *Discret Time Signal Processing*, PHI, 1992.
2. J. G. Proakis and D. G. Manolakis, *Digital Signal Processing Principles*, Algorithms and Applications, PHI 1996.
3. S. K. Mitra, *Digital Signal Processing*, Tata McGraw Hill, 2005.
4. A. Antoniou, *Digital Filters: Analysis, Design and Applications*, Tata McGraw Hill, 2000.

Effective From: **2019-20**

Microwave and Antennas

Course No	**:**	**ELC3510**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2510 (Electromagnetics)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand basic concepts of µwave engineering
2. Model the microwave devices using S-parameters
3. Learn the theory and working of µwave tubes and solid-state devices
4. Identify the different types of antennas and understand their working
5. Carry out analysis of different types of antennas

Syllabus

Unit I: Microwave Components

Guided –Wave Propagation; Modes of Propagation; Wave-guide Components-Tees, Hybrid Rings; Wave-guide- Tuning, Matching, Loading, and Attenuating Components; Directional Couplers, Isolators, Circulators and Detector, Modelling of Microwave Components-Scattering Parameters and their Properties; Measurements of VSWR, Impedance, Frequency, Wavelength, Attenuation and Power

Unit II: Microwave Amplifiers and Oscillators

Introduction to Microwave Tubes; Frequency Limitations of Conventional Tubes; Multi-cavity Klystron Amplifiers and Oscillators; Reflex Klystron Oscillators and Their Applegate Diagrams; Magnetrons and Traveling Wave Tubes (TWTs) their Working and Applications

Unit III: Microwave Semiconductor Devices and Antennas

Introduction to Microwave Semiconductor Devices; Operation and Applications of Schottky Barrier Diode; Varactor Diode; Tunnel Diode; Gunn Diode; PIN Diode; Micro-Strip & Strip Lines; Introduction to Antennas; Antenna Characteristics

Unit IV: Antenna Design

Hertzian Dipole; Isotropic Antennas; Monopole and Dipole Antennas; Microwave Antennas; Antenna Arrays; Broad-side and End-fire Arrays; Multiplication of Patterns; Firris Equation; Antenna Classification based on Frequency Range and Applications

Books:

1. S.Y. Liao, *Microwave Devices & Circuits*, 3rd ed., N. Delhi, Prentice Hall of India, 2003.
2. G. Kennedy and B. Davis, *Electronic Communication Systems*, 4th ed. Tata McGraw-Hill, New Delhi, 1985.
3. M.L. Sisodia & V.L Gupta, *Microwaves*, New Age International Publishers, N. Delhi, 2001
4. J. D. Kraus, R.J. Marhefka & A.S. Khan, *Antennas and Wave Propagation*, 4th ed., Tata McGraw-Hill, New Delhi, 2010.
5. C.G. Christodolou, P.F. Wahid, *Fundamentals of Antennas: Concepts and Applications*, PHI, N. Delhi, 2004.
6. M. M. Radmanesh, *Radio Frequency and Microwave Electronics—Illustrated*, Pearson Education-2001.

Effective From: **2019-20**

VLSI Design and Technology

Course No	**:**	**ELC3610**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2110 (Electronic Devices and Circuits)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand IC processing steps
2. Understand IC process integration
3. Design basic CMOS digital circuits
4. Design basic CMOS analog circuits

Syllabus

Unit I: IC Processing Steps

Mask Making and Pattern Generation; Mask and Printing Defects; Yield; Basic Processing Steps of IC Fabrication; Lithography; Wet and Dry Etching; Oxidation, Diffusion, Ion Implantation; Annealing, Epitaxial Growth, CVD, Metallization

Unit II: IC Process Integration

Self Alignment; Isolations: Junction Isolation; Guard-Ring; Shallow and Deep Trench; Local Oxidation; CMOS Technology: High-k Processes, Bipolar Technology, BiCMOS Technology; Introduction to SOI, SiGe and GaAs

Unit III: CMOS Digital Design

Integrated Circuit Layout and Design Rules; Layout of a CMOS Inverter, NAND and NOR Gates; Design and Performance Optimization of Static CMOS Gates Using Logical Effort,

Unit IV: CMOS Analog Design

Design Flow of Analog Circuits; CMOS Amplifier Topologies: Common Source, Common Gate, Common Drain; Parameter Optimization; Layout of a CMOS Amplifier; Overview of Radio Frequency Circuits

Books:

1. Jan M. Rabaey, Anantha P. Chandrakasan, BorivojeNikolić, *Digital Integrated Circuits*, 2/e, Pearson Education, 2003.
2. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw Hill, 2002.
3. S.A. Campbell, *The Science and Engineering of Microelectronic Fabrication*, Oxford University Press, 2001.
4. J.D. Plummer, M. Deal & P.D. Griffin, *Silicon VLSI Technology: Fundamentals, Practice, and Modeling*, Prentice Hall, 2000.

Effective From: **2019-20**

Digital System Design

Course No	**:**	**ELC3620**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC2130 (Digital Electronics)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand design flow of digital systems using industry standard electronic design automation tools.
2. Learn Verilog HDL for the modelling of Digital systems at a high level.
3. Introduction to implementation technologies like ASICs and FPGA.
4. Describe Digital system in terms of Data subsystem and Control subsystem.

Syllabus

Unit I: Verilog HDL

VLSI Design Problem, IC Design Hierarchy, Introduction to Verilog, Structural, Behavioral and Dataflow Modelling, Simulation Based Verification, Concept of Assertion Based Verification and Formal Verification, Concept of Synthesis, FSM Coding, Introduction to System Verilog

Unit II: Design of RTL Systems

RTL Systems: Organization, Specification and Implementation, Analysis of RTL Systems and Design Examples, Implementation Technologies: Standard Cell ASIC, EPLDs and FPGAs

Unit III: Data and Control Subsystem

Data Subsystem Modules: Storage, Function and Data path; Control Subsystem; Micro-Programmed Controller; Structure, Format and Design, Issues with Multiple Clock Design

Unit IV: Implementation of a Microcomputer

Architecture and Implementation of a Simple Microcomputer System; Operation of the System, Processor Implementation in Verilog, Introduction to Asynchronous Design.

Books:

1. Milos Ercegovac et.al, *Introduction to Digital System*, John Wiley & Sons, 2000.
2. M. D. Ciletti, *Advanced Digital Design with the Verilog HDL*, Prentice Hall of India, 2008.

Effective From: **2020-21**

RF Circuit Design

Course No	**:**	**ELE4110**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC2140 (Electronic Circuits)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Independently understand radio frequency (RF) fundamental
2. Get an exposure to emerging wireless systems;
3. Know the various blocks of wireless systems and how do they work;
4. Identify the low power CMOS devices and their model requirements for RF circuit
5. Developed specialized skill required for design for RF circuits.

Syllabus

Unit I: Introduction of RF System

Overview of RF/wireless Systems and Their Standards; Transmitter and Receiver Architectures; Radio Frequency Identification (RFID) System and Its Applications; Wireless LAN; Wireless PANs; UWB; WiMAX; Basic Concepts of Blue Tooth and Software Defined Radio.

Unit II: Communication Circuits

Integrated Circuit Requirements for Modern RF/wireless System; RF Circuits – Low-Noise Amplifier (LNA) and Power Amplifier (PA), Oscillators, Mixers; Base Band Circuits-Modulators; Demodulators; Integration Issues of RF and Base Band Circuits.

Unit III: RF CMOS Modeling

Device Options and Requirements for Modern Wireless System; Low Frequency (LF) vs Radio Frequency (RF) model; RF Model Development; Equivalent Circuit Model Representation; Parameter Evaluation; Model Verification; Figure-of-Merits (FoMs).

Unit IV: RF Circuit Design

Design – Goals and Objectives; Design specifications; Design Issues and Approach; Circuit Design of Front-End Blocks of Wireless System; Performance Assessments.

Books:

1. T.H. Lee, *The Design of CMOS Radio Frequency Integrated Circuits*, Cambridge University Press, 2004.
2. T. Ytterdal, Y. Chang and T.A. Fjeldly, *Device Modeling for Analog and RF CMOS Circuit Design*, Wiley, 2013.
3. Ulrich L. Rohde and Mathias Rudolph, *RF/Microwave Circuit Design for Wireless Applications*, 2005.
4. Kai Chang, Inder Bahal and Vijay Nair, *RF and Microwave Circuit and Component Design for Wireless System*, Wiley, 2002.
5. B. Razavi, *RF Microelectronics*, 2nd edition Prentice Hall, 2012.

   J. H. Reed, *Software Radio: A Modern Approach to Radio Engineering*, Pearson, 2004.

Effective From: **2020-21**

Semiconductor Device Modelling

Course No	**:**	**ELE4120**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC2110 (Electronic Devices and Circuits)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand electronics properties and physics of charged transport in semiconductors.
2. Analyse semiconductor junctions through energy-band diagrams.
3. Use models of semiconductor devices to predict terminal characteristics under various operating conditions.
4. Understand second order effects in BJT and MOSFETs.

Syllabus

Unit I: Basic Semiconductor Physics

Quantum Mechanical Concepts and Atomic States; Solid State Structure; Band Structure; Semiconductor Statistics; Intrinsic, Extrinsic & Compensated Semiconductors; Electron and Hole Mobilities and Drift Velocities; Hall Effect and Magnetoresistance; Semiconductor Equations Based on the Field Dependent Velocity and Diffusion; Quasi-Fermilevels; Generation and Recombination of Carriers.

Unit II: Models for p-n Junction, Schottky Barrier Junction, Hetero Junction and Ohmic Contacts

P-N Junction Under Zero Bias; I-V Characteristics Of p-n Junction; Generation & Recombination Currents; Depletion & Diff. Capacitances; Junction Breakdown; Tunneling and Tunnel Diodes; Schottky Barrier: Thermionic Emission Model, V-I Characteristics and Thermionic-Field Emission Models; Ohmic Contacts and Heterojunctions.

Unit III: Bipolar Junction Transistors

Minority Carrier Profiles; Current Components; Base Spreading Resistance; Emitter Current Crowding; Graded Base Transistors; Early Effect; Ebers-Moll Model; Gummel-Poon Model; Breakdown; Small signal model and high frequency models.

Unit IV: Field Effect Transistors

MOS Capacitor; C-V Characteristics; MOSFET: Gradual Channel Approximation and Charge Control Model; Charge Sheet Model; Constant Mobility Model; Velocity Saturation Effects; Sub-Threshold Current in MOSFETs; Large Signal Modeling; Small Signal Modeling (Low & Medium Frequency); High Frequency Small Signal Models; MOSFET Modeling for Circuit Simulation.

Books:

1. M. Shur, *Physics of Semiconductor Devices*, Prentice Hall of India, 1990.
2. Neamen, *Semiconductor Physics and Devices* Tata McGraw Hill, 2011
3. Y. Tsividis, *Operation and Modeling of the MOS*, McGraw Hill, 1999.

Effective From: **2020-21**

Industrial Electronics

Course No	**:**	**ELO4110**
Credits	:	4
Course Category	:	Open Elective
Pre-requisite(s)	:	
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1 Apply the knowledge of electronic circuits for industrial applications.
2 Analyse and design general purpose electronic test equipment.
3 Understand the architecture of Microcomputers.
4 Able to solve real world problems using embedded systems

Syllabus

Unit I: Data Acquisition and Conversion

Introduction to Data Acquisition System, Encoders, Decoders, BCD to 7-Segment Decoder/Driver, Multiplexers, Demultiplexers, Flips Flops, Counters, A/D & D/A Converters.

Unit II: General Purpose Electronic Test Equipment

Basic Principles of Digital Voltmeter, Frequency Measurement, Function Generators, Regulated Power Supply, and DSO, Transducers for the Measurement of Non-Electrical Quantities; Concept of Actuator.

Unit III: Basic Microcomputer Organisation

Basic Computer System Organization; Typical Microcomputer Structure and Bus System, Overview of Microprocessor Architecture; ROM and RAM

Unit IV: Applications of Microcomputers in Industries

Interfacing of Microcomputers with the Real World; Temperature Monitoring and Control; Introduction to Microcontrollers, Application of Microprocessor/ Microcontroller in Industry (Real example from Automated Industrial Plants).

Books:

1. H.S Kalsi , *Electronic Instrumentation*, , Tata McGraw Hill, 3rd, Edition (fourth reprint 2012).
2. W.D. Cooper and A.D Helfrick, *Electronic Instrumentation and Measurement Techniques*, Prentice Hall of India Pvt. Ltd., New Delhi
3. David A. Bell, *Electronic Instrumentation and Measurements,* Second Edition, PHI, 2007.
4. A.K Sawhney, *A Course in Electrical And Electronic Measurements and Instrumentation*, Dhanpat Rai & Co, New Delhi, 19th, Revised Edition 2011(Reprint 2012).
5. R. J. Tocci, N. S. Widmer, and, G. L. Moss, *Digital Systems, Principles and Applications*, Pearsons, 10th Edition, New Delhi, (Re-print 2013).

Effective From: **2020-21**

Artificial Intelligence and Neural Network

Course No	**:**	**ELO4310**
Credits	:	4
Course Category	:	Open Elective
Pre-requisite(s)	:	
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the basics of AI and ANN.
2. Solve basic AI problems using different search techniques.
3. Learn and apply logic systems for automated reasoning.
4. Learn basic ANN architectures and design ANN for solution of some simple computational problems.
5. Describe how ANN can be applied in various fields of technology including bioinformatics, communication etc.

Syllabus

Unit I: Introduction to AI and Search Techniques

Foundation of AI, Rational Agents, Problem Solving Agents: Search Strategies – Breadth-First Search, Depth-First Search, Depth-limited Search, Iterative Deepening Depth-first Search, Bidirectional Search, Greedy Best-first Search, A* Search, Hill Climbing, Simulated Annealing, Alpha-Beta Pruning, Minimax Algorithm.

Unit II: Knowledge and Reasoning

Prepositional Logic; First Order Predicate Logic (FOPL); Inference Rules; Resolution, Rule Based Systems – Forward Reasoning, Conflict Resolution, Backward Reasoning; Logic Programming, Introduction to Logic Programming Language (PROLOG).

Unit III: Fundamentals of ANN

Biological Neuron; Introduction to ANN; Artificial Neuron, Activation Functions. Single Layer Perceptron, Limitations of Single Layer Network, Linearly Separable Problems. Multi Layer Perceptron, Learning and Back-propagation; Radial Basis Function Networks; Feedback Neural Networks.

Unit IV: ANN Applications

Applications of ANN in Bioinformatics, Forecasting, Healthcare, Intrusion Detection, Communication, Robotics, Image Processing and Compression, Control, Pattern Recognition, Optimization.

Books:

1. Stuart J. Russel & Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, PHI, 2009.
2. Elaine Rich & Kevin Knight, "Artificial Intelligence", TMH, 2005.
3. Jacek M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 2012.
4. Sivanandam, S. N. Deepa, "Introduction to Neural Networks Using Matlab 6.0", TMH, 2006.

Effective From: **2020-21**

Communication Networks

Course No	**:**	**ELC4410**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELC3420 (Digital Communication)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the principles of data communication with reference to OSI Model
2. Evaluate the performance of different medium access techniques.
3. Understand various routing and flow control mechanism.
4. Understand the concept of internetworking and functions of different layers of TCP/IP.

Syllabus

Unit I: Layered Network Architecture

Growth of Computer Networking; Resource Sharing; Growth of the Internet; Layering; System Design; Network Topology; Packets, Frames and Error Detection

Unit II: Multi access Communication

Introduction to Medium Access; Slotted Multi-access and Aloha Systems; Splitting Algorithms; Carrier Sensing; Multi-access Reservation; Packet Radio Networks

Unit III: Routing and Flow Control

WAN Routing; Interconnected Network Routing; Network Algorithms and Shortest Path Routing; Means of Flow Control; Window Flow Control; Overview of Flow Control in Practice

Unit IV: Internetworking

Concepts of Internetworking, Architecture and Protocols; Internet Protocol Addresses; Binding Protocol Addresses; IP Datagrams and Datagram Forwarding; IP Encapsulation, Fragmentation and Reassembly; Error Reporting Mechanism (ICMP); TCP: Reliable Transport Service

Books:

1. A Leon-Garcia and I. Widjaja, *Communication Networks*, Tata McGraw Hill, 2004.
2. L.L. Peterson & B.S. Davie, *Computer Networks*, Elsevier, 2007.
3. D. Bertsekas & R. Gallager, *Data Networks*, PHI, 1997.
4. B.A. Forouzan, *TCP/IP Protocol Suite*, Tata McGraw Hill, 2005.

Effective From: **2020-21**

Multimedia Systems and Networks

Course No	**:**	**ELE4410**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC3420 (Digital Communication)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand basic multimedia systems.
2. Apply compression algorithms on text and images;
3. Understand basics of audio, speech and video coding techniques and their standards.
4. Understand fundamental concepts of multimedia transmission over networks.

Syllabus

Unit I: Multimedia Systems

Introduction to Multimedia; Characteristics of Multimedia Signals and Systems; Multimedia System and Components; Multimedia information representation; Multimedia Applications; Multimedia Networks; Quality of Service (QoS) parameters for multimedia

Unit II: Text and Image Compression

Basic Principles of Compression; Text Compression: Static and Dynamic Huffman Coding, Arithmetic Coding, LZ and LZW Coding; Image Basics; Types of Image; Image Representation; Colour Models; Compression of Binary Images and its standards; Compression of Gray Scale & Colour Images; JPEG, JPEG2000.

Unit III: Audio and Video Compression

Basics of Speech and Audio; Audio Compression: DPCM, ADPCM, LPC, Perceptual Coding and MPEG audio coders; Basics of Video; Brief overview of Analog TV; Digital Video; High Data Rate & Low Data Rate Digital Video Formats; Principles of Video Compression; Types of frames in a Compressed Video Sequence; ITU and MEPG Video Coding Standards.

Unit IV: Networked Multimedia

Multimedia Streams: Timing Relationships in Networked Multimedia; A/V synchronization with RTP/RTCP; Multimedia Transport Through Circuit Switched and Packet Switched (IP) Networks; Video on Demand & Their Standards; Multimedia Broadcast; Standards for Interactive Multimedia Applications OVER INTERnet; Issues of Scheduling, Buffering, Congestion Control and Queue Management; Signaling Protocols: H.323, SDP, SIP and RTSP; Introduction to Advance QoS.

Books:

1. Fred Halsall, *Multimedia Communications*, Pearson Education (Low Priced ed.), 2002.
2. Ranjan Parekh, *Principles of Multimedia Systems*, Tata McGraw Hill, 2006.
3. Nalin K. Sharda, *Multimedia Information Networking*, Pearson Education, 1999.

Effective From: **2020-21**

Fiber Optic Communication

Course No	**:**	**ELE4510**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC3420 (Digital Communication)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. Describe various signal degradation factors in optical waveguides and dispersion compensation techniques.
3. Learn different analog modulation techniques used in optical fiber communication systems.
4. Learn different digital modulation and demodulation schemes used in optical fiber communication systems and perform design of a point to point digital fiber optic communication link.
5. Explain fiber networks and standards SONET / SDH and multiple access techniques.

Syllabus

Unit I: Fundamentals of Optical Fibers

Introduction to Optical Fibers; Ray Model; Numerical Aperture of Step Index and Graded Index Fibers; Power Coupling; V Number and Modes in Multi-Mode Fibers, Propagation Constant; Mode Groups; Normalized Propagation Constant, Dispersion, Single Mode Fibers; Introduction to Polarization Maintaining Fibers; Losses in Optical Fibers

Unit II: Noncoherent Optical Communication

Attenuation Management and Fiber-optic Amplifiers; Dispersion Management; System Design Consideration; Digital Systems: Receivers, Probability of error, Power Budgeting; Analog Systems: Direct Intensity Modulation, Sub-carrier Intensity Modulation, Sub-carrier Frequency Modulation.

Unit III: Coherent Optical Communication

Introduction to Coherent Optical Communication; Detection Principles; Practical Constraints; Modulation and Demodulation Schemes; Receiver Sensitivities-Probability of Error Calculations; Performance Comparison.

Unit IV: Optical Networks

Fiber Optic Link Design; Distribution Systems; Multiplexing/ Demultiplexing Components and Techniques; Time Division Multiplexing; SONET/SDH; Optical Add/Drop Multiplexing; Wave Division Multiplexing; WDMA – Single Hop and Multiple Hop Networks.

Books:

1. G. Keiser, *Optical Fiber Communication*, Tata McGraw Hill, 2013.
2. J. M. Senior, *Optical Fiber Communications*, Pearson Education, 2010.
3. G. P. Agrawal, *Fiber Optic Communication Systems*, John Wiley & Sons, 2002.
4. M.M.K. Liu, *Principles and Applications of Optical Communication*, Tata McGraw Hill, 1998.

Effective From: **2020-21**

Mobile Communication

Course No	**:**	**ELE4520**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC3420 (Digital Communication)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Explain the design principles of cellular mobile system
2. Characterize wireless channel
3. Identify the challenges and possible solutions for wireless communication
4. Understand existing and emerging wireless systems and standards

Syllabus

Unit I: Cellular System Fundamentals

Overview of Wireless Communication; Frequency Reuse and Cellular Concept; Co-Channel and Adjacent Channel Interferences; Cell Sectoring and Cell Splitting; Handoff Strategies; Channel Assignment Techniques.

Unit II: Propagation Modelling

Propagation Path Loss; Shadowing; Path Loss Models; Multipath Fading; Narrowband Fading Models: Correlation and Power Spectral Density, Envelope and Power Distribution, Level Crossing Rate and Average Fade, Wideband Channel Models: Power Delay Profile, Coherence Bandwidth, Doppler Power Spectrum and Channel Coherence Time.

Unit III: Modulation and Multiple Access Techniques

Performance of Digital Modulation over Wireless Channel; Diversity Techniques; Multiple Access Techniques: Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access, Orthogonal Frequency Division Multiple Access, Hybrid Techniques

Unit IV: Wireless Systems and Standards

Global System for Mobile Communications (GSM); CDMA Cellular System; Evolution of 2G, 3G, 4G Systems and Beyond; Wireless Local Area Network Technology; IEEE 802.11 Standards

Books:

1. T. S. Rappaport, *Wireless Communications: Principles and Practic*e, Pearson Education India, 2002.
2. A. S. Goldsmith, *Wireless Communications*, Cambridge University Press, 2005.
3. J. Schiller, *Mobile Communications*, Pearson Education India, 2nd Edition, 2008.
4. A.F. Molisch, *Wireless Communications*, John Wiley & Sons Ltd., 2nd Edition, 2011.
5. J.W. Mark and W. Zhuang, *Wireless Communications and Networking*, Prentice-Hall India, 2005.
6. G. L. Stuber, *Principles of Mobile Communication*, Springer, 3rd Edition, 2011

Effective From: **2020-21**

Satellite Communication and Radar

Course No	**:**	**ELE4550**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC3420 (Digital Communication)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Visualize the architecture of satellite systems as a means of long range communication system.
2. Design link budget for the given parameters and conditions
3. Understand the essential principles of operation of radar systems
4. Discriminate different Radars and understand their operation.

Syllabus

Unit I: Communication Satellite

Kepler's Laws, Attitude and Orbit Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, LEO, MEO and Geo-Stationary Orbits, Look Angle Determination, Limits of Visibility.

Unit II: Satellite Link Design

Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, VSAT, Satellite Navigational System. Direct Broadcast Satellites

Unit III: Basics of Radar operation

Principle and Historic Developments of Radars; Radar Frequencies; Radar Applications; Pulse Radar Operation; Radar Range Equation; Parameters Influencing Radar Performance and Estimates; Radar Losses; Radar Classification

Unit IV: Radar Types

CW, FMCW, MTI, PD; Search and Tracking Radars, Transmitters; Receivers; Displays and Duplexers; Scanning

Books:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, *Satellite Communications* –Wiley; 2 edition, 2002.
2. Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, *Satellite Communications Engineering* –2nd Edition, Pearson Publications, 2003.
3. Dennis Roddy, *Satellite Communication*, McGraw Hill International, 4th Edition, 2017.
4. Skolnik, M.I., *Introduction to Radar Systems*, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001.
5. Hoveinsen, S.A., *Radar System Design and Analysis*, Artech House, USA, 1984.

Effective From: **2020-21**

Analog IC Design

Course No	**:**	**ELE4610**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC2110 (Electronic Devices and Circuits)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1 Understanding the basic analog building blocks and their analysis using models
2 Ability to design the analog sub-systems
3 The course enables design of circuits with feasibility in IC form
4 The course enables exposure to some of the state-of-art techniques and trends in Analog design
5 The course develops skills for providing unique workable solutions

Syllabus

Unit I: Design of analog building blocks - I

Introduction to analog design, Analog signal processing, Design of analog Switches, active resistors, Voltage and Current References.

Unit II: Design of analog building blocks - II

Design of CMOS Differential Amplifier, Cascode amplifier, CMOS operational amplifier, Gilbert Cell, Current-mode amplifiers, CMOS PLL Design.

Unit III: Sampled Data Networks

Switched capacitor (SC) concept, Resistor emulation, Design of SC Amplifiers: SC integrators and filters, Field Programmable Analog Arrays.

Unit IV: Analog layout techniques

Analog layout techniques: Multi-finger transistors, Symmetry, Common centroid technique, Reference distribution, Pads and ESD protection, Substrate coupling.

Books:

1. Phillip E. Allen, and Douglus R. Holberg, *CMOS Analog Circuit Design*, Oxford Univ. Press, 2007.
2. Behzad Razavi, *Design of Analog CMOS ICs*, Tata Mc Graw Hill, 2008.

Effective From: **2020-21**

Digital IC Design

Course No	**:**	**ELE4620**
Credits	:	4
Course Category	:	Departmental Elective
Pre-requisite(s)	:	ELC2130 (Digital Electronics)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand MOSFET device modelling.
2. Design static/dynamic combinational circuits.
3. Design sequential circuits using different logic styles.

Syllabus

Unit I: Introduction to Digital IC Design

Issues, Cost, Functionality and Robustness; Performance; Power and Energy Consumption, Review of Processing Steps; Behaviour of MOSFET in Digital ICs.

Unit II: The CMOS Inverter

Interconnect Parameter and Models; Properties, Static and Dynamic Behaviour of the CMOS Inverter; Power and Energy Considerations.

Unit III: Combinational Logic Circuits

Static CMOS Design; Complimentary CMOS; Ratioed and PTL; Dynamic CMOS Design

Unit IV: Sequential Logic Design and RC Parasitics

Static Sequential Circuits; Dynamic Sequential Circuit; Capacitive/Resistive Parasitics and Performance.

Books:

1. J.M. Rabacy & others, *Digital Integrated Circuits – A design perspective*, Second edition, Pearson-Prentice Hall, 2002.
2. D.A. Hodges et al, *Analysis and Design of Digital Integrated Circuits*, 3rd edition, Tata McGraw Hill, 2005.
3. Sung-Mo-Kang and Yusuf Lablebici, *CMOS Digital Integrated Circuits*, 3rd edition, Tata McGraw Hill, 2003.

Effective From: **2018-19**

Logic and Digital Circuits

Course No	**:**	**ELA2010**
Credits	:	4
Course Category	:	ESA
Pre-requisite(s)	:	Nil
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Implement the number system.
2. Realize logic circuits
3. Reduce the combinational circuits using K-map and Boolean algebra.
4. Encode, decode, multiplex and de-multiplex the data.
5. Successfully perform acquisition and conversion of signals using digital circuits.

Syllabus

Unit I: Introduction

Number System: Decimal, Binary Octal, Hexadecimal; Base Conversion; Binary Arithmetic; Binary Codes; Boolean Algebra: Basic Theorems and Postulates; Basic AND, OR, NAND, NOR, EX-OR Gates.

Unit II: Digital Circuits

Switching Characteristics of Semi- Conductor Devices: Realization of Various Logic Gates: DTL, TTL, HTL, ECL and MOS Logics; Comparison of Various Logic Families.

Unit III: Design of Combination Circuits

Truth Table Representation; Canonical Forms; Minimization of Switching Functions- Karnaughs Maps; Design of Combinational Circuits; Encoders, Decoders, Multiplexers, ROMs.

Unit IV: Sequential Logic Systems

Definition of Sequential Circuits; State table and Diagram Representation; Flip- Flops: SR, JK, T and D Type; Ripple Counter; Shift Registers; RAMs.

Unit V: Data Acquisition and Conversion

A/D and D/A Converters; Sample and Hold Circuits; Comparators; Multivibrators- Astable and Distable.

Books:

1. M. M. Mano, *Digital Logic and Computer Design*, PHI 1986.
2. A.P. Malvino, *Digital Principles and Application.*
3. Ronald J. Tocci, *Digital Systems- Principles and Applications*, PHI, 1995.

Effective From: **2018-19**

Electronic Devices and Circuits

Course No	**:**	**ELC2110**
Credits	:	4
Course Category	:	Departmental Core
Pre-requisite(s)	:	ELA1110 (Principle of Electronics Engineering)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

5. Understand the physics behind the semiconductor behaviour of materials
6. Understand the various diodes and their applications
7. Understand the working of Bipolar and Field-Effect Transistors
8. Analyze single transistor amplifier configurations

Syllabus

Unit I: Semiconductor Physics

Energy Bands in Silicon, Intrinsic and Extrinsic Silicon; Carrier Transport in Silicon: Diffusion Current, Drift Current, Mobility, and Resistivity; Generation and Recombination of Carriers, Hall Effect.

Unit II: Diodes

PN Junction: Barrier Potential, Energy Band Diagram, Diode Equation, Charge Storage, Recovery Time, Depletion and Diffusion Capacitances; Special Purpose Diodes: Schottky Diode, Tunnel Diode, LED, Photodiodes, P-I-N Diode.

Unit III: BJT and MOSFET

BJT: Minority Carrier Profile, Current Equation, Base Width Modulation, Temperature Effects; MOSFET: Current Equation, Channel Length Modulation, Oxide Capacitance, Biasing and Bias Stability.

Unit IV: Transistor Configurations

Classification of Amplifiers, Small signal models of BJT and MOSFET, Analysis of BJT Configurations: CE, CC, CB; Analysis of MOSFET Configurations: CS, CD, CG; High frequency models of BJT and MOSFET, Frequency Responses.

Books:

4. A. S. Sedra, K. C. Smith, *Microelectronic Circuits*, Oxford Univ Press, 2004.
5. J. Millman, C.Halkias and Chetan D. Parikh, *Integrated Electronics*, Tata McGraw Hill, 2010.
6. Donald A. Neamen, *Semiconductor Physics and Devices,* 3e, Tata McGraw Hill, 2007

Effective From: **2018-19**

Signals and Systems

Course No	**:**	**ELA2410**
Credits	:	4
Course Category	:	ESA (For Computer Engineering Students)
Pre-requisite(s)	:	
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Describe and characterize various properties of signals and systems.
2. Compute convolution of continuous and discrete-time signals.
3. Compute Fourier series, Fourier transform and Laplace transform for continuous time signals.
4. Understand Nyquist sampling theorem and compute Discrete Time Fourier transform, Discrete Fourier transform and Z-transform of discrete time signals.
5. Understand the basic idea of digital signal processing.

Syllabus

Unit I: Introduction to Signals and Systems

Representation and Classifications of Continuous and Discrete Time Signals and Systems; Fourier Series Representation; Singularity Functions; Convolution Integral; Impulse Response and Its Properties

Unit II: Transform Techniques

Fourier Transform and Its Properties; Hilbert Transform; Review of Laplace Transform; Sampling; Z-Transform and Its Properties; Discrete Time Fourier Transform; Discrete Fourier Transforms.

Unit III: Analysis Using Transforms

System Analysis Using Fourier and Laplace Transforms of I & II Order Systems; Transfer Function; Feedback Systems; Block Diagram & Signal Flow Graph Techniques; Discrete Time System Analysis Using Z-Transform.

Unit IV: Random Signals

Review of Random Variables; Probability Distribution and Probability Density Functions; Uniform, Gaussian, Exponential and Poisson Random Variables; Statistical Averages; Random Processes; Correlation; Power Spectral Density; Analysis of Linear Time Invariant Systems With Random Input; Noise and Its Representations

Books:

1. Alan, V. Oppenheim & A.S. Wilsky, *Signals & Systems*, PHI, 1998
2. Simon Haykin, *Signals and Systems*, John Wiley, 1999
3. Simon Haykin, *Communication Systems*, John Wiley, 1995
4. Tarun Kumar Rawat, *Signals and Systems*, Oxford University Press, 2010

Effective From: **2019-20**

Communication Engineering

Course No	**:**	**ELA3400**
Credits	:	4
Course Category	:	ESA
Pre-requisite(s)	:	ELC2410 (Signals and Systems)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the concept and need of modulation
2. Use modulation as a tool to facilitate transmission of signals
3. Convert analog signals into digital signals through the process of sampling and quantization
4. Understand the effects of noise on the performance of communication systems
5. Understand the design challenges of the contemporary communication systems

Syllabus

Unit I: Continuous Wave Modulation

Overview of Communication System; Channels and Their Characteristics; Modulation and Its Benefits; Amplitude Modulations: AM, DSBSC, SSB, and VSB Modulation; Frequency and Phase Modulation; Frequency Division Multiplexing (FDM), Radio Receiver Principle.

Unit II: Pulse Modulation

Introduction to Pulse Modulation; Digital Pulse Modulations: Pulse Code Modulation (PCM), Differential PCM, and Delta Modulation (DM); Time Division Multiplexing (TDM); Overview of Baseband Communication.

Unit III: Digital Modulation

Overview of Digital Modulation; Modulation Techniques: Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying, Quaternary PSK (QPSK); Quadrature Amplitude Modulation (QAM); Comparison of Different Modulation Techniques.

Unit IV: Topics in Digital Communication

Source Coding and Data Compression; Channel Capacity; Error Detection and Correction; Cyclic Redundancy Check (CRC) Codes; Overview of Spread Spectrum Communication and Code Division Multiple Access (CDMA); Introduction to Mobile Communication.

Books:

1. Simon Haykin, *Communication Systems*, 4th Edition, John Wily & Sons Asia Pte. Ltd., 2001.
2. B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems*, OUP, India, 4th Edition, 2010.
3. R. Blake, *Electronic Communication System*, Thomson Asia Pte. Ltd., 2002.

Effective From: **2019-20**

Fundamental of Communication Engineering

Course No	**:**	**ELA3020**
Credits	:	4
Course Category	:	ESA
Pre-requisite(s)	:	EEC2730 (Signals and Systems)
Contact Hours (L-T-P)	:	3-1-0
Type of Course	:	Theory

Course Outcomes

1. Understand the concepts and need of modulation.
2. Understand the waveform coding techniques.
3. Understand the concepts of digital information transfer.
4. Present an overview of contemporary communication systems.

Syllabus

Unit I: Analog Modulation

Introduction to Communication System; Amplitude Modulation; Angle Modulation: Frequency and Phase Modulation; Analog Pulse Modulation: PAM, PWM and PPM

Unit II: Transmission of Digital Information

Digitization Techniques: PCM, DPCM, and Delta Modulation; Digital Multiplexing; Line Coding; Digital Modulation and Modem; Effects of Noise in Communication System

Unit III: Information Theory and Coding

Introduction to Digital Communication; Fundamental Limits on Information Transfer; Source Coding Techniques; Error Detection and Correction; Introduction to Linear Block Codes

Unit IV: Contemporary Communication Systems

Optical Fiber System: Sources, Detectors and Characteristics of Optical Fibers; Overview of Optical Networks; Introduction to Wireless and Mobile Communication Systems

Books:

1. S. Haykin, *Communication Systems*, John Wiley & Sons (Asia) Pt. Ltd., 2003.
2. G. Kennedy and B. Davis, *Electronic Communication Systems*, TMH, 1993.
3. R. Blake, *Electronic Communication System*, Thomson Asia Pt. Ltd., 2002.