

Maulana Abul Kalam Azad University of Technology, West Bengal
Syllabus for B. Tech in Electronics & Communication Engineering
(Applicable from the academic session 2018-2019)

Semester-III

EC301	Electronic Devices	3L:0T:0P	3 credits
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Module I 6L

Energy bands & Current Carriers in Semiconductors: Bonding Forces in Solids, Energy Bands theory in crystals (Qualitative Analysis), Metals, Semiconductors, & Insulators, Fermi-Level, Intrinsic and Extrinsic Semiconductors, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of carriers, continuity equation, Injected minority carrier charge, Recombination and generation of charge carriers. Generation and recombination of carriers; Poisson and continuity equation

Module II 10L

P-N junction: Physical Description of p-n junction, Basic device technologies for fabrication of a p-n junction, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

Bipolar Junction Transistor: Basic Construction, I-V characteristics, Ebers-Moll Model.

Module III 6L

MOSFET: MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor

MODULE IV 10L

Opto-Electronics: Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction)

Integrated circuit: fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
2. D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ. Press, 2011.

Course Outcomes:

At the end of this course students will demonstrate the ability to

- CO1. Differentiate the conduction techniques in semi-conductor materials.
CO2. Analyze characteristics of Semi-conductor diodes and solve problems.

CO3. Analyze characteristics of Bi-polar Transistors and solve problems.

CO4. Analyze characteristics of MOS Transistors and solve problems.

CO5. Differentiate between different Opto-electronic devices.

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EC302	Digital System Design	3L:0T:0P	3 credits
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Module I

10 L

Review of Number System, Signed and Unsigned Number.

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh's map, Binary codes, Code Conversion.

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Fast adders, Barrel shifter and ALU.

Module II

6L

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM. Designing synchronous circuits like Synchronous Counter, Pulse train generator, Pseudo Random Binary Sequence generator,

Module III

8L

Logic Families and Semiconductor Memories: TTL, ECL, CMOS families

Semiconductor Memories, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

Different types of A/D and D/A conversion techniques. Sample & Hold Circuit

Module IV

8L

VLSI Design flow: Design entry Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text/Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Schilling & Belove, Digital Integrated Electronics, Tata McGraw Hill,
3. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
4. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
5. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
6. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.
7. R. Anand, "Digital Electronics", Khanna Publishing House, New Delhi, 2017.

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Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits

EC303	Signals and System	3L:0T:0P	3 credits
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Module I

6L

Signals and systems as seen in everyday life, and in various branches of engineering and science.

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Module II

6L

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations.

Module III

8L

Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases.

Module IV

8L

Evolution of Transforms: Fourier Transform, Laplace Transform, Z-transform (single sided and Double sided)

The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, solution to differential equations and system behavior using Laplace Transformation

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.

Module V

4L

The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.

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4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia).
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar, "Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.
11. R. Anand, Signals and Systems, Khanna Publishing House, 2018.

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outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze different types of signals
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal

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EC304	Network Theory	3L:0T:0P	3 credits
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Module I

8L

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity,

Thevenin's, Norton's, Maximum power Transfer, compensation and Tellegen's theorem as applied to AC circuits.

Module II

6L

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Module III

6L

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Module IV

12L

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Text/Reference Books

1. Ashfaq Husain, Networks & Systems, Khanna Publishing House, New Delhi, 2018.
2. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000
3. Sudhakar, A., Shyammoan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
4. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.
5. Appreciate the frequency domain techniques.

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ES-CS301	Data Structure & Algorithms	3L:0T: 4P	3 credits
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Objectives of the course:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Detailed contents:

Module 1 6L

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.

Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Module 2: 8L

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation corresponding algorithms and complexity analysis. ADT queue,

Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3: 8L

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4: 8L

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested books:

1. Data Structures & Algorithms using C, R.S. Salaria, Khanna Publishing House, New Delhi, 2018.

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“Fundamentals of Data Structures”, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. “How to Solve it by Computer”, 2nd Impression by R.G. Dromey, Pearson Education.
3. Expert Data Structures with C, R. B. Patel, Khanna Publishing House, New Delhi

Course outcomes

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

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BS-M301	Probability and Statistics	3L:0T: 3P	3 credits
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Module 1: Basic Probability: 8L

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Module 2: Continuous Probability Distributions: 4L

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3: Bivariate Distributions: 4L

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Basic Statistics: 6L

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression - Rank correlation.

Module 5: Applied Statistics: 6L

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Module 6: Small samples: 4L

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Suggested Text/Reference Books

- (i) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- (ii) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
- (iii) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
- (iv) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968. (v) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
- (vi) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
- (vii) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010. (viii) Chandrika Prasad & Reena Garg, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi, 2018.
- (ix) Manish Sharma & Amit Gupta, Business Statistics, Khanna Book Publishing Company, New Delhi, 2012.

Course Outcomes

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

The students will learn:

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- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.

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- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.

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MC381	Environmental Science	0L:0T: 2P	0 credits
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Purpose: We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times.

Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

- i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste ii) Slogan making event iii) Poster making event iv) Cycle rally
- v) Lectures from experts

(b) Actual Activities:

- i) Plantation
- ii) Gifting a tree to see its full growth iii) Cleanliness drive
- iv) Drive for segregation of waste
- v) To live some big environmentalist for a week or so to understand his work vi) To work in kitchen garden for mess vii) To know about the different varieties of plants viii) Shutting down the fans and ACs of the campus for an hour or so

Assessment:

1. Attendance: 15 2. Assignment: 15 3. Posters : 15 4. Participation in events: 25 5. Assesment by Teacher: 40

Grading: >90% : O

80-90%: E 70-80%: A 60-70%: B 40-60%: C Below 40%: D

Suggested Text/Reference Books

M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House, New Delhi, 2019

EC391	Electronics Devices Lab	0L:0T:2P	1 credits
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1. identifying and study of different components like resistor, capacitors, diodes, LED, Transistors, FET(JFET & MOSFET) etc
2. Study of different instruments used in the laboratories like, power supply, Oscilloscope, Multimeter etc.
3. CHARACTERISTICS OF PN JUNCTION DIODE
 - a) To Plot the Volt Ampere Characteristics of PN Junction Diode under Forward and Reverse Bias Conditions.
 - b) To find the Cut-in voltage, Static Resistance, Dynamic Resistance for Forward Bias & Reverse Bias

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4. CHARACTERISTICS OF ZENER DIODE & LOAD REGULATION
 - a) To Obtain the Forward Bias and Reverse Bias characteristics of a Zener diode.
 - b) Find out the Zener Break down Voltage from the Characteristics.
 - c) To Obtain the Load Regulation Characteristics.
5. COMMON BASE BIPOLAR TRANSISTOR CHARACTERISTICS
 - a) To plot the Input and Output characteristics of a transistor connected in Common Base Configuration and to find the h – parameters from the characteristics.
6. COMMON EMITTER BIPOLAR TRANSISTOR CHARACTERISTICS
 - a) To plot the Input and Output characteristics of a transistor connected in Common Emitter Configuration and to find the h – parameters from the characteristics
7. DESIGN SELF BIAS BJT CIRCUIT
8. JFET DRAIN & TRANSFER CHARACTERISTICS (COMMON SOURCE)
 - a) Drain characteristics
 - b) Transfer Characteristics.
 - c) To find r_d , g_m , and μ from the characteristics.
9. Study Characteristics of Photo transistor
10. Study Characteristics of LED & LDR

Course Outcome

- a) An ability to verify the working of different diodes, transistors, CRO probes and measuring instruments. Identifying the procedure of doing the experiment.
- b) Ability to understand the characteristics of BJT and FET and how to Determine different parameters for designing purpose..
- c) Ability to understand properties of photoelectric devices
- d) Ability to measure and record the experimental data, analyze the results, and prepare a formal laboratory report.

EC392	Digital System Design Lab	0L:0T:2P	1 credits
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1. Introduction to Digital Electronics Lab- Nomenclature of Digital Ics, Specifications, Study of the Data Sheet, Concept of Vcc and Ground, Verification of the Truth Tables of Logic Gates using TTL ICs.
2. Implementation of the Given Boolean Function using Logic Gates in Both Sop and Pos Forms.
3. Verification of State Tables of Rs, J-k, T and D Flip-Flops using NAND & NOR Gates
4. Implementation and Verification of Decoder/De-Multiplexer and Encoder using Logic Gates.
5. Implementation of 4x1 Multiplexer using Logic Gates.
6. Implementation of 4-Bit Parallel Adder Using 7483 IC.
7. Design , and Verify the 4- Bit Synchronous Counter
8. Design, and Verify the 4-Bit Asynchronous Counter.

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9. Simulation of MOS Inverter with different loads using PSPICE software
10. Simulation of CMOS Inverter for different parameters K_n , K_p as a design variable in suitable circuit simulator software.
11. Design of a 4-bit Multiplexer using VHDL\Verilog
12. Design of a decade counter using VHDL\Verilog.
13. Design of a 3-input NAND gate and its simulation using suitable logic simulator

Book List

1. Douglas L.Perry, "VHDL: Programming by Example", McGraw-Hill, 2002.
2. Charles H. Roth, Lizy Kurian John, "Digital systems design using VHDL", Thomson, 2008.

ES-CS391	Data Structure & Algorithm Lab.	0L:0T:2P	1 credits
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Experiments should include but not limited to :

Implementation of array operations:

Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements

Merging Problem : Evaluation of expressions operations on Multiple stacks & queues :

Implementation of linked lists: inserting, deleting, and inverting a linked list. Implementation of stacks & queues using linked lists:

Polynomial addition, Polynomial multiplication Sparse

Matrices : Multiplication, addition.

Recursive and Nonrecursive traversal of Trees

Threaded binary tree traversal. AVL tree implementation

Application of Trees. Application of sorting and searching algorithms

Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.