Vidyasagar University

Curriculum for B.Sc. Honours in Electronics

[Choice Based Credit System]

Semester-I

Sl.No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C1	**C1T:** Basic Circuit Theory and Network Analysis	Core Course-1		4	0	0	6	75
	C1P: Basic Circuit Theory and Network Analysis	Core Course1 [Practical]		0	0	4		
C2	**C2T:** Mathematics Foundation for electronics	Core Course-2		4	0	0	6	75
	C2P: Mathematical Foundation for electronics labs	Core Course-2 [Practical]		0	0	4		
GE-1	GE-1	GE					4/5	75
	GE-1	GE					2/1	
AECC	English	AECC					2	50
				Total credits =20				

L= Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: English /Modern Indian Language

Interdisciplinary/Generic Elective (GE) from other Department

[**Four papers are to be taken and each paper will be of 6 credits**]:

(Papers are to be taken from any of the following discipline (**Preferable GE-1 from Mathematics**)

Mathematics/Physics/Chemistry/Computer Science/Statistics/Geology/Biotechnology/Economics

Semester -1

Core Course

Core -1

CC-1: Basic Circuit Theory and Network Analysis **Credits 06**

C1T1 - Basic Circuit Theory and Network Analysis **Credits 04**

Lecture hours: 48 - 56

Pre-requisites: Class 11 & 12 knowledge of Ohm's Law, Kirchhoff's Law, Electrostatics and Laws of Electromagnetism. Basic concept of scalers and vectors

Basic Circuit Concepts: **08-10 Lectures**

Circuit elements- different types of resistors, inductors and capacitors – identification and classification based on construction.

Ideal and practical voltage and current sources.

Dependent sources.

Circuit Analysis and DC transient: **12-14 Lectures**

Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Linear Circuits, Superposition Theorem, Thevenin's Theorem, Norton's Theorem,

Principle of Duality, Star-Delta Conversion (Concept only)

Transient response of RL, RC and RLC Circuit under DC excitation

AC Circuit Analysis: **14-16 Lectures**

Sinusoidal energy source, Phasor relationships of RL, RC circuits.

Power in AC Circuits: True and apparent power, concept of wattles component , Power factor.

Series and Parallel RLC Circuits: Resonance, Frequency Response, Quality (Q) Factor and Bandwidth.

Wave shaping by RC circuits: Concept of Filters, Integrator, differentiator.

Network Theorems: **14-16 Lectures**

Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.

AC circuit analysis using Network theorems.

Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.

Network Graph Theory: equivalent graph, incidence matrix, fundamental Tie-Set/cut-set

Minimum Learning Outcome: Student should be able to -

Identify and measure circuit elements

Relate circuit elements and measuring instruments to basic laws of electrostatics and magneto statics learnt at the 10+2 level.

Analyse and calculate circuit parameters under DC and AC excitation.

Reference Books:

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)

2. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)

3. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata Mc) Graw Hill(2005)

4. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

5. A Bruce Carlson, Circuits, Cengage Learning

6. Kuo Network Analysis and Synthesis,Wiley India

7. Dorf Introduction to Electric Circuits,Wiley India

8. Decarlo Lin Linear Circuit Analysis, Oxford

9. Ghosh, Network Theory: Analysis and Synthesis,PHI

C1 P1: Basic Circuit Theory and Network Analysis Credits 02

Credit: 2

Pre-requisite: *Knowledge of passive circuit components and Network theorems*.

1. Familiarization with:

- **a.** Resistance in series, parallel and series – Parallel.
- **b.** Capacitors & Inductors in series & Parallel.
- **c.** Multimeter – Checking of components.
- **d.** Voltage sources in series, parallel and series – Parallel
- **e.** Voltage and Current dividers

2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchoff's Law.
4. Verification of Norton's theorem.
5. Verification of Thevenin's Theorem.
6. Verification of Superposition Theorem.
7. Verification of the Maximum Power Transfer Theorem.
8. RC Circuits: Time Constant, Differentiator, Integrator.
9. Designing of a Low Pass RC Filter and study of its Frequency Response.
10. Designing of a High Pass RC Filter and study of its Frequency Response.
11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

Core-2

CC-2: Mathematics Foundation for Electronics Credits 06

C2T2 - Mathematics Foundation for Electronics

Credit: 5 **Lecture hours: 58 - 68**

Pre-requisites: Basic idea of differential equation, complex plane, sequence and series taught in school in classes 11 and 12.

Ordinary Differential Equation &Series solution of differential equations and special functions: 14-16 Lectures

First Order Ordinary Differential Equations, Basic Concepts and different types of Differential Equations. Second Order homogeneous and non-homogeneous Differential Equations.

Different solution techniques as applied to physical problems- like thermal, hydraulic, electrical systems.

Solution by Power series method.

Error functions and gamma function.

Matrices: 12 -14 Lectures

Introduction to Matrices, Different techniques for solution of a System of Linear Algebraic Equations. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Classification of different types of Real and Complex Matrices.

Sequences and series: 06 -08 Lectures

Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series- conditions and methods.

Complex Variables and Functions: **12 – 14 Lectures**

Complex Variable, Complex Function, Continuity, Differentiability, Analyticity. Different types of functions. Line Integral in Complex Plane, Sequences, Series and Power Series, Taylor's Series, Laurent Series, Zeroes and Poles. Residue integration method.

Laplace: **14-16 Lectures**

Laplace Transform-Properties , Transform of different signals ,inverse transform, application in Circuit Analysis - Equivalent circuit of inductor, capacitor in s-domain

Minimum learning Outcome :

Student should acquire the capability to:

1. Classify a physical problem in mathematical terms,
2. Choose appropriate solution methodology and sole it.

Reference Books

1. E. Kreyszig, advanced engineering mathematics, Wiley India (2008)
2. Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables,
3. Schaum Outline Series, Tata McGraw Hill (2007)
4. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)
5. Pal & Bhunia, Engineering Mathematics, Oxford
6. Garg / Gupta, Engineering Mathematics Volume I & II Pearson
7. Dass H.K./Verma Rama Higher Engineering Mathematics S Chand
8. John Bird Engineering Mathematics

C2P2: Mathematical Foundation for electronics labs/Tutorial

Credit: 01

Pre-requisite: *Knowledge of Scilab/MatLAB/ Other Mathematical Computational software*

1. Solution of First Order Differential Equations.
2. Solution of Second Order homogeneous Differential Equations.
3. Solution of Second Order non-homogeneous Differential Equations.
4. Convergence of a given series.
5. Divergence of a given series.
6. Solution of linear system of equations using Gauss Elimination method.
7. Solution of linear system of equations using Gauss – Seidel method.

General Elective Syllabus

GE-1 [Interdisciplinary for other department]

GE-1: Electronic Circuits and PCB Designing (Theory) Credits 06

GE-1T: Electronic Circuits and PCB Designing (Theory) Credits 04

Lecture hours: 46-56

Pre-requisites:Basic idea of AC & DC circuits and circuit Components

Network theorems (DC analysis only):

8-10 Lectures

Review of Ohms law, Kirchhoff's laws, voltage divider and current divider theorems, open and short circuits.

Thevenin's theorem, Norton's theorem and interconversion, superposition theorem, maximum power transfer theorem.

Semiconductor Diode and its applications and Zener diode regulator

12-14 Lectures

Semiconductor Diode and its applications: PN junction diode and characteristics, ideal diode and diode approximations. Block diagram of a Regulated Power Supply, Rectifiers: HWR, FWR- center tapped and bridge FWRs. Circuit diagrams, working and waveforms, ripple factor & efficiency(no derivations).Filters: circuit diagram and explanation of shunt capacitor filter with waveforms.

Zener diode regulator: circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.

BJT & Small Signal amplifier, Transistor biasing, Voltage divider bias and Small Signal CE amplifier 14-18 Lectures

BJT and Small Signal amplifier: Bipolar Junction Transistor: Construction, principle & working of NPN transistor, terminology. Configuration: CE, CB, CC. Definition of α, β and γ and their interrelations, leakage currents. Study of CE Characteristics, Hybrid parameters.

Transistor biasing: need for biasing, DC load line, operating point, thermal runaway, stability and stability factor.

Voltage divider bias: circuit diagrams and their working, Q point expressions for voltage divider biasing.

Small signal CE amplifier: circuit, working, frequency response, re model for CE configuration, derivation for Av, Zin and Zout.

Types of PCB, Layout and Artwork, Basic Artwork, Laminates and Photo printing, Etching and Soldering **12-14 Lectures**

Types of PCB ,Plated through holes technology, Surface Mount Technology (SMT).

Layout and Artwork: Layout Planning: General rules of Layout, Supply and Ground Conductors, Component Placing and mounting, Cooling requirement and package density, Layout check.

Basic artwork approaches, Artwork taping guidelines, General artwork rules: Artwork check and Inspection.

Laminates and Photoprinting: Properties of laminates, Types of Laminates, Manual cleaning process, Basic printing process for double sided PCB's, Photo resists, wet film resists, Coating process for wet film resists, Dry film resists

Etching and Soldering: Introduction, Etching machine, Etchant system. Principles of Solder connection, Solder joints, Solder alloys, Soldering fluxes. Soldering, Desoldering tools and Techniques.

Minimum Learning Outcome :Students should be able to :

(i) Do DC analysis of a circuit.
(ii) Learn how to construct a simple regulator and amplifier
(iii) Design a PCB of a simple circuit

Reference Books

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronics text lab manual, Paul B. Zbar.
3. Electric circuits, Joeseph Edminister, Schaum series.
4. Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshresta and D.C Gupta -TMH.
5. Electronic devices, David A Bell, Reston Publishing Company/DB Tarapurwala Publ.
6. Walter C.Bosshart "PCB DESIGN AND TECHNOLOGY" Tata McGraw Hill Publications, Delhi. 1983
7. Clyde F.Coombs "Printed circuits Handbook" III Edition, McGraw Hill.

GE-1 P1: Electronic Circuits and PCB Designing Lab (Practical)

(Credit: 02)

Pre-requisite: Knowledge of circuit components and Network theorems.

1. Verification of Thevenin's theorem.
2. Verification of Super position theorem.
3. Verification of Maximum power transfer theorem.
4. Half wave Rectifier – without and with shunt capacitance filter.
5. Centre tapped full wave rectifier – without and with shunt capacitance filter.
6. Zener diode as voltage regulator – load regulation.

7. Transistor characteristics in CE mode – determination of r_i, r_o and β.
8. Design and study of voltage divider biasing.
9. Designing of an CE based amplifier of given gain.
10. Designing of PCB using artwork, its fabrication and testing.
11. Design, fabrication and testing of a 9 V power supply with zener regulator.

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Semester-II

Sl.No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C3	**C3T:** Applied Physics	Core Course-3		4	0	0	6	75
	C3P: Applied Physics Lab	Core Course-3 [Practical]		0	0	4		
C4	**C4T:** C Programming and Data Structures	Core Course-4		4	0	0	6	75
	C4P: C Programming and Data Structures (Lab)	Core Course-4 [Practical]		0	0	4		
GE-2	GE-2	GE					4/5	75
	GE-2	GE					2/1	
AEC C-2	Environmental Studies	AECC					4	100
				Total credits =22				

L= Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: Environmental Studies.

Interdisciplinary/Generic Elective (GE) from other Department
[**Four papers are to be taken and each paper will be of 6 credits**]:
(Papers are to be taken from any of the following discipline (**GE-2 from Mathematics**)**Mathematics/Physics/Chemistry/Computer Science/Statistics/Geology /Biotechnology/Economics**

Semester -II

Core -3

CC-3:Applied Physics — Credits 06

C3T Applied Physics — Credits 04

Lecture hours: 60 – 72

Pre-requisite: Knowledge of school level (class 11 & 12) Physics on Classical Mechanics, Newton's Laws, Basic Electricity, Electrostatics, Electronics, Crystal structure & Atomic structure.

Physics of Crystalline Solids: **06-08 Lectures**

Crystalline materials: Crystal Structure in solids, Concept of Lattice, Basis, Crystal axes and planes, Reciprocal lattice, Primitive cells.
Bonding in solids: Metallic bonds, Ionic bonds, Covalent bonds

Introduction Quantum Concepts: **16-18 Lectures**

Inadequacies of Classical physics (in relevance to) electron diffraction experiment, Compton's effect, Photo-electric Effect, Plank's Law etc. Introduction to Wave particle duality and Heisenberg's Uncertainty Principle.
Basic postulates and formalism of quantum mechanics: Schrodinger wave equation, Eigen-values and Eigen functions in different cases; Tunnelling,
Potential barrier problems [free electron, electron in an infinite well], Kronig-Penney Model and development of band structure.
E-k diagram in solids, classification of conductors, insulators and semi-conductors.

Mechanical Properties of Materials: **04-06 Lectures**

Mechanical Properties: Concept of Elastic and Plastic Deformations, Elastic Moduli, Brittle and Ductile Materials, Tensile Strength.

Thermal Properties: **10-12 Lectures**

Specific heat in solids, Phonons, Heat Capacity, Debye's Law, Basic concept of Thermoelectricity.
Thermodynamics: Laws of Thermodynamics, Concept of Entropy, Thermodynamic potentials, Helmholtz free energy, Enthalpy function, Gibb's free energy, Chemical potential. Relation of chemical potential with Fermi level.

Statistical Mechanics: **10-12 Lectures**

Macroscopic and Microscopic States: Concept of Phase space and Density of states. Statistical interpretation of entropy.
Quantum Statistics: Quantization of phase space. Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution functions and their importance.

Electric and Magnetic Properties: **14-16 Lectures (including tutorials)**
Basic concept of free electron theory and evolution to Quantum theory: Conductivity of metals, Ohm's Law, relaxation time, collision time and mean free path, electron scattering and resistivity of metals, Fermi level- relationship with carrier concentration, concept of Superconductivity.
Insulators: Dielectric properties, concepts of polarisation, permittivity, dielectric constant.
***Conductors*:** Bonding, conductivity, resistivity, relaxation time; scattering, heat developed in current carrying conductor.
***Insulators*:** Dielectric properties, concepts of polarisation, permittivity, dielectric constant.
***Semi-conductors*:** Bonding in elemental and compound semiconductors, Intrinsic, extrinsic, concept of holes, computation of carrier concentrations, Fermi level in semi-conductors, E-k diagrams to explain direct and in-direct band-gap semiconductors.

***Magnetic Materials*:** Magnetic moment, dia, para, ferro and antiferro magnetism, Ferrimagnetic materials, Curie temperature

Minimum learning Outcome:
Students will be made aware of the basic properties of materials –mechanical, thermal, magnetic and electrical.They will also learn the basic concepts of Thermodynamics.The students should be able to calculate the distribution function for the three statistics .They will develop a concept of density of states and Fermi level.

Reference Books

1. W.E.Callister , Material Science and Engineering Wiley India
2. Bransden Quantum Mechanics, 2e Pearson
3. Griffiths Introduction to Quantum Mechanics, 2e Pearson
4. Majumdar Quantum Mechanics in Physics and Chemistry with Applications to Biology, 2nd ed. PHI
5. Lokanathan & Gambhir, Statistical and Thermal Physics: An Introduction PHI
6. Eisberg, Quantum Physics of Atoms,Molecules, Solids, Nuclei
7. S.O.Pillai, Solid State Physics, New Age
8. S.Kasap, Principles of Electrical Engineering Materials and Devices, Mcgraw Hill
9. Roy Fundamentals of Classical and Statistical Thermodynamics, Wiley

C3 P: Applied Physics Lab Credits 02

Pre-requisite: *Knowledge of programming language (C/ Mat Lab/Sci lab)*

1. To measure the resistivity of a Si crystal with temperature by four – probe method from room temperature to 200 ^{O}C).
2. To determine the value of Boltzmann Constant by studying forward characteristics of diode.
3. To determine the value of Planck's constant by using LEDs of at least 4 different wavelengths.
4. Simulation Studies.
   (i) Find lowest Energy Eigen values for1-D Schrodinger equation.
   (ii) Plotting tunnelling probability as a function of barrier width.
   (iii) Plot Energy Band-diagram corresponding to different potential profile.

Core -4

CC-4: C Programming and Data Structures Credits 06

C4 T: C Programming and Data Structures Credits 04

Lecture hours: 48-56

Pre-requisites: Basic idea of binary system, concept of searching and sorting algorithms

C Programming Language: 10-12 Lectures
Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program

Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators. Arrays-concepts, declaration, accessing elements, storing elements, two-dimensional and multi-dimensional arrays. Input output statement and library functions (math and string related functions)

Decision Making, branching & looping, Structures & Introduction to C++:
14-16 Lectures

Decision making, branching & looping: Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions, function arguments and passing, returning values from functions.
Structures: defining and declaring a structure variables, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions. Pointers.
Introduction to C++: Object oriented programming, characteristics of an object-oriented language

Data Structures: **12-14 Lectures**

Definition of stack, array implementation of stack, conversion of infix expression to prefix, postfix expressions, evaluation of postfix expression. Definition of Queue, Circular queues, Array implementation of queues. Linked List and its implementation, Link list implementation of stack and queue, Circular and doubly linked list

Searching and Sorting: **12-14 Lectures**

Searching and sorting: Insertion sort, selection sort, bubble sort, merge sort, linear Search, binary search. Trees : Introduction to trees, Binary search tree, Insertion and searching in a BST, preorder, postorder and inorder traversal (recursive)

Minimum learning Outcome:

Students should be able to independently write programs for solving problems related to mathematical functions using different data structures.

Reference Books

1. Yashavant Kanetkar, Let Us C, BPB Publications
2. Programming in ANSI C, Balagurusamy, 2nd edition, TMH.
3. Byron S Gottfried, Programming with C, Schaum Series
4. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall
5. Yashavant Kanetkar, Pointers in C, BPB Publications
6. Tanenbaum: “Data Structures using C”, Pearson/PHI.
7. Ellis Horowitz and Sartaz Sahani “Fundamentals of Computer Algorithms”, Computer Science Press.
8. Ghosh All of C PHI
9. Samanta, Classic Data Structures, 2nd ed. • (CD)
10. Thareja, Data Structure Using C, ,2E Oxford
11. Thareja, Introduction to C Programming, 2/E Oxford

C4P : C Programming and Data Structures (Lab) **Credits 02**

Pre-requisite : Knowledge of different data structures and series representation of functions.

The list of programs given below is indicative only. Students should do programs which make use of the different programming techniques and data structures.

1. Generate the Fibonacci series up to the given limit N and also print the number of elements in the series.
2. Find minimum and maximum of N numbers.
3. Find the GCD of two integer numbers.
4. Calculate factorial of a given number.
5. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non – zero coefficients A, B and C. Else report error.
6. Calculate the value of sin (x) and cos (x) using the series. Also print sin (x) and cos (x) value using library function.
7. Generate and print prime numbers up to an integer N.
8. Sort given N numbers in ascending order.
9. Find the sum & difference of two matrices of order M×N and P×Q.
10. Find the product of two matrices of order M×N and P×Q.
11. Find the transpose of given M×N matrix.
12. Find the sum of principle and secondary diagonal elements of the given M×N matrix.
13. Calculate the subject wise and student wise totals and store them as a part of the structure.
14. Maintain an account of a customer using classes.
15. Implement linear and circular linked lists using single and double pointers.
16. Create a stack and perform Pop, Push, Traverse operations on the stack using Linear Linked list
17. Create circular linked list having information about a college and perform Insertion at front, Deletion at end.
18. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
19. Implement polynomial addition and subtraction using linked lists.
20. Implement sparse matrices using arrays and linked lists.
21. Create a Binary Tree to perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
22. Implement binary search tree using linked lists. Compare its time complexity over that of linear search.
23. Implement Insertion sort, Merge sort, Bubble sort, Selection sort.

Generic Elective Syllabus
GE-2 [Interdisciplinary for other department]

GE2 : Digital System Design (Theory) **Credits 06**

GE2 T - Digital System Design (Theory) **Credits 04**

Lecture hours: 50-56

Pre-requisites: **Basic ideas of BJT and MOSFET as switch taught in previous semester in paper Semiconductor Devices..**

Number Systems and Boolean Algebra **12-14 Lectures**

Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction, Gray Codes

Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Boolean laws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and

4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay, comparison of TTL and CMOS families

Combinational Logic **12 Lectures**

Combinational logic analysis and design: Multiplexers and Demultiplexers, Adder (half and full) and their use as subtractor, Encoder and Decoder, Code Converter (Binary to BCD and vice versa)

Sequential Logic **12-14 Lectures**

Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs, registers, Counters (ripple, synchronous and asynchronous, ring, modulus)

VHDL **14-16 Lectures**

VHDL: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches.

VHDL: Module, Delays, brief description - data flow style, behavioral style, structural style, mixed design style, simulating design.

Language Elements, Introduction, Keywords, Identifiers, White Space Characters, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Operands, Operators, types of Expressions

Gate level modeling, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

Minimum learning Outcome:

Student will learn to master the following:

1. Handle different types of numbers and their manipulation.
2. Perform Boolean arithmetic.
3. Analyse Truth Table/Transition Table and design digital circuits.
4. Map memories.
5. Simulate simple Logic circuits using VHDL

Reference Books

M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)

Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)

W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)

R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

A Verilog HDL Primer – J. Bhasker, BSP, 2003 II Edition

Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

GE2P: Digital System Design Lab Credits 02

Pre-requisite: Knowledge of digital circuits and VHDL language.

Hardware and Circuit Simulation Software

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a seven segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.

9. Design a shift register and study Serial and parallel shifting of data.

VHDL

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Clocked D FF, T FF and JK FF (with Reset inputs).
5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design and simulation of a 4 bit Adder.
8. Code converters (Binary to Gray and vice versa).
9. 2 bit Magnitude comparator.
10. 3 bit Ripple counter.

Vidyasagar University

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[Choice Based Credit System]

Semester-III

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC-5		**C5T:**Semiconductor Devices	Core Course - 5	4	0	0	6	75
		C5P: Semiconductor Devices		0	0	4		
CC-6		**C6T:**Electronic Circuits	Core Course - 6	4	0	0	6	75
		C6P: Electronic Circuits		0	0	4		
CC-7		**C7T:**Electromagnetic Theory	Core Course - 7	4	0	0	6	75
		C7P: Electromagnetic Theory		0	0	4		
GE-3		**TBD**	Generic Elective -3				4/5	75
							2/1	
SEC-1		**SEC1 :** Design and Fabrication of Printed Circuit Boards **Or** **SEC1 -** Mobile Application Programming	Skill Enhancement Course-1	1	1	0	2	50
Semester Total							**26**	**350**

L=Lecture, **T=** Tutorial, **P=**Practical, **CC =** Core Course, **GE**= Generic Elective, **SEC** = Skill Enhancement Course, **TBD =** to be decided

Generic Elective (GE) (Interdisciplinary) from other Department [**Four papers are to be taken and each paper will be of 6 credits**]:

Papers are to be taken from any of the following discipline:

Mathematics/Physics/Chemistry/Computer Science/Statistics/Geology/Biotechnology/Economics

Modalities of selection of Generic Electives (GE): A student shall have to choose **04** Generic Elective (GE1 to GE4) strictly from **02** subjects / disciplines of choice taking exactly **02** courses from each subjects of disciplines. Such a student shall have to study the curriculum of Generic Elective (GE) of a subject or discipline specified for the relevant semester.

Semester –III
Core Course (CC)

Core-5: Semiconductor Devices — Credits 06

C5T: Semiconductor Devices — **Credits 04**
Lecture hours: 48 – 58

Pre-requisite: (Core paper **Applied Physics**) Basic Quantum concepts, Fermi-Dirac statistics, Different types of materials i.e., conductors, insulators and semiconductors, basic idea of p and n type

Semiconductor Basics: **12-14 Lectures**

Introduction to Semiconductor Material: Elemental & Compound semiconductors, Direct and indirect bandgap semiconductors, Intrinsic & extrinsic semiconductors, Carriers in semiconductors. Concept of Effective Mass, Density of States, Carrier Concentration and relation with position of Fermi Level and doping, Temperature Dependence of Carrier Concentrations; Charge neutrality condition, degenerate and non-degenerate semiconductors
Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation And Recombination Processes, Continuity Equation.

Physics of Junctions: **12-14 Lectures**

Homojunction & Heterojunction; Metal-metal contact; Metal-semiconductor contact (both Ohmic & Schottky junction).

***Semiconductor-semiconductor Homojunction*:** Depletion Layer at the junction, Junction in presence and absence of field, Thermal Equilibrium, Junction capacitance; Junction breakdown.

PN junction diode: Current-voltage Characteristics; DC and AC equivalent circuit (Eber's-Moll equation and Charge balance equation)

Application of Junction properties: Varactor diode, Solar cell; Zener diode.

Bipolar Junction Transistors (BJT): **10-12 Lectures**

BJT as a current control device, Basic Transistor Action, Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base- Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.

Field Effect Transistors: **10-12 Lectures**

Transverse Field Effect & Channel isolation, Categories of FETs.

JFET: Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics.

MOSFET: MOS capacitor, Channel formation, Threshold voltage (ideal & real), Current-voltage relation, Depletion & Enhancement type MOSFET; Complimentary MOS (CMOS).

Power Devices: **04-06 Lectures**

UJT, Basic concept,
SCR, Basic working principle and Characteristics; Triac, Diac,

Minimum Learning Outcome*:* Student should be able to do the following:

1. Calculate carrier concentration and relate it to Fermi Level position, Calculate current components and different coefficients from given data.
2. Draw energy-diagrams for band-bending in all junctions, calculate built-in potentials, junction capacitances, space charge etc.
3. Draw equivalent circuits with all junction circuit components.
4. Explain transistor action & calculate current and other transistor parameters,
5. Differentiate between large and small signal behavior;
6. Explain I-V characteristics of the BJT for different modes of operation.
7. Explain concept of channel modulation and voltage control concepts,
8. Solve Poisson's equation for specific cases;
9. Identify different regions of the I-V curve and identify the dominant current components in each region;
10. Explain the working of CMOS, its advantages and pull-up and pull-down phenomena.
11. Explain the working of Power devices; identify their differences.

Reference Books

1. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
2. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
3. Dennis Le Croissette, Transistors, Pearson Education (1989)
4. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
5. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)
6. Dimitrijev, Principles of Semiconductor Devices, Oxford
7. Neamen, Semiconductor Physics & Devices, Tata McGraw Hill
8. Dutta, Semiconductor Devices & Circuits, Oxford
9. Hu, Modern Semiconductor Devices for Integrated Circuits, Pearson

C5P: Semiconductor Devices Lab **Credit: 02**

Pre-requisite: *Knowledge of working principle of semiconductor devices (diode, transistor, SCR, UJT)*

1. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
2. Study of the I-V Characteristics of the CE configuration of BJT and obtain r_i, r_o, β.
3. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtainr_i, r_o, α.
4. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, r_i, r_o.
5. Study of the I-V Characteristics of the UJT.
6. Study of the I-V Characteristics of the SCR.
7. Study of the I-V Characteristics of JFET.
8. Study of the I-V Characteristics of MOSFET.

9. Study of Characteristics of Solar Cell
10. Study of Hall effect/measurement of temperature sensitivity of carrier concentration

CC-6: Electronic Circuits Credits 06

C6T: Electronic Circuits **Credit: 04**
Lecture hours: 48-56

Pre-requisites: Papers **Circuit Theory** taught in previous semester and basic concept of the characteristics and working of semiconductor devices.

Diode Circuits: **12 - 14 Lectures**
Piece-wise linear characteristics of diode, dc load line analysis, Quiescent (Q) point.
Clipping and clamping circuits.
Rectifiers – DC power supply, Regulation, Filters.

Circuits using Bipolar Junction Transistor: **12-14 Lectures**
Review of CE, CB Characteristics and regions of operation. Hybrid parameters./r_e model
Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor.
Transistor as a switch;
Types of Amplifier, BJT in an amplifier circuit: Voltage and Power amplifier, Classes of amplifiers, BJT amplifiers.

Feedback Amplifiers: **12 - 14 Lectures**
Concept of feedback, negative and positive feedback, Types of feedback circuits
Barkhausen criteria for oscillations, Oscillators;
Regulated power supply: series and shunt (using BJT)

MOSFET Circuits: **12-14 Lectures**
Review of Depletion and Enhancement MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits.
Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits.

Minimum learning Outcome:
1. Students should be able to analyze the circuits containing active elements.
2. Compare relative merits of different biasing techniques.
3. Understand of merits and application areas of different classes of amplifiers.

Reference Books

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronic devices, David A Bell, Reston Publishing Company
3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)

5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill
7. (1991)
8. Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation
9. Sedra, Microelectronic Circuits, 6/E Oxford
10. Bogart Electronic Devices and Circuits, 6e Pearson
11. Jyoti Prasad Bandyopadhyay, Solid State Electronics Devices Vikas Publication

C6P: Electronics Circuit Lab **Credit 02**

Pre-requisite: *Knowledge of working principle of linear active circuits (rectifier, power supply, oscillator)*

Hardware and circuit Simulation software

1. Study of the Half-wave rectifier and Full-wave rectifier.
2. Study of power supply using C filter and Zener diode.
3. Designing and testing of 5 V / 9 V DC regulated power supply and find its load-regulation.
4. Study of clipping and clamping circuits.
5. Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors.
6. Designing of a Single Stage CE amplifier.
7. Study of Class A, B and C Power Amplifier.
8. Study of the Colpitt's Oscillator.
9. Study of the Hartley's Oscillator.
10. Study of the Phase Shift Oscillator
11. Study of the frequency response of Common Source FET amplifier.

CC-7: Electromagnetic Theory **Credits 06**

C7T: Electromagnetic Theory **Credit: 04**
Lecture hours: 48-56

Pre-requisites*:* Knowledge of basic laws of electrostatics, magneto statics and laws of electromagnetic induction.

Vector Analysis, Poisson's Equation and Laplace Equation 10-12 Lectures
Vector Analysis: Scalars and Vectors, Vector Algebra and Operators in different coordinate systems;
Poisson's Equation and Laplace's Equation: Derivation of Poisson's and Laplace's equation, Uniqueness Theorem, Examples of Solution of Laplace's Equation: Cartesian, Cylindrical and Spherical Coordinates.

Electrostatics 10-12 Lectures
Laws of Electrostatics their applications; Electric Potential for different charge distributions, Electric Fields in different materials; Polarization, Dielectric Constant, Isotropic and Anisotropic dielectrics, Boundary conditions, Capacitance and Capacitors. Electrostatic Energy and Forces. Energy density.

Magnetostatics **10-12 Lectures**

Laws of Magnetostatics and their applications; Magnetic Flux; Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Anisotropic materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits. Inductances and Inductors, Magnetic Energy, Forces and Torques.

Time-Varying Fields and Maxwell's Equations **10-12 Lectures**

Faraday's Law of Electromagnetic Induction, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell's Equations in differential and integral form and Constitutive Relations. Potential Functions, Lorentz gauge and the Wave Equation for Potentials, Retarded Potentials (basic concepts).

Electromagnetic Wave Propagation **10-12 Lectures**

Electromagnetic Wave Propagation: Time-Harmonic Electromagnetic Fields; Electromagnetic Spectrum, Wave Equation in a source free isotropic homogeneous media, Uniform Plane Waves in Lossless and Lossy unbounded homogeneous media, Wave Polarization, Concept of Phase and Group velocity, Electromagnetic Power (Poynting Vector).

Guided Electromagnetic Wave Propagation: Waves along Uniform Guiding Structures, TEM, TE and TM waves, Electromagnetic Wave Propagation in Parallel Plate and Rectangular Metallic Waveguides.

Minimum learning Outcome:

Students should be able to apply the basic laws of electrostatics and magnetostatics to find fields for different charge and current distributions; understand the basic principles of electromagnetic wave propagation through free space and guided media

Reference

1. Murray. R. Spiegel, Vector Analysis, Schaum series, Tata McGraw Hill (2006)
2. Nathan Ida Engineering Electromagnetics Springer
3. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press (2001)
4. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
5. D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
6. J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
7. N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Edu, (2006)
8. Introduction to Electrodynamics, D.J. Griffiths, Pearson Education (2012)

C7P: Electromagnetics Lab **Credit : 02**

Pre-requisite: Knowledge of Scilab/any other similar freeware

1. Understanding and Plotting Vectors.
2. Transformation of vectors into various coordinate systems.
3. 2D and 3D Graphical plotting with change of view and rotation.
4. Representation of the Gradient of a scalar field, Divergence and Curl of Vector Fields.
5. Plots of Electric field and Electric Potential due to charge distributions.
6. Plots of Magnetic Flux Density due to current carrying wire.
7. Programs and Contour Plots to illustrate Method of Images
8. Solutions of Poisson and Laplace Equations – contour plots of charge and potential distributions

9. Introduction to Computational Electromagnetics: Simple Boundary Value Problems by Finite Difference/Finite Element Methods.

Skill Enhancement Course (SEC)

SEC1 : Design and Fabrication of Printed Circuit Boards Credits 02

SEC1T: Design and Fabrication of Printed Circuit Boards **Credits 02**
Lecture hours: 22-28

PCB Fundamentals **2-4 Lectures**
PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD).
Classification of PCB - single, double, multilayer and flexible boards, Manufacturing of PCB, PCB standards.

Schematic & Layout Design: **8-10 Lectures**
Schematic diagram, General, Mechanical and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for library, Tracks, Pads, Vias, power plane, grounding.

Technology OF PCB: **10-12 Lectures**
Design automation, Design Rule Checking; Exporting Drill and Gerber Files; Drills; Footprints and Libraries Adding and Editing Pins, copper clad laminates materials of copper clad laminates, properties of laminates (electrical & physical), types of laminates, soldering techniques. Film master preparation, Image transfer, photo printing, Screen Printing, Plating techniques etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing and quality controls.

PCB Technology: **2 Lectures**
Trends, Environmental concerns in PCB industry.

Reference Books

1. Printed circuit Board – Design & Technology by Walter C. Bosshart, Tata McGraw Hill.
2. Printed Circuit Board – Design, Fabrication, Assembly & Testing, R.S. Khandpur, TATA McGraw Hill Publisher.

Or

SEC1 - Mobile Application Programming Credits 02

SEC 1T - Mobile Application Programming **Credits: 02**
Lecture Hours: 26-30

Introduction to Mobile Application Programming **4-6 Lectures**

Introduction: What is mobile Application Programming, Different Platforms, Architecture and working of Android, iOS and Windows phone 8operating system, Comparison of Android, iOS and Windows phone 8 functions)

Android **18-20 Lectures**

Android Development Environment: What is Android, Advantages and Future of Android, Tools and about Android SDK, Installing Java, Eclipse, and Android, Android Software Development Kit for Eclipse, Android Development Tool: Android Tools for Eclipse, AVDs: Smartphone Emulators, Image Editing,
Android Software Development Platform: Understanding Java SE and the Dalvik Virtual Machine, Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes, Launching Your Application: The AndroidManifest.xml File, Creating Your First Android Application.

Android Framework Overview: The Foundation of OOP, The APK File, Android Application Components, Android Activities: Defining the User Interface, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications, Content Providers: Data Management, Android Intent Objects: Messaging for Components, Android Manifest XML: Declaring Your Components.

Views and Layouts, Buttons, Menus, and Dialogs, Graphics Resources in Android: Introducing the Drawables, Implementing Images, Core Drawable Subclasses, Using Bitmap, PNG, JPEG and GIF Images in Android, Creating Animation in Android

Handling User Interface(UI) Events: An Overview of UI Events in Android, Listening for and Handling Events , Handling UI Events via the View Class, Event Callback Methods, Handling Click Events, Touch screen Events, Keyboard Events, Context Menus, Controlling the Focus.
Content Providers: An Overview of Android Content Providers, Defining a Content Provider, working with a Database.
Intents and Intent Filters: Intent, Implicit Intents and Explicit Intents, Intents with Activities, Intents with Broadcast Receivers
Advanced Android: New Features in Android 4.4.

iOS and Windows **4 Lectures**

iOS Development Environment: Overview of iOS, iOS Layers, Introduction to iOS application development.
Windows phone Environment: Overview of windows phone and its platform, Building windows phone application.

Reference Books

1. Beginning Android 4, Onur Cinar , Apress Publication
2. Professional Android 4 Application Development, Reto Meier, Wrox
3. Beginning iOS 6 Development: Exploring the iOS SDK, David Mark, Apress
4. Pradhan Composing Mobile App. Learn-Explore - Apply using Android Wiley
5. RAJKAMAL, MOBILE COMPUTING, 2/E Oxford
6. Professional Windows 8 Programming: Application Development with C# and XML, Allen Sanders and Kevin Ashley, Wrox Publication
7. Programming with Mobile Applications: Android, iOS, and Windows Phone 7 , Thomas Duffy, Course Technology, Cengage Learning 2013

Generic Elective Syllabus

GE-3 [Interdisciplinary for other department]

GE-3 : Instrumentation **Credits 06**

GE-3T : Instrumentation **Credits: 04**
Lecture hours: 50-56

Pre-requisites: **Basic knowledge of statistics, principle of moving coil instruments (class 12 level), digital system, phasor diagram, AC/DC behaviour of circuit elements**

DC and AC indicating Instruments: **8-10 Lectures**
Accuracy and precision, Types of errors, PMMC galvanometer, sensitivity, Loading effect, Conversion of Galvanometer into ammeter, Voltmeter and Shunt type ohmmeter, Multimeter.

Oscilloscopes and Signal Generators: **14-16 Lectures**
Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronisation, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).

Signal Generators: Audio oscillator, Pulse Generator, Function generators,
Transducers:
12 Lectures
Basic requirements of transducers, Transducers for measurement of non- electrical quantities: Types and their principle of working , measurement of Linear displacement, Acceleration, Flow rate, Liquid level, strain, Force, Pressure, Temperature.

Data Acquisition Systems and Bio-Medical Instrumentation **16-18 Lectures**
Data acquisition systems: Block diagram, brief description of preamplifier, signal conditioner, instrumentation amplifier, waveform generator, A/D and D/A converter blocks, computer controlled test and measurement system.
Bio-medical instrumentation: Bio-Amplifiers: Bio potentials - Bio-electricity - Necessity for special types of amplifiers for biological signal amplifications - Different types of Bio-OP - Amps. Electrodes for ECG, EEG, and EMG, block diagram of ECG and EEG systems, brief analysis of graphs.

Minimum learning Outcome:
Students will be able to

(i) gauge the capability of a measuring system, choose appropriate techniques for measurement of different parameters of a system.
(ii) Understand the basic working principles of different Bio=medical instrumentation system

Reference Books

- Electrical Measurement in Measuring Instruments. Goldwing E.W. and Widdies
- Electrical and Electronics Measurement and Instrumentation Sahwany A.K.

- Instrumentation devices and systems: Rangan, Sarma, Mani, TMH
- Instrumentation measurement and analysis: Nakra B C, Chaudry K K, TMH
- Handbook of biomedical instrumentation: Khandpur R S, TMH
- Measurement systems applications and design: Doeblin E O, McGraw Hill, 1990.
- Electron measurements and instrumentation techniques: Cooper W D and Helfric A D, PHI, 1989.
- Biomedical instrumentation and measurements: Leslie-Cromwell, Fred J Weibell, Erich A Pfieffer, PHI, 1994.
- Mechatronics – principles and applications, Godfrey C Onwubolu, Elsevier, 2006.des.

GE-3P: Instrumentation Lab **Credit: 02**

Pre-requisite: *Basic knowledge of, A/D conversion techniques, instrumentation amplifier, transducers and Bio-medical Instrumentation system (should be taught after module on Practical Electronics)*

1. Design of multi range ammeter and voltmeter using galvanometer.
2. To determine the Characteristics of resistance transducer – Strain Gauge (Measurement of Strain using half and full bridge).
3. To determine the Characteristics of LVDT.
4. To determine the Characteristics of Thermistors.
5. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
6. Characterization of bio potential amplifier for ECG signals.
7. Study on ECG simulator.
8. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator.
9. Study of pulse rate monitor with alarm system.
10. Measurement of respiration rate using thermistor /other electrodes.