Dr. Babasaheb Ambedkar Technological University, Lonere

B. Tech (VLSI Design & Technology Engineering)

Curriculum for Semester III [Second Year]

Sr. No.	Course Code	Course Title	Hours Per Week			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
1	BTBS301	Engineering Mathematics - III	3	1	-	20	20	60	100	4
2	BTVTC302	Electronic Device & Circuits	3	-	-	20	20	60	100	3
3	BTVTC303	Digital System Design	3	1	-	20	20	60	100	4
4	BTVTC304	Signals and Systems	3	-	-	20	20	60	100	3
5	BTVTC305	Network Theory	3	-	-	20	20	60	100	3
6	BTVTL306	Electronic Device & Circuits & Digital System Design Lab	-	-	2	60	-	40	100	2
7	BTVTS307	Seminar I	-	-	2	60	-	40	100	2
8	BTES211P	Internship - 1	-	-	-	-	-	-	-	Audit
		Total	**15**	**02**	**04**	**220**	**100**	**380**	**700**	**21**

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Curriculum for Semester IV [Second Year]

Sr. No.	Course Code	Course Title	Hours Per Week			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
1	BTVTC401	System Design through Verilog	3	1	-	20	20	60	100	4
2	BTVTC402	Microcontrollers and Computer Architecture	3	1	-	20	20	60	100	4
3	BTVTC403	Analog and Digital Communication	3	-	-	20	20	60	100	3
5	BTVTC404	Introduction to VLSI lifecycle	3	-	-	20	20	60	100	3
6	BTVTPE405	PEC-1	3	1	-	20	20	60	100	4
7	BTVTL406	System Design through Verilog & Microcontrollers Lab	-	-	4	60	-	40	100	2
8	BTVTS408	Seminar II	-	-	4	60	-	40	100	2
9	BTVTP409 (Internship – 2)	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in 3 sem & fourth semester or in at onetime).	-	-	-	-	-	-	-	Audit (evaluation will be in V sem)
		Total	**15**	**03**	**08**	**240**	**120**	**440**	**700**	**22**

PEC-1
(A) Probability Theory and Random Processes
(B) Analog Circuits
(C) Problem solving through programming in C
(D) Object oriented programming through C++

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Curriculum for Semester V [Third Year]

Sr. No.	Course Code	Course Title	Hours Per Week			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
1	BTVTC501	Electromagnetic Field Theory	3	1	0	20	20	60	100	4
2	BTVTC502	CMOS Design	3	1	0	20	20	60	100	4
3	BTVTC503	Embedded Systems	3	1	0	20	20	60	100	4
4	BTVTPE504	PEC-2	3	1	0	20	20	60	100	4
5	BTVTOE505	OEC-1	3	1	0	20	20	60	100	4
6	BTVTTL506	CMOS Design lab	-	-	4	60	-	40	100	2
7	BTVTM507	Mini Project – 1	-	-	4	60	-	40	100	2
8	BTVTP508	Internship – 2 Evaluation	-	-	-	-	-	-	-	Audit
9	BTHM509	UHV-II	3	-	0	20	20	60	100	3
Total			**18**	**5**	**8**	**240**	**120**	**440**	**800**	**27**

PEC-2	OEC-1
(A) Digital Signal Processing	(A) Micro-fabrication Semiconductor and Materials
(B) Control Systems Engineering	(B) Artificial Intelligence and Machine learning
(C) Compound Semiconductors	(C) Optimization Techniques
(D) SOC Design 1: Design & Verification	(D) Operational Research
	(E) IC Packaging

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Curriculum for Semester VI [Third Year]

Sr. No.	Course Code	Course Title	Hours Per Week			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
1	BTVTC601	VLSI Verification and Testing	3	1	-	20	20	60	100	4
2	BTVTC602	Semiconductor Equipment Design and Technology	3	1	-	20	20	60	100	4
4	BTVTPE603	PEC-III	3	1	-	20	20	60	100	4
5	BTVTOE604	OEC -II	3	1	-	20	20	60	100	4
6	BTHM605	Employability and Skill Development	3	-	-	60	-	40	100	3
7	BTVTL606	VLSI Verification and Testing lab	-	-	4	60	-	40	100	2
8	BTVTM607	Mini Project – 2	-	-	4	60	-	40	100	2
9	BTVTP608	Field Training // Internship /Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Audit
		Total	**15**	**4**	**8**	**220**	**100**	**380**	**700**	**23**

PEC-III	OEC-II
(A) FPGA Programming	(A) Computer Network
(B) Semiconductor Device Modeling	(B) Low Power VLSI Design
(C) Semiconductor Opto-electronics	(C) Patents and IPR
(D) Industrial Safety for the Semiconductor Industry	(D) Memory Design
(E) SOC Design 2: Design & Verification	(E) Research Methodology
(F) Mixed Signal Circuits	(F) Materials for Semiconductor Packaging

Dr. Babasaheb Ambedkar Technological University, Lonere

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Curriculum for Semester VII [Final Year]

Sr.	Course Code	Course Title	Hours Per Week			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
1	BTVTC701	Semiconductor Materials Synthesis and Characterization	3	1	0	20	20	60	100	4
2	BTVTPE702	PEC-IV	3	1	0	20	20	60	100	4
3	BTVTCOE703	OEC-IV	3	1	0	20	20	60	100	4
4	BTVTPE704	PEC-V	3	1	0	20	20	60	100	4
5	BTHM705	Engineering Economics and Financial Mathematics	3	1	0	20	20	60	100	4
6	BTHM706	Foreign Language Studies	–	–	4	60	-	40	100	2
7	BTVTL707	PEC Lab	–	–	4	60	-	40	100	2
8	BTVTM708	Mini Project – 3								
9	BTVTP709	Internship – 2 Evaluation	–	–	–	-	-	-	-	Audit
		Total	**15**	**5**	**8**	**220**	**100**	**380**	**700**	**24**

PEC-IV	OEC-IV	PEC-V
(A) Digital CMOS VLSI Design	(A) Wireless Sensor Networks	(A) Quantum Mechanics for Engineers
(B) Hardware Software Co-Design for FPGA	(B) Entrepreneurship Development	(B)Image and Video Processing
(C) VLSI Architectures for Image Processing	(C) E Waste Management	(C) Advanced SoC Design Concepts
(D) System Verilog	(D) Data Structure & Algorithms Using Java Programming	(D) Advanced CMOS Fabrication
(E) Analog Integrated Circuit Design	(E) Fiber Optic Communication	(E) Digital VLSI Testing and Testability

B. Tech (VLSI Design & Technology Engineering)

Curriculum for Semester VII [Final Year]

Sr.	Course Code	Course Title	Hours Per Week			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
1	BTVTP801	Project work/ Internship	-	-	24	60	-	40	100	12
Total			-	-	24	60	-	40	100	12

Semester III

BTBS301	Engineering Mathematics - III	4 Credits

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetic and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing

Course Outcomes:

On completion of the course, students will be able to:

1. Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
2. Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
4. Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
5. Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

UNIT - 1

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n , scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

UNIT - 2

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

UNIT - 3

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Perceval‟s identity for Fourier Transforms.

UNIT - 4

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange‟s linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation (), and one dimensional wave equation

UNIT - 5

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form ;Cauchy‟s integral theorem; Cauchy‟s integral formula; Residues; Cauchy‟s residue theorem (All theorems without proofs)

TEXT/REFERENCE BOOKS

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO.Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi Sarvate, "Electromagnetism", Wiley Eastern.
5. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.

6. A Text Book of Engineering Mathematics by PeterO‟Neil, Thomson Asia Pte Ltd. , Singapore.
7. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.
8. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
9. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , NewYork

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.

2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.

The minimum number of assignments should be eight covering all topics.

BTVTC302	**Electronic Device & Circuits**	**3 Credits**

Course Objectives:

1. To introduce Static characteristics of ideal two terminals and three terminal devices.
2. To introduce semiconductor devices BJT, JFET and MOSFET, their characteristics, operations, circuits and applications.
3. To analyze and interpret BJT, FET and MOSFET circuits for small signal at low and high frequencies.
4. To simulate electronics circuits using computer simulation software and verify desired results

Course Outcomes:

On completion of the course, students will be able to:

On completion of the course, students will be able to:

1. Comply and verify parameters after exciting devices by any stated method.
2. Implement circuit and test the performance.
3.Analyze BJT, JFET and MOSFET for various applications.
4. Analyze Feedback amplifiers and oscillators.
5. Understand the principles of semiconductor Physics

6. Understand and utilize the mathematical models of semiconductor junctions and MOStransistors for circuits and systems.

UNIT - 1

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices ,E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors.

UNIT - 2

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

UNIT - 3

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers, CS,CD,CG amplifiers ,their analysis using small signal JFET model ,Biasing the FET,TheFETasVVR

UNIT - 4

Overview of DMOSFET, EMOSFET, Power MOSFET, n MOSFET, p - MOSFET and CMOS devices, Handling precautions of CMOS devices, MOSFET as an Amplifier and Switch, Biasing in MOSFET, Small signal operation and models, Single stage MOS amplifier, MOSFET capacitances, CMOS Inverter, Comparison of FET with MOSFET and BJT w.r.t. to deviceandCircuitparameter

UNIT - 5

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

1. 1. G. Streetman, and S. K. Banerjee, ―Solid State Electronic Devices,‖ 7th edition, Pearson,2014.

2. 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.

3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, “Electronics Devices & Circuits”, Synergy Knowledge wareMumbai, 2017.ISBN:9789383352616

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.

6. A.K. Maini, N. Maini, All-in-One Electronics Simplified, Khanna Book Publishing, New Delhi, 2021.

7. A.K. Maini, Analog Electronics, Khanna Book Publishing, New Delhi, 2022.

BTVTC303	Digital System Design	4 Credits

Course Objectives:

1. The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
2. The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
3. This course will explore the basic concepts of digital electronics

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
4. Use HDL & appropriate EDA tools for digital logic design and simulation

UNIT - 1

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan„sTheorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

UNIT - 2

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

UNIT - 3

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edgetriggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

UNIT - 4

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing,Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

UNIT - 5

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. M.Morris Mano and Michel.D.Ciletti, Digital Design with an introduction to HDL, VHDL and Verilog, Sixth edition Pearson education
2. R. Anand, Digital System Design Using VHDL, Khanna Book Publishing Company.
3. R. Anand, Digital Electronics, Khanna Book Publishing Company.
4. R.P. Jain, ―Modern digital Electronics‖, Tata McGraw Hill, 4th edition, 2009.
5. Douglas Perry, ―VHDL‖, Tata McGraw Hill, 4th edition, 2002.
6. W.H. Gothmann, ―Digital Electronics- An introduction to theory and practice‖, PHI, 2nd edition ,2006.
7. D.V. Hall, ―Digital Circuits and Systems‖, Tata McGraw Hill, 1989.
8. Charles Roth, ―Digital System Design using VHDL‖, Tata McGraw Hill 2nd edition 201

BTVTC304	Signals and Systems	3 Credits

Course Objectives:

1. To understand the mathematical description of continuous and discrete time signals and systems.

2. To classify signals into different categories.

3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.

4. To build basics for understanding of courses such as signal processing, control system and communication.

Course 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
5. Understand mathematical description and representation of continuous and discrete time signals and systems.
6. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
7. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
8. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.

UNIT - 1

Introduction and Classification of signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding. Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static anddynamic, stableandunstable, invertible.

UNIT - 2

System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method, Computation of convolution sum. Properties of convolution, properties of the system basedon impulse response, step response in terms of impulse response.

UNIT - 3

Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response andits 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.

UNIT - 4

FT of standard CT signals, FT of standard periodic CT signals, Introduction to Fourier Transform of DT signals, Properties of CTFT and DTFT, Fourier Transform of periodic signals. Concept of sampling and reconstruction in frequency domain

UNIT - 5

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

The Laplace Transform, notion of Eigen functions of LSI systems, a basis of Eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

TEXT/REFERENCE BOOKS

1. R. Anand, Signals and Systems, Khanna Publishing House, 2019.
2. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
3. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
4. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
5. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware, 2017

BTVTC305	Network Theory	3 Credits

Course Objectives:

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits
3. To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.
4. To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
5. To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

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.

UNIT - 1

Basic nodal and mesh analysis, linearity, superposition and source transformation, source transformation and duality. The venin"s, Norton"s and maximum power transfer theorem, network topology

UNIT - 2

Transient Analysis: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit. Frequency Domain Analysis: The phasor concept, sinusoidal steady state analysis; AC circuit Analysis

UNIT - 3

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

UNIT - 4

Two Port Networks: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks

UNIT - 5

State Variable Analysis: State variables and normal-form equations, matrix-based solution of the circuit equations. RL & RC Network Synthesis: Synthesis of one-port networks, transfer function synthesis, Introduction to band pass, low pass, high pass and band reject filters.

TEXT/REFERENCE BOOKS

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

Semester IV

BTVTC401	System Design through Verilog	3 Credits

Course Objectives:

1. To know the basic language features of Verilog HDL and the role of HDL in digital logic design.
2. To know the behavioural modeling of combinational and simple sequential circuits.
3. To know the behavioral modeling of algorithmic state machines.
4. To know the synthesis of combinational and sequential descriptions.
5. To know the architectural features of programmable logic devices.

Course Outcomes:

At the end of the course, the students will be able to

1. Demonstrate knowledge on HDL design flow, digital circuits design, switch de-bouncing, metastability, memory devices applications
2. design and develop the combinational and sequential circuits using behavioral modeling
3. solving algorithmic state machines using hardware description language
4. analyze the process of synthesizing the combinational and sequential descriptions
5. memorizing the advantages of programmable logic devices and their description in Verilog

UNIT - 1

Introduction to Logic Design with Verilog : Structural models of combination logic, logic simulation, design verification, test methodology, propagation delay, truth table models of combinational and sequential logic with Verilog modules, ports, gate types, gate delays, dataflow modelling, continuous assignments delays, expressions, operators, operands, operator types

UNIT - 2

Logic Design With Behavioral Models of Combinational And Sequential Logic : Behavioral modeling, data types for behavioral modeling, behavioral models of combinational logic, propagation delay and continuous assignments, lathes and level sensitive circuits in Verilog, cyclic behavioural models of flip flops and latches, cyclic behavior and edge detection, a comparison of styles for behavioral modeling

UNIT - 3

Behavioral models of multiplexers, encoders and decoders data flow model of a lfsr machines with multicycle operations, algorithmic state machine charts for behavioral modeling, asmd charts, behavioural models of counters, shift registers and register files, switch debounce, metastability, synchronizers for asynchronous signals.

UNIT - 4

Introduction to synthesis : synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of three state devices and bus interfaces, synthesis of sequential logic with flip flops, synthesis of explicit state machines registered logic.

UNIT - 5

Programmable logic devices, storage devices, programmable logic array programmable array logic, programmability of PLDs CPLDs.

TEXT/REFERENCE BOOKS

1. Michael D Ciletti - Advanced Digital Design with the VERILOG HDL, 2ND Edition, PHI, 2009.

2. Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003.

3. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.

4. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

BTVTC402	Microcontrollers and Computer Architecture	4 Credits

Course Objectives:

1. To provide insight into architectural details of microprocessors.
2. To master the assembly language programming using concepts like assembler directives, procedures, macros, software interrupts etc.
3. To understand well the organization of 8085 and 8086 memory, addressing, address decoding concepts.
4. To provide the knowledge of interfacing 8086 with memory, I/O devices, 8255, keyboard etc
5. To understand the concept of Interrupts and their significance in 8086.
6. To study various hardware, software interrupts, Programmable Interrupt Controller etc
7. To provide the knowledge about aspects which differentiates the versions of microprocessors.

Course Outcomes:

At the end of the course, the students will be able to

1. Explain the functional units with respect to computer architecture
2. Develop simple programmes using 8085/8051 assembly language
3. Interface 8085 with peripherals using assembly language
4. Interface 8051 with peripherals using assembly language/C

UNIT - 1

Functional units of a computer, Von Neumann and Harvard computer architectures, CISC and RISC architectures. Processor Architecture – General internal architecture, Address bus, Data bus, control bus. Register set – status register, accumulator, program counter, stack pointer, general purpose registers. Processor operation – instruction cycle, instruction fetch, instruction decode, instruction execute, timing response, instruction sequencing and execution. Algorithms for binary multiplication and division. Fixed and floating-point numberrepresentation

UNIT - 2

Introduction to Microprocessor, Microprocessor architecture and its operations, Memory, Input & output devices, Logic devices for interfacing, The 8085 MPU, Example of an 8085 based computer, Memory interfacing. Basic interfacing concepts, interfacing output displays, interfacing input devices, Memory mapped I/O.

UNIT - 3

Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, addressing modes, writing assembly language programs, Programming techniques: looping, counting and indexing. Additional data transfer and 16 bit arithmetic instruction, Arithmetic operations related to memory, Logic operation: rotate, compare, counter and time delays. Subroutines.Interrupts

UNIT - 4

8255 Programmable peripheral interface, interfacing keyboard and seven segment display, 8254 (8253) programmable interval timer, 8259A programmable interrupt controller, Direct Memory Access and 8237 DMA controller.

Microcontrollers and Embedded Processors. Architecture – Block diagram of 8051, Pin configuration, Registers, Internal Memory, Timers, Port Structures, Interrupts. Assembly Language Programming -Addressing Modes, Instruction set (Detailed study of 8051 instruction set is required).

UNIT - 5

Simple programming examples in assembly language. Interfacing with 8051 using Assembly language programming: LED, Seven segment LED display. Programming in C – Declaring variables, Simple examples – delay generation, port programming, code conversion. Interfacing of – LCD display, Keyboard, Stepper Motor, DAC and ADC -- with 8051 and its programming. 8051 Timers/Counters -Modes and Applications. Serial Data Transfer – SFRs of serial port, working, Programming the 8051 to transfer data serially

TEXT/REFERENCE BOOKS

1. Computer System Architecture, Mano M M , Prentice Hall India
2. 8085 Microprocessor Architecture, Applications and Programming, Ramesh S Gaonkar, Penram International
3. The 8051 microcontroller and Embedded systems, Muhammed Ali Mazidi & Janice Gill Mazidi, Pearson Education

BTVTC403	Analog and Digital Communication	3 Credits

Course Objectives:

1. To study the fundamental concept of the analog communication systems.
2. To analyze various analog modulation and demodulation techniques.
3. To know the working of various transmitters and receivers.
4. To understand the influence of noise on the performance of analog communication systems.
5. To acquire the knowledge about information and capacity.

Course Outcomes:

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

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

UNIT - 1

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

UNIT - 2

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

UNIT - 3

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers

UNIT - 4

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

UNIT - 5

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation

TEXT/REFERENCE BOOKS

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems‖, Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley,1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.
7. R. Anand, Communication Systems, Khanna Book Publishing Company, 2011.

BTVTC404	Introduction to Micro fabrication	3 Credits

Course Objectives:

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

1. Elucidate the CMOS process flow
2. Analyze various critical processing steps in microfabrication
3. Appreciate the advanced methods involved in IC fabrication.
4. Analyze the advancements in CMOS process fabrication with scaling in technology.

Course Outcomes:

At the end of this course students will be able to understand:

1. the principles behind the design and fabrication of both semiconductor and MEMs devices and the effect of processes on their performance;
2. a thorough understanding of the available fabrication technologies;
3. a good working knowledge of possible process architectures;
4. an appreciation of the process plant required to enable microfabrication of devices and systems.

UNIT - 1

History of IC‟s; Operation & Models for Devices of Interest: CMOS and MEMS. Electronic Materials: Crystal Structures, Defects in Crystals, Si, Poly Si, Si Crystal Growth. Clean room and Wafer Cleaning: Definition, Need of Clean Room, RCA cleaning of Si..

UNIT - 2

Dry and Wet Oxidation, Kinetics of Oxidation, Oxidation Rate Constants, Dopant Redistribution, Oxide Charges, Device Isolation, LOCOS, Oxidation System.

Overview of Lithography, Radiation Sources, Masks, Photoresist, Components of Photoresist Optical Aligners, Resolution, Depth of Focus, Advanced Lithography: E-beam Lithography, X-ray Lithography, Ion Beam Lithography

UNIT - 3

Pre-Deposition and Drive-in Diffusion Modeling, Dose, 2-Step Diffusions, Successive Diffusion, Lateral Diffusion, Series Resistance, Junction Depth, Irvin‟s Curves, Diffusion System. Ion Implantation: Problems in Thermal Diffusion, Advantages of Ion Implantation, Applications in ICs, Ion Implantation System, Mask, Energy Loss Mechanisms, Depth Profile, Range & Straggle, Lateral Straggle, Dose, Junction Depth, Ion Implantation Damage,Post Implantation Annealing, Ion Channeling, Multi Energy Implantation

UNIT - 4

Physical Vapor Deposition: Thermal evaporation, Resistive Evaporation, Electron beam evaporation, Laser ablation, Sputtering Chemical Vapor Deposition: Advantages and disadvantages of Chemical Vapor deposition (CVD) techniques over PVD techniques, reaction types, Boundaries and Flow, Different kinds of CVD techniques: APCVD, LPCVD, Metalorganic CVD (MOCVD), Plasma Enhanced CVD etc

UNIT - 5

Anisotropy, Selectivity, Wet Etching, Plasma Etching, Reactive Ion Etching.

Overview of Interconnects, Contacts, Metal gate/Poly Gate, Metallization, Problems in Aluminum Metal contacts, Al spike, Electro migration, Metal Silicide"s, Multi-Level Metallization, Planarization, Inter Metal Dielectric

TEXT/REFERENCE BOOKS

1. Silicon VLSI Technology, Plummer, Deal and Griffin ,1st Edition, Pearson Education,2009
2. Fundamental of Semiconductor Fabrication, Sze and May,2nd Edition, Wiley India, 2009
3. Silicon Process Technology, S K Gandhi,2nd Edition, Wiley India,2009

BTVTC405	Introduction to VLSI lifecycle	1 Credits

Course Objectives:

1. To understand VLSI fundamentals: Gain a solid grasp of VLSI technology, semiconductor materials, and the basics of transistor operation.
2. To Learn about the various stages of the VLSI design lifecycle, including specification, design, verification, synthesis, layout, and fabrication.
3. To Explore design methodologies: Introduce different VLSI design methodologies.

Course Outcomes:

1. At the end of this course students will demonstrate the ability to
2. Understand the intricacies in VLSI Design flow
3. Understand overall process of VLSI Design flow starting from system level all the way to the transistor level.

UNIT - 1

System & Architectural Design: Defining a system specification, performance analysis, cost analysis, identifying various functional blocks/modules; categorizing them in terms of digital, analog, RF and mixed signal blocks..

UNIT - 2

Functional verification, logic design: Verifying the functionality of blocks, behavioral description, logic minimization, synthesis, verification and testing

UNIT - 3

Circuit Optimization and Physical Design: Optimization of synthesized blocks for various performance metric, Introduction to placement and route, Layout Vs Schematic (LVS) verification, Design for Manufacturability

UNIT - 4

Tape Out: Post layout simulations, Process Voltage Testing, Process Design Kit, Design Rule Check, GDSII Metalorganic CVD (MOCVD), Plasma Enhanced CVD etc

UNIT - 5

Fabrication and Packaging: CMOS process flow, dicing, various types of packaging.

TEXT/REFERENCE BOOKS

1. Sneh Saurabh, "Introduction to VLSI Design flow", Cambridge University Press.

1. N. H. E. Weste and C. Harris, "Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007
2. M.Morris Mano and Michel.D.Ciletti, Digital Design with an introduction to HDL, VHDL and Verilog, Sixth edition Pearson education

BTVTPE406	(A) Probability Theory and Random Processes	4 Credits

Course Objectives:

1. To develop basic of probability and random variables.

2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

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

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

UNIT - 1

Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability,

Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes‟ rule and applications

UNIT - 2

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, Function of one random variable, pdf of the function of one random variable; Function of two random variables; Sum of two independent random variables, Expectation: mean, variance and moments of a random variable, conditional expectation; covariance and correlation; independent,

UNIT - 3

Random vector: mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector-space representation of random variables, linear independence, inner product, Schwarz Inequality, Moment-generating functions, Bounds and approximations: Tchebysheff inequality and Chernoff Bound

UNIT - 4

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT - 5

Random process: Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross-correlation function, Ergodicity and its importance, Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, examples with white - noise as input; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
2. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
6. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press

BTVTPE406	(B) Analog Circuits	4 Credits

Course Objectives:

1. To understand characteristics of IC and Op-Amp and identify the internal structure.
2. To introduce various manufacturing techniques.
3. To study various op-amp parameters and their significance for Op-Amp.
4. To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
5. To analyze and identify linear and nonlinear applications of Op-Amp

Course Outcomes:

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

1. Understand the characteristics of diodes and transistors
2. Design and analyze various rectifier and amplifier circuits
3. Design sinusoidal and non-sinusoidal oscillators
4. Understand the functioning of OP-AMP and design OP-AMP based circuits
5. Design ADC and DAC

UNIT - 1

Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Frequency response of amplifiers, Bode plots. Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria..

UNIT - 2

Linear applications of operational amplifiers: Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, instrumentation amplifiers, and Active filters.

UNIT - 3

Non-linear applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors.design of gain stages and output stages, compensation

UNIT - 4

Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square triangle oscillators

UNIT - 5

Analog and Digital interface circuits: Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash type, Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc., V-F, I-V and V-I converter.

TEXT/REFERENCE BOOKS

1. A.V.N. Tilak, Design of Analog Circuits, Khanna Publishing House, 2022.

2. A.S. Sedra and K.C. Smith, Microelectronic Circuits, sixth edition, Oxford University Press

3. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.

4. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge UniversityPress, 1989.

5. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

BTVTPE406 (C) Problem solving through programming in C	4 Credits

Course Objectives:

1. Elucidate the basic architecture and functionalities of a Computer
2. Apply programming constructs of C language to solve the real-world problems
3. Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems
4. Design and Develop Solutions to problems using modular programming constructs such as functions and procedures

Course Outcomes:

At the end of the course the student will be able to:

1. Elucidate the basic architecture and functionalities of a computer and also recognize the hardware parts.
2. Apply programming constructs of C language to solve the real world problem
3. Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting
4. Explore user-defined data structures like structures, unions and pointers in implementing solutions
5. Design and Develop Solutions to problems using modular programming constructs using functions

UNIT - 1

Computer generations, computer types, bits, bytes and words, CPU, Primary memory, Secondary memory, ports and connections, input devices, output devices, Computers in a network, Network hardware, Software basics, software types.

Basic structure of C program, executing a C program. Constant, variable and data types, Operators and expressions.

UNIT - 2

Managing Input and output operations. Conditional Branching and Loops. Example programs, finding roots of a quadratic equation, computation of binomial coefficients, plottingofPascal‟striangle

UNIT - 3

Arrays (1-D, 2-D), Character arrays and Strings, Basic Algorithms: Searching and Sorting Algorithms (Linear search, Binary search, Bubble sort and Selection sort).

UNIT - 4

User Defined Functions and Recursion. Example programs: Finding Factorial of a positiveinteger, GCD of two numbers and Fibonacci sequence.

UNIT - 5

Structures, Unions and Pointers, Pre-processor Directives and Example Programs like Addition of two complex numbers using structures , compute the sum, mean and standard deviation of all elements stored in an array of N real numbers using pointers.

TEXT/REFERENCE BOOKS

1. Byron S Gottfried “Programming with C” Second edition, Tata McGrawhill, 2007 (Paper back)
2. R.G. Dromey, “How to solve it by Computer”, Pearson Education, 2008.
3. Kanetkar Y, “Let us C”, BPB Publications, 2007.
4. Hanly J R & Koffman E.B, “Problem Solving and Programm design in C”, Pearson Education, 2009.
5. E. Balagurusamy, “Programming with ANSI-C”, Fourth Edition,2008, Tata McGraw Hill.
6. Venugopal K. R and Prasad S. R, “Mastering „C‟”, Third Edition, 2008, Tata McGraw Hill.
7. B.W. Kernighan & D. M. Ritchie, “The C Programming Language”, Second Edition, 2001,
Pearson Education
8. ISRD Group, “Programming and Problem Solving Using C”, Tata McGraw Hill,2008.
9. Pradip Dey , Manas Ghosh, “Programming in C”, Oxford University Press, 2007.

BTVTPE406 (D) Object oriented programming through C++ 4 Credits

Course Objectives:

This course enables the students to know about

1. Object Oriented concepts, C++ language .
2. Classes & Objects, Inheritance, Polymorphism.
3. Templates , Streams, Files

Course Outcomes:

At the end of the course the student will be able to:

1. Understand OOPs Concept ,C++ language features. Able to Understanding and Applying various Datatypes, Operators, Conversions in program design.
2. Understand and Apply the concepts of Classes & Objects, friend function, constructors &destructors in program design.
3. Design & implement various forms of inheritance, String class, calling base class constructors.
4. Apply & Analyze operator overloading, runtime polymorphism, Generic Programming.
5. Analyze and explore various Stream classes, I/O operations and exception handling.

UNIT - 1

Object Oriented paradigms, Data abstraction/control abstraction, OOPS principles, Origin of C++, Sample C++ program, dynamic initialization of variables , new and delete operators, C++ keywords, General form of C++ program, Type casting, Introducing C++ classes, Difference between class and structure

UNIT - 2

Defining Classes in C++, accessing class members, access specifiers (Public and Private), defining member functions, static data members, static member functions, friend functions, friend classes, inline functions, nested classes, passing objects to functions, returning objects, object assignment, Array of objects, Constructor and Destructors

UNIT - 3

Polymorphism, Pointers: Pointers to objects, „this‟ Pointer, Pointers to derived types. Operator Overloading: Overloading Unary Operators, and Overloading Binary Operators using friend functions, Function Overloading, Virtual functions: Pure Virtual Functions, Base-class access control, access specifier (Protected), scope rules, Inheriting Multiple Base classes, constructors, destructors &inheritance passing parameters to base class constructors. Virtual base class. String class-Usage of standard library string class with example programs.

UNIT - 4

Abstract classes Templates: Introduction, simple generic classes & generic function, simple example programs. STL-List, Vector, Array

UNIT - 5

Files and Exception Handling: Exception Handling: Fundamentals, exception handling options. C++ I/O Systems Basics: C++ Streams, C++ Stream classes, Unformatted I/O Operations, Formatted I/O Operations, Formatting using Manipulators. C++ File I/O: Introduction, Classes for file stream Operations, Opening and closing a file, detecting end-of file

TEXT/REFERENCE BOOKS

1. Herbert Schildt, The Complete Reference C++, Fourth Edition, TMH Publications.
2. Deitel& Deitel, C++ How to Program, Pearson Education, 3rd Edition
3. E.Balaguruswamy, Object Oriented Programming with C++, TMH Publications,3rdEdition.

Semester V

BTVTC501 Electromagnetic Field Theory 4 Credits

Course Objectives:

1. Learners can be able to explore their knowledge in the area of EM Waves and its analysis.

2. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.

3. To understand the boundary conditions for different materials/surfaces.

4. To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.

5. To get the basics of microwave, transmission lines and antenna parameters.

6. Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

Course Outcomes:

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

1. Understand characteristics and wave propagation on high frequency transmission lines

2. Carryout impedance transformation on TL

3. Use sections of transmission line sections for realizing circuit elements

4. Characterize uniform plane wave

5. Calculate reflection and transmission of waves at media interface

6. Analyze wave propagation on metallic waveguides in modal form Understand principle of radiation and radiation characteristics of an antenna

UNIT – 1 Mathematical Fundamentals and Static Electric Fields:

Introduction, Vector Analysis, Coordinate systems and Transformations, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem, Columb's Law, Electric Field, Electric flux density, Gauss's Law with Application, Electrostatic Potential and Equipotential Surfaces, Boundary conditions for Electrostatic fields, Capacitance and Capacitors, Electrostatic Energy and Energy Density.

UNIT – 2 Steady Electric Currents and Static Magnetic Fields:

Current Density and Ohm's Law, Electromotive force and Kirchhoff's Voltage Law, ContinuityEquationandKirchhoff‟sCurrentLaw,PowerDissipationandJoule'sLaw,Biot-Savart Law and its Application, Ampere's Circuital Law and its Application, Magnetic Flux Density, Magnetic

Scalar and Vector Potentials, Boundary Condition Magnetic Fields, Inductance and Inductor, Energy stored in Magnetic Field.

UNIT – 3 Time Varying Field &Maxwell's Equations:

Introduction, Faraday's Law of electromagnetic Induction, Maxwell's Equation, Boundary Conditions for Electromagnetic fields, Time Harmonic Fields

UNIT – 4 Transmission Lines:

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

UNIT – 5 Electromagnetic Waves:

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

TEXT/REFERENCE BOOKS:

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India,2005

2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India

3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall,1997.

4. David Cheng, “Electromagnetics”, PrenticeHall.

5. Sadiku, "Elements of Electromagnetics",Oxford. 6. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.

7. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi,1999.

8. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.

BTVTC502 CMOS Design 4 Credits

Course Objective:

This course presents the fundamental of Digital CMOS VLSI design with different VLSI design methodologies and combinational, sequential and semiconductor memory circuit design. It also covers the limitations of CMOS in NANO technology with introduction to the NANO Technology

Course Outcomes:

1- Understand the advancement of CMOS devices and circuits

2- Design CMOS circuits with specified noise margin and propagation delay.

3- Implement efficient techniques at circuit level for improving power and speed of combinational and sequential circuits.

4- Design and optimization of layout for Digital ICs.

5-Design and analysis of efficient memory architectures

Unit I Introduction to MOSFETs technology:

Construction and working of MOSFET, Current-Voltage Characteristics, Performance metrics for digital design, Scaling of MOSFETs, Fabrication flow of CMOS n-well process.

Unit II CMOS Inverter:

Design , analysis of NMOS inverter (resistive, enhancement and depletion load) , CMOS inverters; transfer characteristics, Noise margins, , rationing of transistor size, logic voltage levels, rise and fall of delays, Propagation Delay, Power Consumption.

Unit III Layout and stick diagram:

Layout design rules: Lambda and micron based design rules- stick diagram, Layer properties of various conducting layers in MOS and CMOS technology (diffusion, poly-silicon and metal), Layout design of different CMOS circuit, area estimation.

Unit IV Combinational Circuits:

Design of basic gates in NMOS technology; CMOS logic design styles: static CMOS logic (NAND, NOR gates), complex gates, Pass Transistor logic, Transmission gate, Dynamic MOS design: pseudo NMOS logic, clocked CMOS (C2 MOS) logic, domino logic, NORA, Half and Full adder), Multiplexer, XOR, XNOR

Unit V Sequential and Memory Design:

Sequential MOS Logic and Memory Design: Static latches; Flip flops & Register.

BOOKS RECOMMENDED:

[1]. Sung-mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuit analysis and Design, Tata McGraw-Hill, 3/e.

[2]. R. Jacob Baker, Harry W. Li and David E. Boyce, CMOS Circuit design, layout and Simulation, PHI,IEEE press, Series Edition,

[3]. Yuan Taur and Tak H. Ning, Fundamentals of Modern VLSI Devices, Cambridge university Press, Special Edition, 1998

[4]. Neil H.E. Weste and Kamran Esharhian, Principal of CMOS VLSI design, PHI, 2/e

[5]. Jan M. Rabaey, Digital Integrated Circuit, PHI, 2/e

BTVTC503 Embedded Systems 4 Credits

Course Objectives

1. **Differentiate Embedded and General Computing Systems**: Understand the key distinctions between embedded systems and general-purpose computing systems.
2. **Master Embedded C Programming**: Develop proficiency in Embedded C, including data types, structures, and optimization techniques.
3. **Understand ARM Processor Fundamentals**: Gain detailed knowledge of ARM architecture, instruction sets, and interrupt handling.
4. **Implement Communication Protocols**: Learn and apply various communication protocols such as UART, I2C, SPI, and CAN in embedded systems.
5. **Grasp RTOS Fundamentals**: Understand the core concepts of Real-Time Operating Systems, including multitasking, memory management, and task scheduling.

Course Outcomes

1. **System Classification**: Students will be able to classify and differentiate embedded systems from general computing systems.
2. **Efficient Programming**: Students will write efficient and optimized Embedded C programs tailored for specific hardware.
3. **ARM Architecture Proficiency**: Students will demonstrate proficiency in ARM processor architecture and programming, including exception and interrupt handling.
4. **Protocol Implementation**: Students will implement and troubleshoot communication protocols in embedded applications.
5. **RTOS Integration**: Students will integrate and manage real-time operating systems in embedded solutions, handling tasks, resources, and events efficiently.

Unit I: Introduction to Embedded systems

Embedded system vs general Computing system. Classification of Embedded system. Core of Embedded system. RISC vs CISC controllers. Harvard vs Van Neumen architecture, Architecture of Embedded System, Design Methodology, Design Metrics.

Unit II: Embedded C Programming

Introduction to Embedded C, Data Types and Variables, Complex Data Types, Data Type Modifiers, Storage Class Modifiers, C Statements, Structures, and Operations, Libraries, Optimizing and Testing Embedded C Programs

Unit III: ARM processor fundamentals

ARM Processor Families, Registers, Current Program Status Registers (CPSR), Pipeline, exceptions, Interrupts and the vector table, Data Processing Instruction, Branch Instruction, Load-Store Instructions, Software Interrupts instructions, Program Status Register Instructions, Loading Constants, Thumb register usage, ARM-Thumb Interworking, Stack instructions.

Unit IV: Communication protocols

Use of communication protocols in embedded systems, Serial communication basics, synchronous/asynchronous interfaces, UART Protocol, I2C protocol, SPI protocol, USB Protocol, SPI protocol, CAN Protocol, 1 Wire protocol.

Unit V: RTOS fundamentals,

Multitasking in small embedded systems, Memory management, Task management, Queue management, software timer management, interrupt management, resource management, event, Task notification

PROFESSIONAL ELECTIVE -2

BTVTPE504A Digital Signal Processing 4 Credits

Course Objectives:

1. To introduce students with transforms for analysis of discrete time signals and systems.
2. To understand the digital signal processing, sampling and aliasing.
3. To use and understand implementation of digital filters.
4. To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real-world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESING

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB. COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATIONS Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT II ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT III EXECUTION CONTROL AND PIPELINING

Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models. PROGRAMMABLE DIGITAL SIGNAL PROCESSORS Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIT IV IMPLEMENTATIONS OF BASIC DSP ALGORITHMS

The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing. IMPLEMENTATION OF FFT ALGORITHMS An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, BitReversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum.

UNIT V INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODECDSP interface example.

TEXT BOOKS

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co

3. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.

4. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.

BTVTPE504B Control Systems Engineering 4 Credits

Course Objectives:

1. To introduce the elements of control system and their modeling using various Techniques.

2. To introduce methods for analyzing the time response, the frequency response and the stability of systems.

3. To introduce the concept of root locus, Bode plots, Nyquist plots.

4. To introduce the state variable analysis method.
5. To introduce concepts of PID controllers and digital and control systems.
6. To introduce concepts programmable logic controller.

Course Outcomes:

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

1. Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.

UNIT – 1 Introduction to control problem:

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback

UNIT – 2 Mathematical modeling:

Mathematical modeling of electrical systems, mechanical systems, electro-mechanical systems. Laplace transforms, transfer functions, electrical analogues of other dynamical systems. State-space modelling of dynamical systems. Block diagrams, block diagram reductions. Signal flow graph, Mason's gain formula. Linearity, time-invariance versus nonlinearity and time-variance. Linearization. Distributed parameter systems.

UNIT – 3 Time Response Analysis and Stability Analysis:

Time response analysis of first order and second order system: Transient response analysis, steady state error and error constants. Absolute stability and relative stability. Routh's stability criterion, Root locus method of analysis.

UNIT –4 Frequency-response analysis:

Frequency domain method; Bode plot, Polar plots and Nyquist stability criterion. Relationship between time and frequency response,

UNIT – 5 State variable Analysis:

Representation of state equations, Relationship between state equations and differential equations and transfer functions, solution of state equations, state transition matrix, state transition equation. Controllability and observability of control systems.

TEXT/REFERENCE BOOKS:

1. N. J. Nagrath and M. Gopal, "Control System Engineering", New Age International Publishers,

5th Edition,2009.

2. Benjamin C. Kuo, “Automatic control systems”, Prentice Hall of India, 7thEdition,1995.

3. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.

4. Schaum‟sOutlineSeries,“FeedbackandControlSystems”TataMcGraw-Hill,2007.

5. John J. D‟Azzo& Constantine H. Houpis, “Linear Control System Analysis andDesign”, Tata McGraw-Hill, Inc.,1995.

6. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 1999.

BTVTPE504C Compound Semiconductors 4 Credits

Course Outcomes:

Upon successful completion of this subject , students will have the knowledge and skills to:

1. Relate semiconductor material properties to the underlying physical concepts and engage in independent investigation to describe trends.

2. Describe basic semiconductor fabrication technologies

3. Relate the operation of semiconductor device building blocks (the diode and transistor) to the charge carrier action.

4. Identify and critically evaluate current developments and emerging trends in semiconductor technologies

Unit 1 : Introduction

Fundamentals of Semiconductors: Carrier concentration of semiconductor, Transport Equations, P-N Junction Diode, Schottky Junction Diode and MOSFET. Fundamentals of Compound Semiconductors: Introduction of Compound Semiconductors, Properties of Compound semiconductors

Unit 2: Overview of compound semiconductors

Overview of compound semiconductors and their significance. Historical context and evolution of compound semiconductor technologies. Introduction to key compound semiconductor materials. Crystal structures and properties of compound semiconductors. Comparison with elemental semiconductors.

Unit 3: Device Physics of Compound Semiconductors

Device physics principles specific to compound semiconductors. Electronic devices: High-speed transistors and integrated circuits. Principles and applications of optoelectronic devices using compound semiconductors. Lasers, photodetectors, and light-emitting diodes (LEDs).

Unit 4: Fabrication Techniques for Compound Semiconductors

Epitaxial growth techniques for compound semiconductors. Lithography and etching processes specific to compound semiconductors. Applications of compound semiconductors in high-frequency devices. Microwave transistors and communication devices.

Unit 5: Emerging Technologies in Compound Semiconductors

Latest developments and trends in compound semiconductor technology. Advanced applications and emerging technologies.

Recommended Books

1. Keh Yung Cheng. III-V Compound Semiconductors and Devices. Springer,2020.

2. Udo W. Pohl. Epitaxy of Semiconductors Physics and Fabrication of Heterostructures. Springer, 2020.

3. Gupta, S. OPTOELECTRONIC DEVICES AND SYSTEMS. PHI Learning Pvt. Ltd., 2014.

4. Birtalan, Dave. Optoelectronics. CRC Press, 2018. 5.

5. Semiconductor Devices, M.K.Achuthan and K N Bhat, The McGraw Hill

BTVTPE504D SOC Design 1: Design & Verification 4 Credits

Course Outcomes:

1. Understand and apply the complete SoC chip design flow, from conception to implementation.

2. Master Verilog as a language for RTL design

3. Integrate digital and analog IPs into a cohesive SoC design

4. Use simulation techniques for thorough RTL verification.

Unit 1 Introduction to SoC Chip Design Flow

Overview of the complete SoC chip design flow. Introduction to EDA tools: Synopsys, Cadence, Siemens, and open-source alternatives.

Unit 2: Verilog-Based RTL Design

Verilog-Based RTL Design , In-depth study of Verilog syntax and constructs. Verilog-based digital system design.

Unit 3 Integration of Digital and Analog IPs in SoC Design

Understanding digital and analog IPs. Techniques for integrating diverse IPs into a single SoC.

Unit 4: RTL Verification

Simulation-based verification techniques. RTL Verification using Formal Methods Introduction to formal verification. Application of formal methods in RTL verification.

Unit 5: Scripting Languages for Chip Design Automation

Introduction to scripting languages (TCL and Perl). Development of automation scripts for design tasks. Rapid prototyping using FPGAs. Validation of designs using emulation hardware.

Recommended Books

1. Cem Unsalan, Bora Tar. Digital System Design with FPGA: Implementation using Verilog and VHDL. McGrawHill, First Edition.

2. Nekoogar, Farzad. From ASICs to SOCs. Prentice Hall Professional, 2003.

3. Wolf, Wayne. Modern VLSI Design. Pearson Education, 2002.

4. Chakravarthi, Veena. A Practical Approach to VLSI System on Chip (SoC) Design. Springer Nature, 2019.

OPEN ELECTIVE -1

BTVTOE505A Micro-fabrication Semiconductor & Materials 4 Credits

Upon completion of this course, students will be able to:

● Understand the basic principles of micro-fabrication

● Design and implement micro-fabrication processes

● Characterize semiconductor materials and devices

● Apply micro-fabrication techniques to fabricate electronic devices

Unit 1 ;

Introduction to Micro System design, Material properties, micro-fabrication Technologies. Structural behavior, sensing methods, micro scale transport – feedback systems.

Unit 2 :

Micromechanics: Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties –Phase transformations in crystalline solids including marten site, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials

Unit 3:

Micro-fabrication: Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining- Electrical Discharge Machining – Ultrasonic Machining- Electro chemical Machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer devices.

Unit 4:

Mechanical micromachining: Theory of micromachining-Chip formation-size effect in micromachining-micro turning, micro milling, micro drilling- Micro machining tool design. Precision Grinding-Partial ductile mode grinding- Ultra precision grinding- Binderless wheel – Free form optics.

Unit 5:

Micro electro mechanical system fabrication: Introduction – Advance in Microelectronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS.

Recommended Books

1. Sze, S. M. (1981). VLSI technology (2nd ed.). New York, NY: McGraw-Hill.
2. Madou, M. J. (2002). Fundamentals of microfabrication (2nd ed.). Boca Raton, FL: CRC Press.
3. Jaeger, R. C. (2002). Introduction to microelectronic fabrication (2nd ed.). Upper Saddle River, NJ: Prentice Hall.
4. Sze, S. M., & Kwok, K. N. (2006). Physics of semiconductor devices (3rd ed.). Hoboken, NJ: Wiley.

BTVTOE505B Artificial Intelligence and Machine learning 4 Credits

Course Objectives:

1. Apply AI techniques to solve the given problems.

2. Implement trivial AI techniques on relatively large system

3. Explain uncertainty and Problem-solving techniques.

4. Compare various learning techniques.

Course Outcomes:

This course will enable students to

1. Identify the AI based problems.

2. Apply techniques to solve the AI problems.

3. Define learning and explain various logic inferences.

4. Discuss different learning techniques.

Unit 1: Introduction:

Artificial Intelligence, Application of AI, AI Problems, Problem Formulation, The Foundations of Artificial Intelligence, Intelligent Agents, Architecture of Intelligent agents. Types of Agents, Agent Environments, PEAS representation for an Agent, Reasoning and Logic, Prepositional logic, First order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining.

Module 2: Search Strategies:

Formulating problems, Well-defined problems and solutions, Problem-Solving Agents, Real world problems, Solving problems by searching, Search- Issues in The Design of Search Programs, Un-Informed Search- BFS, DFS; Heuristic Search Techniques: Generate-And Test, Hill Climbing, Best-First Search, A* Algorithm, Alpha beta search algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis.

Module3: ANN and Introduction to ML:

Introduction, Activation Function, Optimization algorithm- Gradient decent, Networks Perceptrons, Adaline, Multilayer Perceptrons, Backpropogation Algorithms Training Procedures, Machine Learning basics, Applications of ML, Supervised Learning- Naïve Bayes Classifier, Classifying with k-Nearest Neighbour classifier, Decision Tree classifier,. Unsupervised Learning - Grouping unlabeled items using k-means clustering, Association analysis with the Apriori algorithm, Introduction to reinforcement learning.

Module 4: Forecasting, Learning Theory and Kernel Machines:

Non-linear regression, Logistic regression, Random forest, Baysian Belief networks, Bias/variance tradeoff, Tuning Model Complexity, Model Selection Dilemma Clustering : Expectation-Maximization Algorithm, Hierarchical Clustering, Supervised Learning after Clustering. Introduction to kernel machines, Optimal Separating Hyperplane, Separating data with maximum margin, Support Vector Machine (SVM), Finding the maximum margin, The Non-Separable Case: Soft Margin Hyperplane, Kernel Trick, Defining Kernels.

Module 5: Ensemble Methods and Dimensionality Reduction:

Mixture Models, Classifier using multiple samples of the data set, Improving classifier by focusing on error, weak learner with a decision stump, Bagging , Stacking, Boosting ,Implementing the AdaBoost algorithm, Classifying with AdaBoost Bootstrapping and cross validation, Introduction to Dimensionality Reduction, Subset Selection, Principal Components Analysis, Multidimensional Scaling, Linear Discriminant Analysis.

BTVTOE505C Optimization Techniques 4 credits

Course Outcomes:

By the end of the course, students should be able to:

- Cast engineering minima/maxima problems into optimization framework.
- Learn efficient computational procedures to solve optimization problems.
- Use Matlab to implement important optimization methods

Unit 1: Introduction

Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.

UNIT – 2 Linear Programming:

Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming.

UNIT – 3 Non-linear programming:

Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods

UNIT – 4 Constrained optimization techniques

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different technique

UNIT – 5 Modern methods of Optimization

Genetic Algorithms – Simulated Annealing – Ant colony optimization – Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of Matlab to solve optimization problems.

TEXT BOOK(S)

1. Rao S.S,"Optimization – Theory and applications", Wiley Easter Ltd., 1979.

2.David G.Luerbeggan, "Introduction to Linear and Non Linear Programming", Addison Wesley Publishing Co. 1973.

3. Hadley G. "Nonlinear and – dynamic programming" Addison Wesley Publishing Co. 1964.

4. Cordan C.C. Beveridge and Robert S. Schedther, "Optimization, Theory and Practice" McGraw Hill Co.1970.

5. HarndyA.Tahh. "operations Research, An Introduction", Macmillan Publishers Co.NewYork,1982.

6. Beightferand S. others, "Foundations of Optimization Pill", New Delhi, 1979.

BTVTOE505D Operational Research 4 credits

Course Objectives:

- To help students understand Evolution of Management Thought, Concepts, basic functions and recent trends managerial concepts and practices for better business decisions.

- To introduce students to framework those are useful for diagnosing problems involving human behavior.
- To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- To teach students about networking, inventory, queuing, decision and replacement models.
- To introduce students to research methods and current trends in Operations Research.

Course Outcomes:

Student will be able to

- Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.
- Solve transportation problems using various OR methods.
- Illustrate the use of OR tools in a wide range of applications in industries.
- Analyze various OR models like Inventory, Queuing, Replacement, Simulation, Decision etc and apply them for optimization.
- Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

UNIT – 1

Definition of operations research, models of operations research, scientific methodology of operations research, scope of operations research, importance of operations research in decision making, role of operations management, limitations of OR

UNIT – 2

Linear Programming: Introduction – Mathematical formulation of a problem – Graphical solutions, standard forms the simplex method for maximization and minimization problems. Method application to management decisions.

UNIT – 3

Transportation problem – Introduction – Initial basic feasible solution - NWC method – Least cost method – Vogel's method – MODI – moving towards optimality – solution procedure without degeneracy

UNIT – 4

Assignment Problem- Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems. 1

UNIT – 5

Network models and simulation. Network models for project analysis CPM; Network construction and time analysis; cost time trade off, PERT – problems.

BTVTOE505E IC Packaging 4 credits

Course Outcomes:

1: Understand the relevance of packaging for electronic systems

2: Elaborate various materials and techniques used in electronic packaging

3: Inspect electronic package for reliability, thermal management and testability.

Unit 1 : Introduction to IC Packaging Technologies

Overview of IC packaging and its significance. Historical context and evolution of packaging technologies. Introduction to packaging types: through-hole, surface-mount, ball grid array.

Unit 2: Packaging Materials and Interconnection Techniques

Study of materials used in semiconductor packaging. Interconnection techniques: wire bonding, flip-chip, and solder bump technologies.

Unit 3: Thermal Management in IC Packaging

Principles of thermal management in IC packaging. Techniques for heat dissipation and cooling, Signal integrity challenges in IC packaging, Power integrity considerations and solutions.

Unit 4: Packaging Types and Trade-offs

In-depth study of through-hole, surface-mount, and ball grid array packaging, Trade-offs involved in selecting packaging types.

Unit 5 : Reliability in IC Packaging

Factors affecting reliability in IC packaging , Testing and validation techniques for packaged ICs, Advanced Topics in IC Packaging ,Emerging trends in IC packaging technologies, Advanced materials and techniques.

Recommended Books

1. John H. Lau. Semiconductor Advanced Packaging. Springer, 2021.

2. King-Ning Tu, Chih Chen, Hung-Ming Chen. Electronic Packaging Science and Technology. John Wiley and Sons Inc., 2022.

SEM -VI

BTVTC601 VLSI Verification and Testing 4 credits

Prerequisites:

- Basic knowledge of digital logic design and simulation.

Course Outcomes:

CO1: Understand the need for VLSI verification and various methodologies.

CO2: Identify key verification challenges in VLSI design.

CO3: Design and implement effective test benches.

CO4: Analyze assertion-based verification techniques.

CO5: Implement DFT techniques such as scan chains, ATPG, and BIST.

CO6: Analyze and apply boundary scan testing.

Program Outcomes :

- **PO1:** Apply fundamental engineering concepts to VLSI verification.
- **PO2:** Demonstrate knowledge of industry-standard verification methods.
- **PO3:** Develop test benches using SystemVerilog and UVM.
- **PO5:** Utilize modern verification tools and methodologies.

Module 1: Introduction to VLSI Verification

VLSI Design Flow & Challenges ,Overview of ASIC and FPGA design flows ,Need for verification in the VLSI lifecycle ,Functional vs. structural verification

Verification Methodologies ,Traditional verification vs. modern verification approaches ,Simulation-based, Emulation-based, and Formal Verification

Introduction to HDL & Verification Languages ,Verilog vs. System Verilog, Overview of VHDL for verification

Verification Planning & Test Strategies ,Verification planning concepts ,Coverage-driven verification, Test plan development

Module 2: Functional Verification & Test benches

Test-bench Architecture Types: Procedural, Reactive, Layered Test-benches ,Test-bench components: Stimulus generator, DUT, Checker, Monitor

Assertion-Based Verification (ABV) Concept of assertions ,Property Specification Language (PSL) and System Verilog Assertions (SVA)

Code Coverage & Functional Coverage ,Statement, branch, FSM, and path coverage ,Functional coverage with System Verilog

Universal Verification Methodology (UVM) UVM test-bench components: Driver, Monitor, Sequencer, UVM transaction-level modelling (TLM)

Module 3: Design for Testability (DFT)

Need for Design for Testability (DFT) Importance of DFT in VLSI circuits ,Fault models and fault detection techniques

Scan Design & Automatic Test Pattern Generation (ATPG) ,Basics of scan chain insertion ATPG principles: Stuck-at, Transition, Path Delay fault models

Built-in Self-Test (BIST) Logic and memory BIST techniques ,Pseudorandom pattern generation ,Signature analysis and response compaction

Boundary Scan Testing (JTAG/IEEE 1149.1) Basics of boundary scan architecture ,JTAG TAP controller and scan registers

Module 4: Advanced Verification Techniques

Transaction-Level Modeling (TLM) ,Introduction to TLM in System C ,TLM-1 vs. TLM-2.0

Constraint Random Verification (CRV) ,Concept of constraints in System Verilog , Randomization techniques in test- benches

Coverage-Driven Verification (CDV) ,Functional coverage collection and analysis ,Coverage-based test-bench optimizations

Hardware Acceleration and Emulation ,FPGA-based emulation ,Co-simulation techniques

Module 5: VLSI Testing & Industry Trends

Defects and Faults in VLSI Chips ,Physical defects vs. electrical faults ,Yield enhancement techniques

Memory Testing Techniques, March Test algorithms ,Built-in Self-Repair (BISR) techniques

High-Speed Testing Challenges ,Testing at GHz speeds ,Analog and mixed-signal verification

Emerging Trends in VLSI Verification & Testing ,AI/ML in Verification ,Formal verification advancements

Textbooks & Reference Books:

1. **"A Practical Guide for VLSI Design"** by S. K. S. Gupta
2. **"VLSI Design and Test"** by V. K. Jain, S. K. S. Gupta
3. **"Digital VLSI Chip Design with Cadence and Synopsys CAD Tools"** by Erik Brunvand
4. **"VLSI Test Principles and Architectures"** by Laung-Terng Wang
5. **"CMOS VLSI Design: A Circuits and Systems Perspective"** by Neil Weste, David Harris

BTVTC602 Semiconductor Equipment Design & Technology 4 credits

Semiconductor Equipment Design & Technology

Prerequisites:

- Basic understanding of semiconductor physics and materials science.

Course Outcomes:

CO1: Understand semiconductor fabrication processes and related equipment.

CO2: Analyze and compare different lithography, deposition, and etching equipment.

CO3: Understand the role of thermal processing in semiconductor device fabrication.

CO4: Implement automation solutions in semiconductor manufacturing.

CO5: Analyze industry trends and emerging semiconductor manufacturing techniques.

Program Outcomes :

PO1: Apply fundamental engineering concepts to semiconductor manufacturing.

PO2: Utilize semiconductor equipment design principles for advanced manufacturing.

PO3: Solve real-world semiconductor equipment design problems.

PO4: Engage in continuous learning about next-generation semiconductor equipment.

Module 1: Semiconductor Manufacturing Overview & Equipment Basics

Semiconductor fabrication flow ,Types of semiconductor processing equipment ,Cleanroom protocols & contamination control ,Vacuum and plasma technology.

Module 2: Lithography, Deposition & Etching Equipment

Photolithography: Principles, tools, and EUV ,Deposition techniques: CVD, PVD, ALD ,Etching systems: Plasma-based and wet etching ,Equipment design considerations for precision processing.

Module 3: Thermal Processing & Metrology Equipment

Ion implantation and diffusion equipment ,Rapid Thermal Processing (RTP) ,Chemical Mechanical Planarization (CMP) tools ,Metrology and defect inspection tools

Module 4: Equipment Control & Automation

Automation in semiconductor equipment: PLCs, motion control ,AI/ML for predictive maintenance and process optimization ,Robotics in wafer handling and transport

Module 5: Emerging Technologies & Industry Trends

Advanced packaging equipment (flip-chip, 3D ICs) ,Flexible and printed electronics manufacturing ,Trends in quantum computing and AI-driven semiconductor manufacturing

Textbooks & Reference Books:

1. **"Semiconductor Manufacturing Technology"** by Yung Chien
2. **"Introduction to Semiconductor Manufacturing Technology"** by Hong Xiao
3. **"Semiconductor Equipment and Materials for Solar Cell Fabrication"** by Frank R. Chen
4. **"Handbook of Semiconductor Manufacturing Technology"** by Hwaiyu Geng
5. **"Fundamentals of Semiconductor Manufacturing and Process Control"** by Gary S. May, Simon M. Sze

PEC-III

BTVTPE603A FPGA Programming 4 credits

Prerequisites:

- Basic knowledge of digital circuits and logic design.
- Familiarity with hardware description languages (HDL), especially VHDL or Verilog.

Course Outcomes:

CO1: Understand FPGA architecture and design flow.

CO2: Apply knowledge of HDLs to design basic digital circuits.

CO3: Design and simulate digital circuits using Verilog and VHDL.

CO4: Interface external devices with FPGA.

CO5: Apply FPGA for advanced applications like communication systems and machine learning.

Program Outcomes :

PO1: Apply fundamental knowledge of digital design to FPGA development.

PO2: Use FPGA development tools for designing circuits.

PO3: Interface FPGA with external hardware using various protocols.

PO4: Optimize FPGA resource usage for DSP applications.

Module 1: Introduction to FPGA and Digital Design Concepts

Introduction to FPGA and Hardware Description Languages (HDLs) :FPGA vs. ASIC vs. Microcontrollers ,Overview of FPGA architecture (LUTs, flip-flops, multiplexers, etc.) ,Introduction to HDL: Verilog and VHDL ,Basic digital design concepts: combinational logic, sequential logic
FPGA Design Flow ,Synthesis, implementation, and programming flow ,FPGA development tools (Xilinx Vivado, Altera Quartus) ,Constraints and timing analysis
FPGA Board Setup and Configuration: Understanding FPGA hardware components ,Connecting FPGAs to development boards ,Programming an FPGA using the development environment

Module 2: Verilog/VHDL Programming for FPGA

Verilog Syntax and Semantics :Modules, data types, operators ,Behavioral and structural modeling in Verilog ,Blocking vs. non-blocking assignments ,Finite State Machine (FSM) design in Verilog
VHDL Syntax and Semantics : VHDL design entities and architectures ,Processes, signals, and variables , Concurrent and sequential statements in VHDL ,FSM design in VHDL
FPGA Design Examples : Designing basic circuits: Adders, multiplexers, counters ,Implementing FSMs for control applications
Simulation and Debugging Techniques : Writing test-benches for Verilog and VHDL designs ,Debugging and waveform analysis

Module 3: Advanced FPGA Concepts and Design Techniques

Clocking and Timing in FPGA Designs : Clock domains, synchronization, and timing constraints, Timing analysis and optimization techniques ,Meta-stability and solutions
Memory and I/O Interfaces in FPGA :Implementing SRAM, DRAM, and ROM in FPGA designs ,I/O interfacing: GPIOs, UART, SPI, I2C ,Interfacing with external peripherals (LEDs, switches, displays)
High-Level Design in FPGA: Using IP cores for common functions (multiplier, divider, etc.) ,Implementing DSP algorithms in FPGA ,High-Level Synthesis (HLS) for FPGA (using C/C++ to generate HDL)

Module 4: FPGA Implementation for Digital Signal Processing (DSP)

Introduction to Digital Signal Processing (DSP): Basic DSP concepts: Sampling, quantization, and filters, FPGA-based implementation of FIR and IIR filters ,Real-time signal processing applications
Fast Fourier Transform (FFT) on FPGA ,Basics of FFT algorithm ,Implementing FFT on FPGA for real-time processing
Fixed-point Arithmetic and Optimization :Floating-point vs. fixed-point representation ,Optimizing DSP algorithms for FPGA resources

Module 5: FPGA Applications and Advanced Topics

FPGA in Communication Systems : FPGA for Modulation and Demodulation ,Communication protocols: Ethernet, Wi-Fi, Bluetooth
Embedded Systems with FPGA :Combining FPGA with microcontrollers (e.g., ARM, RISC-V) , Implementing custom peripherals using FPGA
FPGA in Machine Learning & AI :Accelerating neural networks on FPGA ,Implementing basic ML models on FPGA

Textbooks & Reference Books:

1. **"FPGA Prototyping by VHDL Examples"** by Pong P. Chu
2. **"FPGA Design: Best Practices for Team-based Design"** by Philip Simpson
3. **"Digital Design and Verilog HDL Fundamentals"** by Joseph Cavanagh
4. **"FPGA: Fundamentals, Advanced Features, and Applications"** by Stephen Brown and Zvonko Vranesic
5. **"Practical FPGA Programming in Verilog"** by Zainalabedin Navabi

BTVTPE603B Semiconductor Device Modeling 4 credits

Prerequisites:

- Basic semiconductor physics and device behavior.

Course Outcomes:

CO1: Understand the fundamental semiconductor physics behind device behaviour.
CO2: Analyze the electrical properties of semiconductors and devices.
CO3: Understand the operation and characteristics of BJTs.
CO4: Apply simulation tools and numerical methods to semiconductor device modeling.

Program Outcomes :

PO1: Apply semiconductor physics to device modeling and analysis.

PO2: Solve fundamental electrical problems related to semiconductor materials and devices.

PO3: Design and analyze BJTs for different operational regions and applications.

PO4: Solve complex semiconductor modeling problems using computational tools.

Module 1: Introduction to Semiconductor Physics & Devices

Semiconductor Materials and Properties: Crystal structure, Fermi level, electrical properties
Basic Semiconductor Physics: Energy bands, carrier generation, and recombination
Introduction to Devices: Diodes, BJTs, MOSFETs and basic device models

Module 2: PN Junction and Diode Modeling

PN Junction Theory: Depletion region, built-in potential, reverse breakdown
Small-Signal Modeling: Dynamic resistance, capacitance of diodes
Diode Characteristics: Forward and reverse characteristics, Shockley model

Module 3: Bipolar Junction Transistor (BJT) Modeling

BJT Characteristics: Active, saturation, cut-off regions, current gain
Small-Signal Model: Hybrid-pi model, small-signal parameters
Large-Signal Model: Nonlinear characteristics, BJT switching behavior

Module 4: MOSFET Modeling

MOSFET Basics: Structure, threshold voltage, current flow
I-V Characteristics: Strong and weak inversion, channel charge modeling
Small-Signal Model: Small-signal parameters, capacitance effects
Large-Signal Model: Short-channel effects, DIBL

Module 5: Advanced Topics in Device Modeling

Device Simulation: Introduction to TCAD tools, numerical methods
Quantum Effects and FinFETs: Quantum mechanical effects, FinFET modeling
Device Scaling: Scaling laws, performance trade-offs for advanced devices

Textbooks & Reference Books:

1. **"Semiconductor Device Fundamentals"** by Robert F. Pierret
2. **"Fundamentals of Modern VLSI Devices"** by Yuan Taur, Tak H. Ning
3. **"The Physics of Semiconductor Devices"** by Simon M. Sze
4. **"MOSFET Modeling for VLSI Simulation"** by J. P. Colinge
5. **"Semiconductor Device Modeling with SPICE"** by Larry D. Dietz

BTVTPE603C Semiconductor Opto-electronics 4 credits

Prerequisites:

- Semiconductor physics and basic understanding of light and optics.

Course Outcomes:

CO1: Understand the basic principles of opto-electronics and light interaction with semiconductors.
CO2: Explain the optical properties of semiconductors and their significance in opto-electronic devices.
CO3: Analyze the factors affecting the performance of opto-electronic devices.
CO4: Design and optimize opto-electronic devices for communication applications.
CO5: Identify and develop new applications for opto-electronics in sensing, imaging, and flexible devices.

Program Outcomes :

PO1: Apply the knowledge of semiconductor physics to opto-electronic applications.
PO2: Solve problems related to light-matter interactions in semiconductor materials.
PO3: Apply semiconductor materials and design principles to photodetectors and solar cells.
PO4: Use knowledge of opto-electronics for effective communication system development.
PO5: Understand the latest trends and apply emerging opto-electronic technologies.

Module 1: Introduction to Opto-electronics and Semiconductor Physics

Opto-electronics: Light-matter interaction, applications
Semiconductor Physics: Direct/indirect band gap semiconductors, energy bands
Optical Properties: Absorption, reflection, photoluminescence

Module 2: Light Emitting Diodes (LEDs) and Laser Diodes (LDs)

LEDs: Principle, efficiency, material selection (GaN, GaAs)
Laser Diodes: Stimulated emission, threshold current, modes of operation
Applications: Display, communication, medical

Module 3: Photodetectors and Solar Cells

Photodetectors: Photodiodes, avalanche photodiodes, quantum efficiency
Solar Cells: Photovoltaic effect, material selection, efficiency
Advanced Solar Cells: Thin-film, organic, and multi junction cells

Module 4: Opto-electronic Devices for Communication Systems

Optical Communication: Modulation techniques, fiber optic communication
Transmitters/Receivers: Laser diodes, photodiodes, error correction
Photonic Integration: Photonic circuits for communication

Module 5: Advanced Topics in Opto-electronics

Quantum Dots and Nanostructures: LED/laser applications, nano-optics
Organic Opto-electronics: OLEDs, organic solar cells, flexible devices
Emerging Technologies: Photonic integrated circuits, terahertz opto-electronics

Textbooks & Reference Books:

1. **"Semiconductor Optoelectronics: Physics and Technology"** by Pallab Bhattacharya
2. **"Introduction to Semiconductor Optics"** by Mark Fox
3. **"Optoelectronics and Photonics: Principles and Practices"** by Safa O. Al-Sarawi
4. **"Optical Semiconductor Devices"** by P. Bhattacharya
5. **"Optoelectronics: An Introduction"** by J. Wilson

BTVTPE603D Industrial Safety for the Semiconductor Industry 4 credits

Prerequisites:

- Basic understanding of safety protocols in industrial settings.

Course Outcomes:

CO1: Understand the key aspects of industrial safety in semiconductor manufacturing.
CO2: Identify potential hazards and risks in semiconductor environments.
CO3: Implement electrical safety practices and LOTO protocols in VLSI manufacturing.
CO4: Implement safe waste disposal and PPE usage procedures.

Program Outcomes :

PO1: Apply VLSI-specific safety protocols in semiconductor manufacturing environments.

PO2: Maintain a safe electrical environment in VLSI manufacturing through proper protocols.

PO3: Integrate safety management practices into daily operations in semiconductor facilities.

Module 1: Introduction to VLSI Industry Safety

- **VLSI Overview**: Semiconductor processes, fabrication facilities (fabs)
- **Hazard Identification**: Chemical, electrical, mechanical, and contamination risks in VLSI manufacturing
- **Cleanroom Standards**: Cleanroom protocols (ISO 14644), contamination control

Module 2: Chemical Safety in VLSI Manufacturing

- **Chemical Handling**: Safety protocols for chemicals used in photolithography, etching, and deposition
- **Spill Response**: Procedures for chemical spill management and emergency response
- **Fire Safety**: Fire risks from chemicals and gases, emergency evacuation procedures

Module 3: Electrical Safety in VLSI Manufacturing

- **Electrical Hazards**: Handling high-voltage equipment, grounding, static electricity control
- **LOTO Procedures**: Lockout/Tagout for safe equipment servicing and maintenance
- **ESD Control**: Electrostatic discharge prevention in semiconductor manufacturing

Module 4: Cleanroom Safety & Ergonomics

- **Cleanroom Practices**: Airflow, temperature, and humidity control, PPE usage in VLSI fabs
- **Ergonomics**: Safe workstation design, reducing repetitive strain injuries
- **Waste Disposal**: Safe handling and disposal of semiconductor manufacturing waste

Module 5: Safety Management & Compliance

- **Safety Audits**: Regular audits, inspections, and safety report documentation
- **Regulatory Compliance**: SEMI, OSHA, ISO standards for semiconductor manufacturing
- **Training**: Safety training, fostering a safety culture, emergency drills

Textbooks & Reference Books:

1. **"Semiconductor Safety Handbook"** by J. S. Dickerson
2. **"Introduction to Industrial Safety"** by S. K. Srivastava
3. **"Handbook of Semiconductor Manufacturing Technology"** by Yung Chien
4. **"Workplace Safety: A Guide for Small and Medium-Sized Companies"** by Christopher R. Findlay
5. **"Semiconductor Manufacturing Handbook"** by Hwaiyu Geng

BTVTPE603E SOC Design 2: Design & Verification 4 credits

Prerequisites:

- Digital logic design, HDL, and VLSI design.

Course Outcomes:

CO1: Understand the architecture and components of SOC.

CO2: Learn the importance of verification in SOC design.

CO3: Understand the integration of processor cores and peripherals in SOC design.

CO4: Integrate prototyping and emulation techniques for SOC verification.

Program Outcomes :

PO1: Apply knowledge of SOC design and verification methodology.
PO2: Analyze design flows and challenges in the context of SOC.
PO3: Implement efficient processor and peripheral integration in SOC designs.
PO4: Utilize simulation and formal verification to check SOC functionality.

Module 1: Introduction to SOC Design and Verification

- **SOC Components**: Processor cores, memory, peripherals, interconnects
- **SOC Design Flow**: Top-down and bottom-up design approaches, RTL design, synthesis, verification
- **Verification Overview**: Challenges, importance, and methodologies in SOC verification

Module 2: SOC Architecture and Integration

- **Processor Architectures**: ARM, MIPS, RISC-V cores
- **Peripheral Integration**: UART, SPI, I2C, GPIO, buses (AHB, AXI)
- **Design Considerations**: Performance, power, and area trade-offs, low-power techniques

Module 3: Verification Methodology

- **Testbench Design**: Testbench architecture, test planning, and coverage analysis
- **Simulation**: RTL simulation and waveform analysis
- **Formal Verification**: Model checking and comparison with simulation

Module : Advanced Verification Techniques

- **SystemVerilog**: Assertions, randomization, coverage
- **UVM (Universal Verification Methodology)**: Agents, sequences, scoreboards for SOC verification
- **Coverage Analysis**: Code, functional, and path coverage

Module 5: Verification Tools and Prototyping

- **SOC Design Tools**: RTL design tools (Cadence, Synopsys)
- **Verification Tools**: ModelSim, Questa, VCS, debugging tools (ChipScope, SignalTap)
- **Prototyping & Emulation**: FPGA-based prototyping, hardware/software co-simulation

Textbooks & Reference Books:

1. **"System-on-Chip Design and Modeling"** by Ricardo Reis
2. **"Verification of Digital and Mixed-Signal Circuits"** by Kenneth S. Kundert
3. **"System Design with SystemVerilog"** by Peter Flake
4. **"ASIC Design and Verification"** by S. J. Jha
5. **"Digital Systems Design with FPGAs and CPLDs"** by Ian Grout

BTVTPE603F Mixed Signal Circuits 4 credits

Prerequisites:

- Basic analog and digital electronics knowledge.

Course Outcomes:

CO1: Understand the basic principles of analog and digital circuits.
CO2: Comprehend the significance and applications of mixed signal circuits in modern technology.
CO3: Learn how to design and evaluate ADC/DAC circuits for performance and accuracy.
CO4: Learn the principles of analog and digital filters for mixed-signal applications.
CO5: Understand the design techniques for integrating analog and digital subsystems.

Program Outcomes :

PO1: Apply knowledge of analog and digital circuit principles in mixed signal designs.

PO2: Identify real-world applications and challenges in mixed signal circuits.

PO3: Analyze trade-offs in converter designs, focusing on power, speed, and resolution.
PO4: Design effective signal conditioning circuits for accurate analog-to-digital conversion.

Module 1: Introduction to Mixed Signal Circuits

- **Analog vs Digital Circuits**: Basic concepts of analog and digital systems
- **Importance of Mixed-Signal Circuits**: Applications in communications, sensors, and data converters

Module 2: ADC (Analog-to-Digital) & DAC (Digital-to-Analog) Converters

- **Types of ADCs**: SAR, Flash, Delta-Sigma, Pipeline ADCs
- **Types of DACs**: Binary-Weighted, R-2R Ladder, Current-Steering DACs
- **Design Challenges**: Power, resolution, speed

Module 3: Signal Conditioning & Filtering

- **Signal Conditioning**: Amplification, impedance matching
- **Analog Filters**: Low-pass, high-pass, band-pass
- **Digital Filters**: FIR, IIR filters

Module 4: Mixed Signal Circuit Design Techniques

- **Analog-Digital Integration**: Reducing noise and interference
- **Power Management**: Low-power techniques for mixed-signal systems
- **Clocking & Synchronization**: Timing in mixed-signal systems

Module 5: Advanced Mixed Signal Systems & Applications

- **High-Speed Systems**: RF, data converters for high-speed applications
- **Practical Applications**: Sensors, communication, and IoT systems
- **Design Challenges**: Signal integrity, noise immunity

Textbooks & Reference Books:

1. **"Design of Analog CMOS Integrated Circuits"** by Behzad Razavi
2. **"Mixed-Signal Systems: A VLSI Perspective"** by C. L. Liu
3. **"CMOS Analog Circuit Design"** by Phillip E. Allen
4. **"Analog and Digital Signal Processing"** by K. L. S. Sharma
5. **"CMOS Mixed-Signal Circuit Design"** by Sung-Mo Kang

OEC-II

BTVTOE604A Computer Network 4 credits

Course Outcomes:

CO1. To develop an understanding of modern network architectures from a design and performance perspective.
CO2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
CO3. To provide an opportunity to do network programming
CO4. To provide a WLAN measurement idea.

Program Outcomes:
1. To master the terminology and concepts of the OSI reference model and the TCP-IP reference model.
2. To master the concepts of protocols, network interfaces, and design/performance issue s in local area networks and wide area networks.
3. To be familiar with wireless networking concepts.
4. To be familiar with contemporary issues in networking technologies.

UNIT – 1 Physical Layer:
Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

UNIT – 2 Data Link Layer:
Introduction to Data Link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet, 10 Gigabit Ethernet.

UNIT– 3 Wireless LANS & Virtual Circuit Networks and Network Layer:
Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, connecting devices and Virtual LANS: Connecting devices, Virtual LANS. Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT – 4 Transport Layer:
Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT – 5 Application Layer:
Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

TEXT/REFERENCE BOOKS:
1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan,McGraw-Hill.
2. TCP/IP Protocol Suite, 4th Edition, Behrouz A. Forouzan, TataMcGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice HallIndia.

4. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

BTVTOE604B Low Power VLSI Design 4 credits

Prerequisites:

- Basics of CMOS logic and VLSI design.

Course Outcomes:

CO1: Understand the need and importance of low power in VLSI design.
CO2: Comprehend different power consumption models and estimation techniques.
CO3: Learn digital circuit power reduction techniques such as clock gating and multi-Vt design.
CO4: Learn energy-efficient techniques for analog-to-digital conversion.
CO5: Understand the principles of adiabatic logic and its application to low power design.

Program Outcomes:
PO1: Apply power estimation methods for VLSI circuit analysis.
PO2: Identify challenges in achieving low power in VLSI systems.
PO3: Design energy-efficient analog and mixed-signal circuits for low power consumption.
PO4: Apply adiabatic logic techniques in VLSI circuit designs for ultra-low power operation

Module 1: Introduction to Low Power VLSI Design

- **Overview of Low Power Design**: Importance in modern VLSI circuits
- **Power Consumption Models**: Dynamic power, leakage power, and short-circuit power
- **Design Challenges**: Impact of technology scaling on power

Module 2: Power Reduction Techniques in Digital Circuits

- **Clock Gating**: Principles and applications in power saving
- **Multi-Vt Design**: High-Vt and low-Vt transistors for power optimization
- **Power Gating**: Power reduction using sleep transistors during idle states

Module 3: Low Power Design in Analog and Mixed-Signal Circuits

- **Low Power Analog Circuits**: Biasing, sizing, and transistor scaling
- **ADC/DAC Power Optimization**: Techniques for low power in converters
- **Energy Efficient Techniques**: Sub-threshold operation for ultra-low power

Module 4: Low Power CMOS Logic Design

- **CMOS Logic Optimization**: Power-efficient design techniques for CMOS gates
- **Adiabatic Logic**: Power reduction through adiabatic switching
- **Multi-Level Logic**: Power-efficient design for complex circuits

Module 5: Low Power Design Methodologies and Tools

- **Low Power Design Flows**: Methodologies for power optimization at various abstraction levels

- **Power-Aware Simulation**: Simulation techniques for low power circuits
- **CAD Tools**: Tools for low power design, such as Cadence, Synopsys

Textbooks & Reference Books:

1. **"Low Power VLSI Design"** by Kaushik Roy, Sharat C. Prasad
2. **"CMOS VLSI Design: A Circuits and Systems Perspective"** by Neil Weste, David Harris
3. **"Low-Power CMOS VLSI Circuit Design"** by Kaushik Roy
4. **"Design of Low-Power Integrated Circuits and Systems"** by A. Chandrakasan
5. **"Digital Integrated Circuits: A Design Perspective"** by Jan M. Rabaey

BTVTOE604C Patents and IPR 4 credits

Course Outcomes:

1. Understand the basics of intellectual property (IP) and its importance.
2. Learn different types of IPR (patents, copyrights, trademarks).
3. Understand the patent filing process and patent databases.
4. Study patent laws and regulations at national/international levels.
5. Analyze the role of patents in innovation and industry.

Program Outcomes:

1. Apply knowledge of IP laws to protect technological innovations.
2. Recognize the importance of patents and IPR in research and industry.
3. Analyze and apply IP protection mechanisms.
4. Develop skills in patent filing and legal documentation.
5. Communicate effectively about patenting strategies and licensing.

UNIT –1 Patents:

Designs, Trade and Copyright, Classification of patents in India, Categories of Patent, Special Patents, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models

UNIT – 2 Patent Rights:

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT – 3 Overview of Intellectual Property:

Introduction of IPR, Need for intellectual property right (IPR), IPR in India – Genesis and Development IPR in abroad,

UNIT – 4 New Developments in IPR:

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies.

UNIT – 5 Case studies:

Case studies related to patents and IPR.

TEXT/REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.Saeed Benjamin Niku, "Introduction to Robotics – Analysis, Control, Applications", Wiley India Pvt. Ltd., Second Edition,2011

2. Mayall, "Industrial Design", McGraw Hill,1992

3. Niebel , "Product Design", McGraw Hill,1974.

4. Asimov, "Introduction to Design", Prentice Hall,1962.

5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age",2016.

BTVTOE604D Memory Design 4 credits

Prerequisites:

- Understanding of digital circuits and VLSI design principles.

Course Outcomes:
CO1: Understand the importance of memory systems and their classifications.
CO2: Learn about the memory hierarchy and the technologies involved.
CO3: Learn about the design considerations for both static and dynamic memories.
CO4: Explore emerging memory technologies and their potential future applications.

Program Outcomes :
PO1: Apply knowledge of memory systems in practical design scenarios.
PO2: Analyze and compare various memory technologies for system design.
PO3: Develop the ability to analyze and troubleshoot memory design issues.
PO4: Design advanced memory systems, including 3D and high-performance memories.

Module 1: Introduction to Memory Systems

- Types of memory: SRAM, DRAM, Flash, ROM
- Memory hierarchy and technologies
- Challenges in memory design (speed, cost, power)

Module 2: Static and Dynamic Memory Design

- SRAM: Basic structure, 6T cell design
- DRAM: Cell architecture, refresh mechanism
- Design considerations for SRAM and DRAM

Module 3: Memory Access and Performance

- Memory timing, control signals, and addressing
- Memory access modes (sequential, random)
- Error detection (Parity, ECC)

Module 4: Non-Volatile Memory (NVM) Design

- Flash memory: Types (NAND, NOR), cycles, endurance
- Emerging NVMs: PCM, MRAM, ReRAM

- Challenges in NVM design (speed, power, retention)

Module 5: Advanced Memory Design and Future Trends

- 3D memory architecture and applications
- Memory for high-performance systems (GPUs, processors)
- Emerging technologies: Neuromorphic memory, memristors

Textbooks & Reference Books:

1. **"Digital Integrated Circuits: A Design Perspective"** by Jan M. Rabaey
2. **"Memory Systems: Cache, DRAM, Disk"** by Bruce Jacob, Spencer Ng, David Wang
3. **"CMOS Memory Circuit Design"** by M. L. Laskar
4. **"VLSI Design: From Architecture to Gate-Level Implementation"** by Michael John Sebastian
5. **"Memory Design and Optimization"** by Ronald Sass

BTVTOE604E Research Methodology 4 credits

Prerequisites:

- Basic knowledge of scientific research and technical writing.

Course Outcomes:
CO1: Understand the purpose and process of research.
CO2: Formulate research problems and hypotheses effectively.
CO3: Understand and design research methodologies (experimental, observational).
CO4: Develop skills for writing and structuring research papers.

Program Outcomes :
PO1: Apply the knowledge of research methodologies in problem-solving.
PO2: Understand and develop research questions and hypotheses relevant to engineering.
PO3: Use research design techniques to structure experiments and studies.
PO10: Understand the process of publishing research and its impact on academic and professional growth.

Module 1: Introduction to Research

- Definition, objectives, and types of research
- Research process and methodology
- Research problem formulation and hypothesis

Module 2: Literature Review and Research Design

- Importance of literature review
- Sources of literature and citation tools
- Research design: Experimental, observational, and descriptive studies

Module 3: Data Collection and Analysis

- Data collection methods: Surveys, interviews, and experiments

- Sampling techniques and sample size determination
- Data analysis: Descriptive statistics, inferential statistics, and software tools (SPSS, R, MATLAB)

Module 4: Research Ethics and Writing

- Ethical issues in research
- Writing research papers, reports, and theses
- Citation styles and plagiarism

Module 5: Research Presentation and Publication

- Effective presentation skills for research work
- Preparing and submitting research papers for publication
- Journal impact factor, peer review process, and conference presentations

Textbooks & Reference Books:

1. **"Research Methodology: A Step-by-Step Guide for Beginners"** by Ranjit Kumar
2. **"The Craft of Research"** by Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams
3. **"Practical Research: Planning and Design"** by Paul D. Leedy & Jeanne Ellis Ormrod
4. **"Research Methods for Engineers"** by David V. Thiel
5. **"The Essentials of Research Methodology"** by H. R. Glick

BTVTOE604F Materials for Semiconductor Packaging 4 credits

Prerequisites:

- Basic understanding of semiconductor devices and electronics.

Course Outcomes:
CO1: Understand the role and importance of packaging in semiconductor devices.
CO2: Learn about different types of semiconductor packaging technologies & materials.

Program Outcomes :
PO1: Apply knowledge of packaging materials to enhance semiconductor device performance.
PO2: Understand the design requirements for semiconductor packaging.

Module 1: Introduction to Semiconductor Packaging

- Overview and importance of semiconductor packaging
- Types of packages: Through-hole, surface mount, flip-chip
- Key requirements for packaging materials: Electrical, mechanical, thermal

Module 2: Materials Used in Semiconductor Packaging

- **Substrate Materials:** PCB, ceramic, organic materials
- **Lead frame Materials:** Copper, brass, and alloys
- **Encapsulate & Molding Compounds:** Epoxy-based compounds, underfill materials
- **Soldering Materials:** Lead-based and lead-free solders

Module 3: Thermal Management

- Thermal management techniques: Heat sinks, thermal vias, TIMs
- Materials for heat dissipation and low thermal resistance
- Thermal cycling impact on materials

Module 4: Electrical Performance and Reliability

- Electrical conductivity and dielectric properties
- Signal integrity and EMI in packaging
- Reliability testing: Thermal cycling, moisture, mechanical stress
- Failure modes in packaging: Delamination, corrosion

Module 5: Advanced Materials and Future Trends

- Emerging materials: Carbon nanotubes, graphene, nanomaterials
- 3D packaging and heterogeneous integration
- Sustainability and environmental considerations in packaging

Textbooks & Reference Books:

1. **"Semiconductor Packaging"** by John H. Lau
2. **"Microelectronics Packaging Handbook"** by R. G. O’Rourke, A. S. L. Loh
3. **"Electronic Packaging: Design and Manufacture"** by Keith B. Brown
4. **"Handbook of Semiconductor Manufacturing Technology"** by Yung Chien
5. **"Semiconductor Assembly and Packaging Technology"** by D. L. R. Mayne

BTHM605 Employability and Skill Development 3 credits

Course Objectives:

1. To develop analytical abilities.
2. To develop communication skills.
3. To introduce the students to skills necessary for getting, keeping and being successful in a profession.
4. To expose the students to leadership and team-building skills.

Course Outcomes: On completion of the course, student will be able to:

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

UNIT – 1 Soft Skills & Communication basics

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

UNIT – 2 Interpersonal Skills:

Critical Thinking, Assertiveness, Decision Making, Problem Solving, Negotiation, Building Confidence, Time Management, Personal Presentation, Assertiveness, negotiation, avoiding Stress. Commercial Awareness: Professional etiquettes and manners, Global negotiating and Persuading, Integrity. Global trends and statistics about civil engineering businesses.

UNIT – 3 Grammar and Comprehension

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

UNIT – 4 Skills for interviews:

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skillsvirtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

UNIT – 5 Problem Solving Techniques

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions. Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

TEXT/REFERENCE BOOKS:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, "Soft Skills- An integrated approach to maximize personality", ISBN: 987-81-265-5639-7, First Edition 2016, WileyWren and Martin, "English grammar and Composition", S. Chandpublications.

2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chandpublications.

3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & SonsLtd.

4. Philip Carter, Ken Russell, "Succeed at IQ test", KoganPage.

5. Eugene Ehrlich, Daniel Murphy, "Schaum‟s Outline of English Grammar", McGraw Hills.