Gurugram University Gurugram

SCHEME & CURRICULUM

for

BACHELOR OF TECHNOLOGY

UG DEGREE PROGRAMME

in

Electronics Engineering (VLSI Design and Technology)

Engineering & Technology

(w.e.f. Session 2022-2023)

Gurugram University,Gurugram, Haryana

Gurugram University Gurugram

DEPARTMENT

OF

ENGINEERING & TECHNOLOGY

Electronics Engineering
(VLSI Design and Technology)

FACULTY OF SCIENCES & TECHNOLOGY

Gurugram University Gurugram

Gurugram University Gurugram

Vision

Gurugram University aspires to be a front runner in global education; role model for institutional excellence, trans-cultural quality learning, intellectual growth, contemporary research, capacity building and nurturing socially and morally responsible disciples through a learner- centric approach. The university seeks to ensure a journey from studentship to epitome of discipleship by working on academic, professional, technical, industry and life skills of its students.

Mission

1. **To become a socially conscious centre of knowledge and advancement equipped to take up the challenges of the global change as well as committed to empower its teachers for the development of the students.**
2. **To move up through international alliances and collaborative initiatives to achieve global excellence.**
3. **To create rigorous academic and research environment for creation of knowledge and its perpetual advancement.**
4. **To attract and build people in a rewarding and inspiring environment by fostering freedom, empowerment, creativity, scientific zeal and innovation.**

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DEPARTMENT OF ENGINEERING & TECHNOLGY

ELECTRONICS ENGINEERING

(VLSI Design and Technology)

VISION

- To become center of quality education, research with innovation in the field of Electronics Engineering (VLSI Design and Technology) and be recognized at National and International level for serving society.

MISSION

1. To provide quality education to aspiring young minds for improving their scientific knowledge and technical skills in the area of Electronics Engineering (VLSI Design and Technology)
2. To produce socially committed trained professionals who can contribute effectively to the advancement of their organization and society through their scientific knowledge.
3. To foster innovation in VLSI Design and Technology and allied areas by collaborating with industry and other R&D organizations.

ABOUT THE PROGRAM

The Bachelor of Technology (B.Tech.) program in Electronics Engineering (VLSI Design and Technology) **has a strong flavor on design and hands-on experience. The program includes a deeper study of a number of engineering subjects to which students are introduced at the core curriculum level, theoretical and programming solutions of real world problems and design of systems relevant to the software organizations. The areas introduced by the department include Electronics Engineering, Mathematical and Computational Techniques, Scientific & Technical writing Skills, VLSI Design, Fundamentals of Artificial Intelligence & Machine Learning, VLSI Processing Technology, Computer Networks & Internet of Things etc. Besides the theoretical and laboratory based curriculum, students complete an advanced programming project in the final year of the program including one full semester in an industry/R&D. This degree provides a solid foundation in core Electronics Engineering , VLSI Design and Technology and VLSI for AI (Computer Engineering). Through the academic program, students also develop excellent written and oral communication skills, learn to work as a team and project management.**

NOTE:

1. The scheme will be applicable from Academic Session 2022-23 onwards.

2. The scheme will also be applicable to the students who are admitted in 2022-23 academic session and are transiting in 3rd Semester of their program.

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B.TECH PROGRAM
Electronics Engineering
(VLSI Design and Technology)

PROGRAM EDUCATION OBJECTIVES

PEO1	To create knowledge about core areas related to the field of computer science and information technology.
PEO2	To enable students to apply mathematics, science and computer engineering principles to model, design and implement software projects to meet customers' business objectives.
PEO3	To develop the ability to evaluate the computing systems from view point of quality, security, privacy, cost effectiveness, utility and ethics.
PEO4	To inculcate lifelong learning by introducing principles of group dynamics, public policies, environmental and societal context

PROGRAM OUTCOMES

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1	Ability to design and develop computing systems using concepts of Mathematics, Computer Engineering and other related disciplines to meet customers' business objectives.
PSO2	Ability to test and analyze the quality of various subsystems and to integrate them in order to evolve a larger computing system.

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GENERAL COURSE STRUCTURE & CREDIT DISTRIBUTION

STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM

S.No.	Category	Breakup of Credits (Total 160)
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	20
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	29.5
4	Professional core courses	68
5	Professional Elective courses relevant to chosen specialization/branch	12
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	15
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	Non-credit
9	**Total**	**168.5**

SEMESTER WISE SUMMARY OF THE PROGRAM

S.No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	27/26	900	20.5/19.5
2.	II	28/29	1000	23/24
3.	III	34	1000	22
4.	IV	34	1000	24
5.	V	36	1100	25
6.	VI	31	1000	24
7.	VII	30	1000	20
8.	VIII	11	600	16
	Total	231	7600	168.5

COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project

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CREDIT DISTRIBUTION IN THE FIRST YEAR OF UNDERGRADUATE ENGINEERING PROGRAM

Sr. No.	Course Code	Subject	Lecture (L)	Tutorial (T)	Laboratory/ Practical (P)	Total credits (C)
1.	HSE-101	Communication Skills in English	2	0	0	2
2.	BSM-103	Mathematics-I	3	1	0	4
3.	BSP-103 OR EEE-103	Physics OR Basic of Electrical Engineering	3 3	1 0	0 0	4 OR 3
4.	CSE-101	Programming for problem solving using C	3	0	0	3
5.	ENV-101	Basics of Environmental Science	2	0	0	2
6.	HSE-101P	Communication Skills in English (P).	0	0	2	1
7.	BSP-103P OR EEE-103P	Physics (P) OR Basic of Electrical Engineering (P)	0	0	2	1 OR 1
8.	CSE-101P	Programming for problem solving using C (P)	0	0	2	1
9.	MEE-102P	Workshop Practices (P)	1	0	3	2.5
10.	AUS-101	Sports (Audit Course) Compulsory	0	0	2	0
11.	BSM-104	Mathematics-II	3	1	0	4
12.	HSV-102	Human Value & Soft Skills	2	0	2	3
13.	CSE-102	Data Structure Using C	3	0	0	3
14.	CSE-106	Python Programming	3	0	0	3
15.	ECE-102	Electronics Engineering – I	3	0	0	3
15.	CSE-102P	Data Structure Using C (P)	0	0	2	1
16.	CSE-106P	Python Programming (P)	0	0	2	1
17.	ECE-102P	Electronics Engineering- I (P)	0	0	2	1
Total Credits						43.5

MANDATORY INDUCTION PROGRAM (3-WEEKS DURATION)

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. A 3-week long induction program for the UG students entering the institution, right at the start, has to be planned. Normal classes will start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

Tentative activities which can be planned in this Induction Programme are as follows:

- Physical Activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to Local Area
- Familiarization to Dept./Branch & Innovations

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HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

S. No.	Code No.	Course Title	Hours Per week			Total Credits	Semester
			L	T	P		
1	HSE-101	Communication Skills in English	2	0	0	2	1st
2	ENV -101	Basic of Environmental Science	2	0	0	2	1st
3	HSE-101 P	Communication Skills in English (P)	0	0	2	1	1st
4	HSV-102	Human Values and Soft Skills	2	0	2	3	2nd
5		Economics for Engineers	0	0	2	2	5th
6		Scientific and Technical Writing Skills	0	0	2	2	4th
					Total Credits	12	

BASIC SCIENCE COURSES (BSC)

S. No.	Code No.	Course	Hours Per Week			Total Credits	Semester
			L	T	P		
1	BSM – 103	Mathematics – I	3	1	0	4	1st
2	BSP- 103	Physics	3	1	0	4	1st/2nd
3	BSP-103P	Physics (P)	0	0	2	1	1st/2nd
4	BSM – 104	Mathematics – II	3	1	0	4	2nd
5	BSC	Probability theory and Stochastic Processes	3	1	0	3	3rd
6		Indian Constitution	2	0	0	2	3rd
7		Renewable Energy Resources	2	0	0	2	6th
					Total Credits	20	

ENGINEERING SCIENCE COURSE (ESC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	EEE-103	Basic of Electrical Engineering	3	0	0	3	1st /2nd
2	EEE-103P	Basic of Electrical Engineering(P)	0	0	2	1	1st /2nd
3	MEE-102P	Workshop Practices (P)	1	0	3	2.5	1st
4	ECE-102P	Electronics Engineering (P)	0	0	2	1	2nd
5	ECE-102	Electronics Engineering	3	0	0	3	2nd

6	CSE-101	Programming for Problem Solving Using C	3	0	0	3	1st
7	CSE-101P	Programming for Problem Solving Using C (P)	0	0	2	1	1st
8	CSE-102	Data Structure Using C	3	0	0	3	2nd
9	CSE-106	Python Programming	3	0	0	3	2nd
10	CSE-102P	Data Structure Using C (P)	0	0	2	1	2nd
11	CSE-106P	Python Programming (P)	0	0	2	1	2nd
12		Computer architecture and Organization	3	1	0	3	3rd
13		Mathematical and Computational Techniques	3	1	0	3	5th
14		Mathematical and Computational Techniques Lab	0	0	2	1	5th
					Total Credits	**29**	

PROFESSIONAL CORE COURSES (PCC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	PCC	Digital Electronics	3	1	0	3	3rd
2	PCC	Electronics Engineering II	3	1	0	3	3rd
3	PCC	Network Analysis and Synthesis	3	1	0	3	3rd
4	PCC	Signals and Systems	3	1	0	3	3rd
5	PCC	Digital Electronics Lab	0	0	2	1	3rd
6	PCC	Electronics Engineering II Lab	0	0	2	1	3rd
7	PCC	Network Analysis and Synthesis Lab	0	0	2	1	3rd
8	PCC	Analog and Digital Communication	3	1	0	3	4th
9	PCC	Electromagnetic Wave and Field Theory	3	1	0	3	4th
10	PCC	Microprocessors and Interfacing	3	1	0	3	4th
11	PCC	Information Theory and Coding	3	1	0	3	4th
12	PCC	Digital system and design	3	1	0	3	4th
13	PCC	Introduction to VLSI lifecycle	3	1	0	3	4th
14	PCC	Analog and Digital Communication Lab	0	0	2	1	4th
15	PCC	Microprocessors and Interfacing Lab	0	0	2	1	4th
16	PCC	Digital system and design	0	0	2	1	4th

		Lab					
17	PCC	Introduction to VLSI lifecycle Lab	0	0	2	1	4th
18	PCC	Digital signal Processing	3	1	0	3	5th
19	PCC	Electronic Instruments and Measurements	3	1	0	3	5th
20	PCC	Digital VLSI Design	3	1	0	3	5th
21	PCC	Digital signal Processing Lab	0	0	2	1	5th
22	PCC	Electronic Instruments and Measurements Lab	0	0	2	1	5th
23	PCC	Digital VLSI Design Lab	0	0	2	1	5th
24	PCC	VLSI Processing Technology	3	1	0	3	6th
25	PCC	Control System Engineering	3	1	0	3	6th
26	PCC	Embedded System Design	3	1	0	3	6th
27	PCC	VLSI Processing Technology Lab	0	0	2	1	6th
28	PCC	Control System Engineering Lab	0	0	2	1	6th
29	PCC	Embedded System Design Lab	0	0	2	1	6th
30	PCC	VLSI verification and Testing	3	1	0	3	7th
31	PCC	Semiconductor Materials Synthesis and Characterizations	3	1	0	3	7th
32	PCC	VLSI verification and Testing Lab	0	0	2	1	7th
33	PCC	Semiconductor Materials Synthesis and Characterizations Lab	0	0	2	1	7th
					Total Credits	**68**	

PROFESSIONAL ELECTIVE COURSES (PEC)

S. No.	**Code No.**	**Course Title**	**Hours Per Week**			**Total Credits**	**Semester**
			L	**T**	**P**		
1	PEI	Program Elective I	3	1	0	3	5th
2	PEII	Program Elective II	3	1	0	3	6th
3	PEIII	Program Elective IIII	3	1	0	3	6th
4	PEIV	Program Elective IV	3	1	0	3	7th
					Total Credits	**12**	

OPEN ELECTIVE COURSES (OEC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	OEI	Open Elective I	3	1	0	3	5th
2	OEII	Open Elective II	3	1	0	3	6th
3	OEIII	Open Elective III	3	1	0	3	7th
4	OEIV	Open Elective IV	3	1	0	3	7th
					Total Credits	12	

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

Sl. No	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	PW	Micro Project/Training I	5th	0	0	2	1
2	PW	Mini Project/Training	6th	0	0	2	1
3	PW	Major Project I	7th	0	0	4	2
4	PW	Project Training/ Seminar II	7th	0	0	2	1
5	PW	Major Project II/Industrial Training	8th	0	0	5	10
						Total Credits	15

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Semester wise Structure and Curriculum for

UG Course in Electronics Engineering (VLSI Design and Technology)

(Engineering & Technology)

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[B.Tech. VLSI Design and Technology (1st Semester)]

Sr. No.	Course Code	Subject	L	T	P	Credits	Marks for Sessional	Marks for end-term examination	Total
1.	HSE-101	Communication Skills in English	2	0	0	2	30	70	100
2.	BSM-103	Mathematics-I	3	1	0	4	30	70	100
3.	BSP-103 OR EEE-103	Physics OR Basic of Electrical Engineering	3 3	1 0	0 0	4 OR 3	30 30	70 70	100 100
4.	CSE-101	Programming for problem solving using C	3	0	0	3	30	70	100
5.	ENV-101	Basics of Environmental Science	2	0	0	2	50	50	100
6.	HSE-101P	Communication Skills in English (P).	0	0	2	1	50	50	100
7.	BSP-103P OR EEE-103P	Physics (P) OR Basic of Electrical Engineering (P)	0	0	2	1 OR 1	50 50	50 50	100 100
8.	CSE-101P	Programming for problem solving using C (P)	0	0	2	1	50	50	100
9.	MEE-102P	Workshop Practices (P)	1	0	3	2.5	50	50	100
10.	AUS-101	Sports (Audit Course) Compulsory*	0	0	2	0	50	50	100*
Total Credits						20.5/19.5			900

L: Lecture , T: Tutorial , P: Practical/Laboratory

Sports: Non-credit mandatory course, students have to attain pass marks (40%)

Note: Exams duration will be as under

(a) Theory exams will be of 03 hours duration.

(b) Practical exams will be of 02 hours duration

Question paper Instructions: Attempt Five Questions in all; Question No.1 is compulsory and attempt four questions from the remaining selecting atleast one question from each Unit. Use of Non-programmable scientific calculator is allowed.

Note: For Labs: Hands-on experiments related to the respective course contents …

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Course code	HSE-101 **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	Humanities and Social Sciences			
Course title	Communication Skills in English			
Scheme and Credits	L	T	P	Credits
	2	0	0	2
Class work/ Practical	30 Marks			
Exam	70 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			
Class work/ Practical	30 Marks			

Objectives of the course:

1.The course will focus on the four integral skills of language, improving the proficiency levels in all of them and to learn to use language as a tool for effective communication.

2.This course will widen the understanding of the learners in all genres of literature (short stories, poetry, autobiographies.) with the help of expository pieces.

3.The course will strive to equip the learner with the ability to express oneself and be understood by others with clarity and precision, in both written and spoken forms.

4.This course will encourage creative use of language through translation, paraphrasing and paragraph writing.

5.Along with the above, the course will also build confidence and encourage the students to use a standard spoken form of English in order to prepare them to face job interviews, workplace and in higher studies.

Unit: 1

Remedial English : Parts of speech, Gerunds, Participles and infinitives; Clauses; Sentence constructions (unity; avoidance of choppy and rambling sentences, logic and consistency, conciseness, sequencing of ideas); Sentence errors-agreement between verb and subject, pronoun and antecedents, sequence of tenses, problems involving modifiers (dangling and misplaced modifiers); Shifts in point of view consistency of number and person, tense, mood, voice and subject; Parallelism; Omissions and mixed constructions.

Unit: 2

Vocabulary : Methods of building vocabulary-etmological roots, prefixes and suffixes; Commonly used foreign words and phrases; spelling; words often confused synonyms and homonyms; one word substitutes; verbal idioms.

Unit: 3

Punctuation and Mechanics: End Punctuation; internal Punctuation; Word Punctuation. Comprehension: Abstracting; Summarizing; Observation, Findings and Conclusions; Illustration and Inductive Logic; Deduction and Analogy.

Unit: 4

Presentation: Oral presentation- Extempore, discussion on topics of contemporary relevance, Interviews.

Written Comprehension: The ability to write after listening to and reading select speeches, news bulletins, presentations and answering questions based on what has been heard. Reading the given texts to skim, scan, infer and answer comprehension questions. Reading texts like case studies and project reports for critical assessment and book Review.

Suggested Books:

1. Nitin Bhatnagar and Mamta Bhatnagar, Communicative English for Engineers and Professionals. Pearson Education.

2.Bhatnagar, k. Manmohan. Ed. The Spectrum of Life: An Anthology of Modern Prose. Delhi: Macmillan India Ltd., 2006.

3 C. Murlikrishna & Sunita Mishra, Communication Skills for Engineers, Pearson Ed.

4 Sinha, R.P.Current English Grammar and Usage. OUP.
5.Rizvi, M. Ashraf. Effective Technical Communication. McGraw Hill Education (India) Pvt. Ltd., 2014.
6.Eastwood, John. Oxford Guide to English Grammar.OUP, 2010.
7.Kumar, Sanjay and Pushp Lata. Communication Skills. OUP, 2011.
8. Raman, Meenakshi and Sangeeta Sharma. Communication Skills. New Delhi: OUP,2011.
9.Hill, L.A.A Guide to Correct English.London:OUP,1965.
10.Oxford Dictionary of English Idioms. New Delhi: OUP, 2009
11*http://yousigma.com/religionandphilosophy/swamivivekananda/thescecretofwork.pdf

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Course Code	BSM-103 **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	Basic Science Course			
Course title	Mathematics-I			
Scheme and Credits	L	T	P	Credits
	3	**1**	**0**	**4**
Class work	30 Marks			
Exam	70 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Objectives of the course

1. To develop logical understanding of the subject
2. To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Engineering fields.
3. To make aware students about the importance and symbiosis between Mathematics and Engineering.

Unit-I

Matrices & Its Application: Elementary Matrices, Elementary Transformations, Inverse using elementary transformations, Rank of a matrix, Normal form of a matrix, Linear dependence and independence of vectors, Consistency of linear system of equations, Linear and Orthogonal Transformations, Eigenvalues and Eigenvectors, Properties of eigenvalues, Cayley-Hamilton Theorem, Diagonalization of Matrices.

Unit-II

Sequences and Series: Convergence of sequence and series, Tests for convergence, Power series: Taylor's series, series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit-III

Differential Calculus: Limit, Continuity and Differentiability of function of single variable, Successive Differentiation, Leibnitz Theorem, Taylor's and Maclaurin's Series for Single Variable function, Partial derivatives, Homogeneous functions, Euler's Theorem, Jacobian, Maxima-Minima of function of two variables, Lagrange's Method of undetermined multipliers.

Unit-IV

Integral Calculus: Basic concepts of integration and properties of definite integrals, Applications of single integration to find volume of solids and surface area of solids of revolution, Double integral, Change of order of integration, Double integral in Polar Co-ordinates, Applications of double integral to find area enclosed by plane curves, Triple integral, Beta and Gamma functions.

Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Pearson Education.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3. D. Poole, Linear Algebra: A Modern Introduction, Brooks Cole.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
7. V. Krishnamurthy, V.P. Mainra and J. L. Arora, An introduction to Linear Algebra, Affiliated East– West Press Private limited

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Course code	BSP-103	**[B.Tech. VLSI Design and Technology (1st Semester)]**		
Category	**Basic Science Course**			
Course title	**Physics**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**4**
Class work	**30Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

UNIT – I

Electrostatics in vacuum and linear dielectric medium Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential Boundary conditions of electric field and electrostatic potential; energy of a charge distribution and its expression in terms of electric field. Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement.

UNIT – II

Electromagnetism and Magnetic Properties of Materials Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, applications of dielectric Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

UNIT – III

Wave Optics and Lasers Wave Optics: Huygens' principle, superposition of waves and interference of light by wave-front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Lasers: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity.

UNIT – IV

Introduction to Solids and Semiconductors Free electron theory of metals, Fermi level, density of statesin1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p -n junction.

Suggested Reference books

1. E. Hecht, "Optics", Pearson Education
2. D. J. Griffiths, "Quantum mechanics", Pearson Education
3. B.G. Streetman, "Solid State Electronic Devices", Pearson Education
4. G. Main, "Vibrations and waves in physics", Cambridge University Press
5. H. J. Pain, "The physics of vibrations and waves", Wiley
6. A. Ghatak, "Optics", McGraw Hill Education,
7. O. Svelto, "Principles of Lasers", Springer Science & Business Media,
8. R. Robinett, "Quantum Mechanics", OUP Oxford
9. D. McQuarrie, "Quantum Chemistry", University Science Books
10. D. A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago
11. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore

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Course code	EEE-103 **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	**Engineering Science Course**			
Course title	**Basics of Electrical Engineering**			
Scheme and Credits	L	T	P	Credits
	3	**0**	**0**	3
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Objectives of the course

1. To explain the laws used in the analysis of DC and AC circuits.
2. To explain the behavior of circuit elements in single-phase circuits.
3. To explain the construction and operation of transformers, DC generators and motors, Induction motors, and synchronous generators.

Unit: 1.

DC Circuits: Concept of electrical fields, charge, current, voltage, energy and their inter relationships. Electrical networks elements (R, L and C), voltage and current sources (ideal & controlled), series and parallel circuits.
Classification of electrical networks, Ohm's law, Kirchhoff's law and their applications for network solutions (Nodal and Mesh Analysis), Source transformation, star delta conversion. Network theorems: Superposition theorem, Thevenin and Norton Theorems, Millman Theorem, maximum power transfer theorem, Substitution and Reciprocity theorems.

Unit: 2

Electrostatics: Electrostatics field, electric flux density, electric field strength, absolute permittivity, relative permittivity, capacitance and capacitor, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and time constant.

AC Fundamentals: Sinusoidal voltages and currents, their mathematical and graphical representation, concept of instantaneous, peak (maximum), average and R.M.S. values, frequency, cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

Unit: 3

AC Circuits: Study of Single phase series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams. Concept of active power, reactive power, apparent power, complex power, power factor and resonance in series and parallel RLC circuit. Q- factor and bandwith. Introduction to three- phase circuits.

Single phase transformers: Construction, principle of working, E.M.F. equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. autotransformers and dimmer stats

Unit: 4

Electrical Machines: Introduction, Generation of rotating magnetic fields. Construction and working of separately excited DC motor, Single-phase induction motor, Three-phase induction motor and Synchronous generators.

Safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock, and Working principle of Fuse and Miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

Suggested books:

1. E. Huges, "Electrical Technology", ELBS.

Suggested reference books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. V. Del Toro, "Principles of Electrical engineering", PHI.
3. Basic Electrical Engineering, A.E. Fitzgerald , David Higginbotham 2009 , Arvin Grabel, Tata McGraw-Hill Publishing Company; 5th Edition.

Course code	EEE-101 **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	**Engineering Science Course**			
Course title	**Programming for Problem Solving Using C**			
Scheme and Credits	L	T	P	Credits
	3	**0**	**0**	3
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Unit 1

Introduction to Programming: Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. C Programming: Keywords, Variables and Data Types: basic, derived and user defined, Type Conversions, Header Files, Basic Input and Output Functions and Statements, Compilation, Syntax and Logical Errors in compilation, Object and Executable Code, Storage Classes, Arithmetic Expressions and Precedence.

Unit 2

Preprocessors, Conditional and Branching Statements, Loops/ Iterative Statements, Writing and evaluation of conditionals and consequent branching.

Unit 3

Arrays (1-D, 2-D), Character Arrays and Strings, Arrays with Pointers, Functions (including using built in libraries), Parameter passing in functions, Call by Value, Call by Reference, Passing arrays to functions, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc.

Unit 4

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, Introduction to Dynamic Memory Allocation and its Methods, Structures, Union, Defining Structures and Array of Structures, File Handling.

Suggested Text Books:

1. Ajay Mittal, Programming in C, 'A Practical Approach', Pearson Education.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
4. Yashavant Kanetkar, Let Us C, BPB Publication.

Suggested Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

Gurugram University Gurugram

Course code	ENV-101 **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	**Humanities and Social Sciences**			
Course title	**Basics of Environmental Science**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	2	**0**	**0**	**2**
Class work	**50Marks**			
Exam	**50Marks**			
Total	**100Marks**			
Duration of Exam	**03 Hours**			

Course Objective:

To impart the knowledge and awareness for the environmental protection for real-time contribution during an execution of engineering practices in the society.

Unit 1

Environmental studies and Natural Resources: Definition, scope and importance of environmental studies.

Natural Resources: Renewable and non-renewable resources, and associated problems

(a) Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people.

(b)Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.

(c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.

(d)Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers-pesticides problems, water logging, salinity.

(e) Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.

Unit 2

Eco Systems: Concept of an eco-system, Structure and function of an eco-system, Producers, consumers, decomposers, Energy flow in the ecosystems, Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystems: (a) Forest ecosystem (b) Grass land ecosystem (c) Desert ecosystem (d) Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3

Environmental Pollution: Definition, Causes, effects and control measures of; (a) Air pollution (b)Soil pollution (c) Marine pollution (d)Noise pollution (e) Nuclear hazards

Disaster management: Floods, earth quake, cyclone and landslides.

Unit 4

Social issues and the Environment: From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management.

Environmental ethics: issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment protection Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act, Wildlife protection Act, Forest conservation Act, Issues involved in enforcement of environmental legislations.

Recommended Books:

1. Textbook of Environmental studies, Erach Bharucha, UGC.
2. Fundamental concepts in Environmental Studies, D. D. Mishra, S Chand & Co Ltd.

Course Outcomes :

1.To understand the basic concepts of environmental studies and natural resources.

2. To learn about the various eco-systems of nature.
3. To gain knowledge about different types of environmental pollutions and their control measures.
4. To acquire the knowledge about the various social aspects related to the environment.

Course code	HSE-101P **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	**Humanities and Social Sciences**			
Course title	**Communication Skills in English (P)**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work/ Practical	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Communication Skills in English (P)

Lab Activity: The students will acquire basic proficiency in English with special emphasis on listening, comprehension and speaking skills both at social and professional platforms.

1. Listening comprehension
2. Recognition of phonemes in International Phonetic Alphabet
3. Self introduction and introduction of another person
4. Conversation and dialogues in common everyday situations
5. Communication at work place (Standard phrases and sentences in various situations)
6. Telephonic communication
7. Speeches for special occasions (Welcome speeches, Introduction speeches, Felicitation speeches and Farewell speeches)
8. Tag Questions
9. Formal Presentations on literary texts prescribed in theory paper, Question Formation & Mock Press Conference

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Course code	BSP-103P **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	**Basic Science Course**			
Course title	**Physics (P)**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. To find out wavelength of monochromatic light using Newton's ring experiment.
2. To find out wavelength of monochromatic light using Diffraction grating.
3. To find out wavelength of monochromatic light using Freshnel's bi-prism
4. To study interference phenomena using Michelson's Interferometer and to find out wavelength of monochromatic light.
5. To study Hall effect in semiconductors and measure the Hall coefficient.
6. To find frequency of AC mains using sonometer.
7. To study the magnetic properties of materials using B-H curve.
8. To study the Curies temperature of materials using Dielectric set up.
9. To verify the inverse square law with the help of a photovoltaic cell.
10. To determine Planks constant using photocell.
11. To study the characteristics of Solar cell and find out the fill factor.
12. To find temperature co-efficient of platinum using Callender Griffith bridge.
13. To study the forward and reverse characteristics of P-N junction diode.

Course code	EEE-103P **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	Engineering Science Course			
Course title	**Basics of Electrical Engineering (P)**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 8 experiments are to be performed by the students.
List of Subject related Experiments:
1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. (Resistors, Capacitors and Inductors)
2. Verification of Ohm's Law, Kirchhoff current and voltage laws
3. To measure the power in three phase circuits using two wattmeter method.
4. To verify Thevenin's and Norton theorems.
5. To verify Maximum power transfer and Superposition theorems.
6. To perform direct load test of a transformer and plot efficiency Vs load characteristic.
7. To perform O.C. and S.C. tests of a transformer.
8. Measurement of power in a 3-phase system by two wattmeter method.
9. Measurement of power by 3 voltmeter/3 Ammeter method.
10. To verify the resonance in R-L-C circuits.
11. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
12. Torque Speed Characteristic of shunt dc motor.

Course code	**CSE-101P [B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	**Professional Core Course**			
Course title	**Programming for Problem Solving Using C (P)**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 6 experiments are to be performed by the students.

List of Subject related Experiments:

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions

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Course code	MEE-102P **[B.Tech. VLSI Design and Technology (1st Semester)]**			
Category	**Engineering Science Course**			
Course title	**Workshop Practices (P)**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	1	**0**	**3**	**2.5**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Objectives of the course

1. To impart fundamental Knowledge of engineering practices such as fitting, wood working, foundry, machining, welding, etc. for manufacturing a product.
2. To prepare the students to understand the various tools and equipment's used in these processes and their working principle
3. To impart fundamental Knowledge of Lathe machine
4. To able to understand the basic knowledge of various welding processes

Class Work

Introduction: Introduction to Manufacturing Processes and their Classification, Introduction to additive manufacturing, Industrial Safety.

Machining Shop : Lathe, description of lathe: headstock, tailstock, gearbox, carriage, apron, cutting speed, feed & depth of cut, cutting tools, Chucks: 3 jaw, 4 jaw.

Fitting shop: Introduction, classification of metals: ferrous and nonferrous, fitting tools: measuring and marking tools, marking schemes for a fitting jobs, cutting tools.

Carpentry shop:Introduction of carpentry, types of woods, carpentry tolls: measuring tools, marking tolls, cutting tools: saws, chisels, planning tools, drilling tools, striking tools, drilling tools, wood working joints, wood working lathe.

Foundry Shop : Introduction, foundry hand tools, measuring boxes, ladle, moulding, furnaces,Pattern: Types of Pattern and Allowances

Welding Shop: Introduction to welding, Classification of Welding Processes,Arc welding & Gas welding equipment's.

Reference Books:

1. S K Hajra Choudhury, Nirjhar Roy, A K Hajra Choudhury, Elements of workshop Technology (vol. 1&2), Media Promoters.
2. B S Raghuwanshi, A Course in Workshop Technology (manufacturing Process vol. 1& 2) Dhanpat Rai & CO.
3. O.P. Khanna, Workshop Technology. Dhanpat Rai Publication.
4. W A J Chapman, Workshop technology in SI unit (part – 1 &2), Mc Graw Hill Education.
5. M.P. GROOVER, Principles of Modern Manufacturing, Wiley.
6. Kalpakjian, Manufacturing Process for Engineering Materials, Pearson Education India.

Lab Work

List of Experiments

1. To study different types of measuring tools used in metrology and determine least counts of vernier callipers, micrometres and vernier height gauges.
2. To study different types of machine tools (lathe, shaper, planer, milling, drilling machines)
3. To prepare a job on a lathe involving like facing, outside turning, taper turning, step turning, radius making and parting-off.
4. To study different types of fitting tools and marking tools used in fitting practice.
5. To prepare a job made out of MS Flats, making saw – cut filling V-cut taper at the corners.
6. To prepare lay out on a metal sheet by making and prepare rectangular tray pipe shaped components e.g. funnel.
7. To prepare joints for welding suitable for butt welding and lap welding.

8. To study various types of carpentry tools and prepare simple types of at least two wooden joints.
9. To prepare simple engineering components/shapes by forging.
10. To prepare mold and core assembly.
11. To prepare horizontal surface/vertical surface/curved surface/slats or V-grooves on a shaper/planner.
12. To prepare a job involving side and face milling on a milling
13. To prepare a job on CNC Machine/Additive Manufacturing.

Note : At least eight experiments/jobs are to be performed/prepared by the students in the semester.

Gurugram University Gurugram

Gurugram University
Scheme of Studies and Examination
Bachelor of Technology (VLSI Design and Technology) Semester-2

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credits	Marks	Marks	Total
			L	T	P			For sessional	For End term Exam.	
1.	BSM-104	Mathematics-II	3	1	0	4	4	30	70	100
2.	HSV-102	Human Value & Soft Skills	2	0	2	4	3	30	70	100
3.	EEE-103 OR BSP-103	Basics of Electrical Engineering OR Physics	3 3	0 1	0 0	3 OR 4	3 OR 4	30 30	70 70	100 100
4.	CSE-102	Data Structure Using C	3	0	0	3	3	30	70	100
5.	CSE-106	Python Programming	3	0	0	3	3	30	70	100
6.	ECE-102	Electronics Engineering-I	3	0	0	3	3	30	70	100
7.	EEE-103P OR BSP-103P	Basics of Electrical Engineering (P) OR Physics (P)	0	0	2	2	1	50 50	50 50	100 100
8.	CSE-102P	Data Structure Using C (P)	0	0	2	2	1	50	50	100
9.	CSE-106P	Python Programming (P)	0	0	2	2	1	50	50	100
10.	ECE-102P	Electronics Engineering-I (P)	0	0	2	2	1	50	50	100
Total 28 / 29							**23/24**			**1000**

L: Lecture , T: Tutorial , P: Practical/Laboratory

Sports: Non-credit mandatory course, students have to attain pass marks (40%)

Note: Exams duration will be as under

(a) Theory exams will be of 03 hours duration.

(b) Practical exams will be of 02 hours duration

Question paper Instructions: Attempt Five Questions in all; Question No.1 is compulsory and attempt four questions from the remaining selecting atleast one question from each Unit. Use of Non-programmable scientific calculator is allowed.

Note: For Labs: Hands-on experiments related to the respective course contents …

Gurugram University Gurugram

Course code	BSM-104 **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Basic Science Course			
Course title	Mathematics-II			
Scheme and Credits	L	T	P	Credits
	3	4	0	4
Class work/ Practical	30 Marks			
Exam	70 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			
Class work/ Practical	30 Marks			

Objectives of the course:

1. Demonstrate their understanding of mathematical ideas from multiple perspectives.
2. To develop logical understanding of the subject
3. To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Engineering fields.
4. To make aware students about the importance and symbiosis between Mathematics and Engineering.

Unit-I

Ordinary Differential Equations: Exact differential equations, Equations reducible to exact differential equations, Applications of differential equations of first order & first degree to simple electric circuits, Newton's law of cooling, Heat flow and Orthogonal trajectories, Linear Differential equations of second and higher order, Complete solution, Complementary function and Particular integral, Method of variation of parameters to find particular integral, Cauchy's and Legendre's linear equations.

Unit-II

Laplace Transforms and its Applications: Laplace transforms of elementary functions, Properties of Laplace transforms, Existence conditions, Transforms of derivatives, Transforms of integrals, Multiplication by tn , Division by t, Evaluation of integrals by Laplace transforms, Laplace transform of unit step function, Unit impulse function and Periodic function, Inverse transforms.

Unit-III

Partial Differential Equations: Formation of partial differential equations, Lagrange' linear partial differential equation, First order non-linear partial differential equation, Charpit's method, Method of separation of variables

Unit-IV

Basic Statistics: Measures of Central tendency: Mean, Median, Mode, Measures of Dispersion, Moments, Skewness and Kurtosis, Moments, Variance of a sum, Correlation coefficient, Correlation and regression – Rank correlation; Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Reference Books:

1) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Pearson Education.
2) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3) Ramana B.V., Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited.
4) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
6) P. Sivaramakrishna Das and C. Vijyakumari, Engineering Mathematics, Pearson Education.
7) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India.
8) S. L. Ross, Differential Equations, Wiley India.
9) R. K, Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publication House Private Limited

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Course Code	HSV-102 **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Humanities and Social Sciences			
Course title	Human Values and Soft Skills			
Scheme and Credits	L	T	P	Credits
	2	**0**	**2**	**3**
Class work	30 Marks			
Exam	70 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Ojectives of the course

1.The course aims at developing the desired English language skills of students of Engineering and Technology so that they become proficient in communication to excel in their professional lives. The course has been designed as to enhance their linguistic and communicative competence.

2.Understanding (Clarity) of Human Relationships and Family.

3.Exposure to Issues in Society and nature (larger manmade systems and Nature).

Unit: 1

Motivation and Objectives of Human Values Course, Purpose of Education, Complimentarily of skills and values, how the current education system falls short, Peers Pressure, Social Pressure In various dimensions of life, Concept of Competition and Time Management.

Unit: 2

Concept of Preconditioning, Concept of Natural Acceptance in Human Being, Understanding Relationships, Dealing with anger, Nine universal values in human relationships. Concept of prosperity, idea of Society, Idea of decentralization of politics, economics, education, justice etc., Its comparison with centralized systems, Balance in nature.

Unit: 3

Techniques of Good Writing, Writing self assessment tasks, Precis writing and note making. Paragraph and Essay writing, Article writing and summarizing

Unit: 4

Business Communication: Formal and Informal Letter writing, Statement of Purpose, Job application & CV (summary statement of academic & professional profiles) and Power point presentations through relevant slides.

English Lab Activity: Blog Writing/Creating a Newsletter, Script writing & enacting for a street play. Develop negotiating skills by using appropriate language of courtesy, Recording individual efforts and holding paired interactions and Group Discussions, Preparing and practising for Interviews.

Suggested reference books

Recommended Readings:

1. Bhatnagar, Nitin andMamtaBhatnagar.Communicative English for Engineers and Professionals.Pearson Education, 2013.
2. Swan, Michael.Practical English Usage. OUP, 1995.
3. Gangal, J.K. Practical Course in Spoken English. New Delhi: PHI Learning, 2015.
4. Konar,Nira. Communication Skills for Professionals. New Delhi: PHI Learning Pvt. Ltd., 2009.
5. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Longman, 1983.
6. Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. Delhi: PHI Learning Pvt. Ltd., 20
7. Annie Leonard, `` The Story of Stuff,'' Free Press
8. Mohandas Karamchand Gandhi,`` The Story of My Experiments with Truth,"

Beacon Press
9. J Krishnamurthy,`` On Education,” Official repository
10. Hermann Hesse ,`` Siddhartha,” Bantam Books
11. ThichNhatHanh,`` Old Path White Clouds,” Parallex Press
12. On Education - The Mother Aurobindo Ashram Publication

Course code	BSP-103 **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	**Basic Science Course**			
Course title	**Physics**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**4**
Class work	**30Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

UNIT – I

Electrostatics in vacuum and linear dielectric medium

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential Boundary conditions of electric field and electrostatic potential; energy of a charge distribution and its expression in terms of electric field. Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement.

UNIT – II

Electromagnetism and Magnetic Properties of Materials

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, applications of dielectric Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

UNIT – III

Wave Optics and Lasers

Wave Optics: Huygens' principle, superposition of waves and interference of light by wave-front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Lasers: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity.

UNIT – IV

Introduction to Solids and Semiconductors

Free electron theory of metals, Fermi level, density of statesin1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p -n junction.

Suggested Reference books

1. E. Hecht, "Optics", Pearson Education
2. D. J. Griffiths, "Quantum mechanics", Pearson Education
3. B.G. Streetman, "Solid State Electronic Devices", Pearson Education
4. G. Main, "Vibrations and waves in physics", Cambridge University Press
5. H. J. Pain, "The physics of vibrations and waves", Wiley

6. A.Ghatak, “Optics”, McGraw Hill Education,
7. O. Svelto, “Principles of Lasers”, Springer Science & Business Media,
8. R. Robinett, “Quantum Mechanics”, OUP Oxford
9. D. McQuarrie, “Quantum Chemistry”, University Science Books
10. D. A. Neamen, “Semiconductor Physics and Devices”, Times Mirror High Education Group, Chicago
11. 10.E.S. Yang, “Microelectronic Devices”, McGraw Hill, Singapore

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Course code	EEE-103 **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	**Engineering Science Course**			
Course title	**Basics of Electrical Engineering**			
Scheme and Credits	L	T	P	Credits
	3	**0**	**0**	3
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Objectives of the course

1. To explain the laws used in the analysis of DC and AC circuits.
2. To explain the behavior of circuit elements in single-phase circuits.
3. To explain the construction and operation of transformers, DC generators and motors, Induction motors, and synchronous generators.

Unit: 1.

DC Circuits: Concept of electrical fields, charge, current, voltage, energy and their inter relationships. Electrical networks elements (R, L and C), voltage and current sources (ideal & controlled), series and parallel circuits.
Classification of electrical networks, Ohm's law, Kirchhoff's law and their applications for network solutions (Nodal and Mesh Analysis), Source transformation, star delta conversion. Network theorems: Superposition theorem, Thevenin and Norton Theorems, Millman Theorem, maximum power transfer theorem, Substitution and Reciprocity theorems.

Unit: 2

Electrostatics: Electrostatics field, electric flux density, electric field strength, absolute permittivity, relative permittivity, capacitance and capacitor, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and time constant.

AC Fundamentals: Sinusoidal voltages and currents, their mathematical and graphical representation, concept of instantaneous, peak (maximum), average and R.M.S. values, frequency,
cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities
and phasor representation. Rectangular and polar representation of phasors.

Unit: 3

AC Circuits: Study of Single phase series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams. Concept of active power, reactive power, apparent power, complex power, power factor and resonance in series and parallel RLC circuit. Q- factor and bandwith. Introduction to three- phase circuits.

Single phase transformers: Construction, principle of working, E.M.F. equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. autotransformers and dimmer stats

Unit: 4

Electrical Machines: Introduction, Generation of rotating magnetic fields. Construction and working of separately excited DC motor, Single-phase induction motor, Three-phase induction motor and Synchronous generators.

Safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock, and Working principle of Fuse and Miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

Suggested books:

1.E. Huges, "Electrical Technology", ELBS.

Suggested reference books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. V. Del Toro, "Principles of Electrical engineering", PHI.
3. Basic Electrical Engineering, A.E. Fitzgerald , David Higginbotham 2009 , Arvin Grabel, Tata McGraw-Hill Publishing Company; 5thEdition.

Course code	CSE-102 **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Professional Core Course			
Course title	Data Structures Using C			
Scheme and Credits	L	T	P	Credits
	3	**0**	**0**	3
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Unit: 1

Introduction Fundamentals of pointers in C, pointer declaration, passing pointer to functions, pointers and arrays, dynamic memory allocation, Definition of Algorithm, Data Abstraction, Performance Analysis & Measurement, Files and related operations inC. Data Structures vs Data Types.

Searching and SortingTechniques

Searching techniques: Linear and Binary, Sorting techniques: Selection, Bubble, Insertion, Merge sort, Quicksort, List and Table Sorting.

Unit: 2

Linear Data Structures- I Arrays: Definition of array, Array storage, sparse arrays; Transpose, addition, and multiplication of sparse matrices, Stacks and Queues and their applications, expression evaluation, A mazing problem; multiple stacks and queues in an array, Application of stacks recursion polish expression and their compilation conversion of infix expression to prefix and postfix expression, Tower of Hanoi problem.

Unit: 3

Linear Data Structures- II Linked Lists; definition, allocation for stacks and queues. Examples of linked lists, polynomial addition, comparison of sequential and linked allocation of storage; inversion, concatenation & copying of the lists. Implementations in C language.

Doubly Linked List: Definition of circular and doubly linked list, header node, insertion and deletion, sparse matrix, representation using doubly linked lists. Examples for application of doubly linked lists; dynamic storage management; node structures, routines for allocation and deallocation, generalized lists and recursive algorithms for copying and comparison oflists.

Unit: 4

Non Linear Data Structures Trees, Basic concepts and definitions of a tree and binary tree and associated terminology, Binary tree traversal techniques, Binary tree representation of trees, transformation of trees into binary trees, some more operations on binary trees, Binary Search Trees, Heaps and heapsort, threaded binary trees, Graphs: Representation of graphs and their traversal, Minimum cost Spanning Trees.

BOOKS:

1. Seymour Lipschutz:Data Structures with C, Schaum's outline by TMH
2. E Horowitz and S. Sahni: Fundamentals of Data Structures in C, Second Edition, Universities Press, Hyderabad.
3. R.B. Patel: Expert Data Structures in C, Khanna Publishers,2001.
4. R.L. Kruse: Data Structures & Program Design in C, PHI.
5. D.F. Knuth: The art of Computer Programming Vol 1, Narosa Publications,1985.
6. Byron S. Gottfried & J K Chhabra: Theory and Problems of Programming with C Language, SchaumSeries, TMH,2005.

Course code	CSE-106 **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Professional Core Course			
Course title	Python Programming			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**0**	**0**	**3**
Class work	**30Marks**			
Exam	**70Marks**			
Total	**100Marks**			
Duration of Exam	**03 Hours**			

Unit: 1

Introduction: Installing Python; basic syntax, interactive shell, editing, saving, and running a script; data types; variables, assignments; numerical types; arithmetic operators and expressions; Loops and selection statements, Control statements String manipulations: subscript operator, indexing, slicing a string; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file

Unit: 2

Lists, dictionary and Design with functions: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding, and removing keys, accessing and replacing values; traversing dictionaries. Hiding redundancy, complexity; arguments and return values; Program structure and design. Recursive functions.

Unit: 3

Object Oriented concepts: Design with Classes persistence storage of objects, inheritance, polymorphism, operator overloading, exception handling, module, packages. Graphical User Interfaces: Terminal based and GUI based programs, Simple GUI-Based Programs, Windows and Window Components, Input and Output with Entry Fields, Defining and Using Instance Variables, Other Useful GUI Resources

Unit: 4

Advance concepts: Simple graphics and image processing, Turtle operations, Manipulating turtle screen, Drawing two dimensional shapes, examining an object attributes, Taking a random walk, Image processing: Image manipulation operations, properties of images.

Basics of panda and numpy, use of anaconda, How to create dashboard and overview of Django

Suggested books:

1.Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.

2.Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.

Suggested reference books

1. Fundamentals of Python: First Programs, Kenneth Lambert, Course Technology, Cengage Learning, 2012.
2. Introduction to Computer Science Using Python: A Computational Problem-Solving Focus, By Charles Dierbach, John Wiley & Sons, December 2012

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Course code	ECE-102 **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	**Engineering Science Course**			
Course title	**Electronics Engineering -I**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**0**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Objective of the Course :-

1. To familiarize students to the electronics devices.
2. To introduce p-n junction theory, operation of the semiconductor devices and their use in basic electronic circuits.
3. To introduce BJT & FET, operation of the semiconductor devices and their use in basic electronic circuits.

Unit: 1

Conducting materials: Review of energy bands, description of materials, drift velocity, collision time, Mean free path, mobility, conductivity, relaxation time, factors affecting conductivity of materials, types of thermal conductivity, Wiedmann-Franz law, super conductivity, effect of magnetic field, conducting materials, applications.

Semiconductor characteristics: Review of Si and Ge as semiconducting materials, Continuity Equation, P-N junction, Drift & Diffusion, Diffusion & Transition capacitances of P-N junction. Introduction to p-n junction diode and its applications.

Unit: 2

P-N junction diode and its applications: Introduction to p-n junction diode and its applications. Half wave & full wave rectifiers. clipping circuits, clamping circuits, filter circuits, peak to peak detector and voltage multiplier circuits.

Some Special Devices: Zener diode, Photodiodes, photo detectors, solar cell, light emitting diodes, semiconductor lasers, and light emitting materials.

Unit: 3

Bipolar junction transistors: Fundamentals of BJT, BJT biasing :base bias, emitter feedback bias, collector feedback bias, voltage divider bias and its operation , BJT voltages and currents characteristics: CE, CB and CC, and DC & AC load line and bias point. Thermal stability, BJT as a switching circuits, transistor power dissipation. Construction and working of SCR (semiconductor controlled rectifier), DIAC, TRIAC, IGBT,

Unit: 4

Field Effect Devices: JFET: basic Operation and characteristics, drain and transfer characteristics, pinch off voltage, parameters of JFET: Transconductance (gm), ac drain resistance (rd), amplification factor(μ) ,Small Signal Model & Frequency Limitations. MOSFET: basic operation, depletion and enhancement type, pinch-off voltage, Shockley equation and Small Signal Model of MOSFET, MOS capacitor. UJT: Introduction and its applications. Brief introduction to Planar Technology for device fabrication.

Suggested books:

1. J. Millman and C. Halkias, Integrated Electronics, McGraw Hill, 2nd Edition, 2009
2. A.Sedra and C. Smith, Microelectronic Circuits: Theory and Applications, Oxford University Press,

6th Edition 2013

Suggested reference books

1. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory" Pearson publishers, 10th Edition
2. Tyagi M.S., "Introduction to Semiconductor Materials and Devices", John Wiley & Sons, 1993.
3. Spencer and Ghausi, Introduction to Electronic Circuit Design, Pearson Education, 2003
4. Dutta, Semiconductor Devices and Circuits, Oxford University Press, ND 2008

Course code	BSP-103P **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	**Basic Science Course**			
Course title	**Physics (P)**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. To find out wavelength of monochromatic light using Newton's ring experiment.
2. To find out wavelength of monochromatic light using Diffraction grating.
3. To find out wavelength of monochromatic light using Freshnel's bi-prism
4. To study interference phenomena using Michelson's Interferometer and to find out wavelength of monochromatic light.
5. To study Hall effect in semiconductors and measure the Hall coefficient.
6. To find frequency of AC mains using sonometer.
7. To study the magnetic properties of materials using B-H curve.
8. To study the Curies temperature of materials using Dielectric set up.
9. To verify the inverse square law with the help of a photovoltaic cell.
10. To determine Planks constant using photocell.
11. To study the characteristics of Solar cell and find out the fill factor.
12. To find temperature co-efficient of platinum using Callender Griffith bridge.
13. To study the forward and reverse characteristics of P-N junction diode.

Course code	EEE-103P **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Engineering Science Course			
Course title	**Basics of Electrical Engineering (P)**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 8 experiments are to be performed by the students.
List of Subject related Experiments:
1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. (Resistors, Capacitors and Inductors)
2. Verification of Ohm's Law, Kirchhoff current and voltage laws
3. To measure the power in three phase circuits using two wattmeter method.
4. To verify Thevenin's and Norton theorems.
5. To verify Maximum power transfer and Superposition theorems.
6. To perform direct load test of a transformer and plot efficiency Vs load characteristic.
7. To perform O.C. and S.C. tests of a transformer.
8. Measurement of power in a 3-phase system by two wattmeter method.
9. Measurement of power by 3 voltmeter/3 Ammeter method.
10. To verify the resonance in R-L-C circuits.
11. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
12. Torque Speed Characteristic of shunt dc motor.

Course code	CSE-102P **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Professional Core Course			
Course title	Data Structures Using C (P)			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Write a program to search an element in a two-dimensional array using linear search.
2. Using iteration & recursion concepts write programs for finding the element in the array using Binary Search Method
3. Write a program to perform following operations on tables using functions only
(a) Addition (b) Subtraction (c) Multiplication (d) Transpose
4. Using iteration & recursion concepts write the programs for Quick Sort Technique
5. Write a program to implement the various operations on string such as length of string concatenation, reverse of a string & copy of a string to another.
6. Write a program for swapping of two numbers using 'call by value' and 'call by reference strategies.
7. Write a program to implement binary search tree.
8. (Insertion and Deletion in Binary search Tree)
9. Write a program to create a linked list & perform operations such as insert, delete, update, reverse in the link list
10. Write the program for implementation of a file and performing operations such as insert, delete, update a record in the file.
11. Create a linked list and perform the following operations on it (a) add a node (b) Delete a node

Course code	ECE-102P **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Professional Core Course			
Course title	Electronics Engineering -I (P)			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 8 experiments are to be performed by the students.

Objective: To attain expertise in lab equipment handling and understanding the basic devices, their properties, characteristics in detail. Along with their practical usage in the circuit

1. Study of lab equipments and components: CRO, Multimeter, Function Generator, Power supply- Active, Passive Components & Bread Board.
2. Study of V-I Characteristics of Si and Ge Diodes
3. Study of Zener Diode Characteristics and Zener Diode as Voltage Regulator
4. Study of Half Wave and Full Wave Rectifiers
5. Study of Rectifiers with Filters
6. Study of BJT Characteristics
7. Study of FET Characteristics
8. Study of BJT Biasing
9. To plot V-I Characteristics of DIAC.
10. To draw V-I characteristics of TRIAC for different values of Gate Currents.
11. Study of Characteristic of silicon-controlled rectifier.

Course code	CSE-106P **[B.Tech. VLSI Design and Technology (2nd Semester)]**			
Category	Professional Core Course			
Course title	Python Programming (P)			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	0	**0**	**2**	**1**
Class work	**50 Marks**			
Exam	**50 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

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B.Tech. Electronics Engineering
(VLSI Design and Technology)
Scheme of Studies/Examination
Semester 3

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	BSC		**Probability Theory and Stochastic Processes**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
2	PCC		**Digital Electronics**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
3	PCC		**Electronics Engineering-II**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
4	PCC		**Network Analysis and Synthesis**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
5	PCC		**Signals and Systems**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
6	ESC		**Computer architecture and Organization**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
7	PCC		**Digital Electronics _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
8	PCC		**Electronics Engineering- II _ Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
9	PCC		**Network Analysis and Synthesis _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
10	MC		**Indian Constitution***	**2**	**0**	**0**	**0**	**50**	**50**	**50***
Total							**21**			**900**

***Indian Constitution: Non-credit mandatory course, students have to attain pass marks (40%)**

Note: Exams duration will be as under

(c) Theory exams will be of 03 hours duration.

(d) Practical exams will be of 02 hours duration

Question paper Instructions: Attempt Five Questions in all; Question No.1 is compulsory and attempt four questions from the remaining selecting atleast one question from each Unit. Use of Non-programmable scientific calculator is allowed.

Note: For Labs: Hands-on experiments related to the respective course contents …

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Course code	**[B.Tech. VLSI Design and Technology (3rd Semester)]**			
Category				
Course title	**Probability and Stochastic Processes**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Objectives:

1. To understand the basics of probability.
2. To be able finding the difference between probability density function, probability distribution function.
3. To understand the characteristic functions of a random variable.

Course Contents:

UNIT-I
Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

UNIT-II
Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions.

UNIT-III
Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

UNIT-IV
Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.
Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density.

NPTEL course (if any): https://archive.nptel.ac.in/courses/117/105/117105085/

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.

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.
5. Ability of understanding the different stationary process.
6. Understanding of Power spectral density.

Course code	**[B.Tech. VLSI Design and Technology (3rd Semester)]**			
Category				
Course title	**Digital Electronics**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Objectives:

1. To understand the number systems-representation-conversions.
2. To get the ideas about implementation of logic gate and families.

CONTENTS

Unit-1

Review of number systems-representation-conversions, error detection and error correction. Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms-minterm and maxterm, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates.

Unit-2

Switching properties of Diodes, BJT and FET, Logic gates, Overview and comparison of logic families DTL, TTL, ECL, I 2L, CMOS Gates and their parameters and comparisons.

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realization of Boolean expressions- using decoders-using multiplexers.

Unit-3

Sequential circuits: latches, flip flops, edge triggering, asynchronous inputs. Shift registers, Universal shift register, applications. Binary counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

Unit-4

Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machine- serial binary adder, sequence recognizer, state table reduction, state assignment.

Semiconductor Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs. Introduction to advanced memory concepts.

Web link(s):

1. https://nptel.ac.in/courses/108/105/108105132/ (NPTEL Video by Prof. GautamSaha from IIT Kharagpur)
2. https://nptel.ac.in/courses/108/105/108105113/ (NPTEL Video by Prof.Santanu from IIT Kharagpur)

Text Books:

1. D. D. Givone, "Digital Principles and Design", Tata Mc-Graw Hill, New Delhi, 2003.
2. Wakerly J F, "Digital Design: Principles and Practices, Prentice-Hall", 2nd Ed., 2002.
3. S.Brown and Z.Vranesic, "Fundamentals of Digital Logic with Verilog Design", Tata McGraw Hill, 2008.

Reference Books:

1. M. M. Mano, "Digital Design", 3rd ed., Pearson Education, Delhi, 2003.
2. D.P. Leach, A. P. Malvino, GoutamGuha, "Digital Principles and Applications", Tata McGraw Hill, New Delhi, 2011.
3. R.J.Tocci and N.S.Widner, "Digital Systems - Principles& Applications", PHI, 10th Ed., 2007.

Course outcomes:

After completion of the course, student will be able to:

1. Review number systems and Boolean algebra.
2. Logic families, Design combinational circuits with basic logic gates.
3. Devise sequential logic circuits with basic logic gates.
4. Analyze synchronous circuit using state diagrams based on Moore and Mealy configurations.
5. Optimization of Counters for random sequence.
6. Introduction to advanced memory concepts.

Course code	[B.Tech. VLSI Design and Technology (3rd Semester)]			
Category				
Course title	**Electronics Engineering -II**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Objectives:

1. Understand the characteristics of diodes and transistors
2. Design and analyze various rectifier and amplifier circuits
3. Design sinusoidal and non-sinusoidal oscillators

CONTENTS

Unit-1

Introduction to op-amps: ideal Characteristics, Pin configuration of 741 op-amp. Bias, offsets and drift, bandwidth and slew rate. Offset and Frequency compensation. Exercise problems. Practical op amps, Basic building blocks: Current sources and active loads.

Unit-2

Linear and non-linear applications of op-amps: Inverting and non-inverting amplifiers, Applications: inverting and non- inverting summers, difference amplifier, differentiator and integrator, Voltage to current converter. Instrumentation amplifier, Log and antilog amplifiers. Precision rectifier, Non-linear function generator.Analog IC Multipliers, Comparators, Astable and Monostable multi vibrator.

Unit-3

Wave form- generators: Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.

Active filters: Low pass, High pass, Band pass and Band Reject filters. IC voltage regulators: IC 723 general purpose regulator, Switching Regulator.

Unit-4

Timers: 555 Timer functional diagram, monostable and astable operation, applications.

Digital to analog and analog to digital converters: Weighted resistor DAC, R-2R and inverted R2R DAC. Counter type ADC, successive approximation ADC, Flash ADC, dual slope ADC, sigma-Delta ADC.

Web link(s):

1. https://nptel.ac.in/courses/108/108/108108125/ (NPTEL Video by Prof. Hardik J Pandya from IISC Bangalore)
2. https://nptel.ac.in/courses/108/108/108108114/ (NPTEL Video by Prof.Hardik J Pandya from IISC Bangalore)
3. https://nptel.ac.in/courses/108106084

Text Books:

1. G B Clayton, Operational Amplifiers, 5th Edition, Elsevier science, 2003
2. Sergio Franco, Design With Operational Amplifier and Analog Integrated Circuits, 4th Edition, TMH, 2011.

3. Roy Choudary D. and Shail B. Jain, Linear Integrated circuits, 4th Edition, New Age International Publishers, 2010
4. RamakantA.Gayakward, Op-Amps and Linear Integrated Circuits, 4th Edition, PHI, 2010.

Reference Books:

1. Sedra and Smith, Microelectronics Circuits, Oxford Univ. Press, 2004
2. Coughlin, Driscoll, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 2001.
3. B.G.Streetman and S. Banerjee, Solid State Electronic Devices, Prentice Hall.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Describe the characteristics of op-amp and design op-amp circuits to perform arithmetic operations.
2. Design linear and non-linear applications using op-amps.
3. Waveform generators, Apply filters and voltage regulators using functional ICs.
4. Evaluate the functions of timer functional ICs. Choose appropriate A/D and D/A converters for signal processing applications.
5. Design ADC and DAC
6. Design sinusoidal and non-sinusoidal oscillators

Course code	[B.Tech. VLSI Design and Technology (3rd Semester)]			
Category				
Course title	Network Analysis & Synthesis			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Objectives:

1. To get ideas about solving the big electrical network.
2. To find the ability of getting the knowledge of different network theorems.
3. To understand the concept of different circuits of R,L,C.

Unit-1

Fundamentals of network elements: Linear versus nonlinear, time-variant and time invariant, passive verses active, causal and non-anticipated, stable and unstable networks, Network theorems: superposition, Thevenin and Norton's maximum power transfer, Y-Delta transformation.

Unit-2

Network concept, Network graph theory, notations and definitions, incidence matrix, cutsets and fundamental loops, fundamental cutsets matrix, Kirchoff voltage law, Kirchoff current low, interrelation ship between matrices of a graph, Tellegen's theorem and its application. Network equilibrium equations.Node and Mesh method.Source superposition.Thevenin's and Norton's theorems.

Unit-3

First and second order networks.State variable analysis of circuits, formulation of state equations, solution of state equations.Transient Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace Transform, Sinusoidal steady-state analysis, Network functions. Determination of the natural frequencies and mode vectors from network functions. Millman Theorem, Maximum power-transfer theorem. Resonance.Equivalent and dual networks.Design of equalizers.Substitution Theorem.

Unit-4

Two-port network parameters.Interconnection of two port networks.Barlett,,s bisection theorem.Image and Iterative parameters.Design of attenuators.Network graph theory, Tree, Cutset, Incident Matrix.

Two-terminal network synthesis.Properties of Hurwitz polynomial and Positive real function.Synthesis of LC, RC and RL Networks, Foster Forms and Cauer Forms.Introduction to passive filters low pass, high pass, band pass and band reject filters.

Web link(s):

1. https://nptel.ac.in/courses/108/105/108105159/ (NPTEL Video by Prof.Tapas Kumar from IIT Kharagpur)
2. https://nptel.ac.in/courses/108/102/108102042/ (NPTEL Video by Prof.S.C.Dutta Roy from IIT Delhi)
3. https://nptel.ac.in/courses/108106075

Text Books:

1. Hayt W. H., Kemmerly J. E. and Durbin S. M., ―Engineering Circuit Analysis, 6th Ed., Tata McGraw-Hill Publishing Company Ltd.,2008.
2. AChakrabarty, - Circuit Theory : Analysis and Synthesis, DhanpatRai and Co.
3. F.F. Kuo, ―Network analysis and Synthesis, Wiley International Edition, 2008. 41
4. Valkenberg V., ―Network Analysis, 3rd Ed., Prentice Hall International Edition, 2007

Reference Books:

1 B.S.Nair and S.R.Deepa, ―Network analysis and Synthesis, Elsevier,2012
2 Charles A Desoer, Ernest S Kuh, Basic Circuit Theory, McGraw Hill, 1969
3 G.K. Mithal and Ravi Mittal, Network Analysis, Khanna Publications, 1998

Course Outcomes:

After completion of the course, student will be able to:

1. Analyze the electric circuit using network theorems
2. Explain transient & forced response of first and second order networks.
3. Determine sinusoidal steady state response.
4. Discuss the two–port network parameters and overall response for interconnection.
5. Combine one port networks using Foster form, and Causer form.
6. Discussion on network synthesis.

Course code	[B.Tech. VLSI Design and Technology (3rd Semester)]			
Category				
Course title	**Signal and Systems**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course objectives:

1. To understand the signals physically and mathematically.
2. To get the ideas about stability of systems.
3. To understand physically realizable and non- realizable.

Unit-1

Signal and its representation, Introduction of signals and systems; classification of signal, continuous time and discrete time signals, operations performed on them, even and odd signals, periodic and non-periodic signals, deterministic and random signals, energy signals, power signals, elementary signals; impulse, unit step, ramp and exponentials, classification of systems. Properties of Systems; linearity, causality, stability, linear time invariant (LTI) systems, convolution integral for continuous-time systems, convolution sum for discrete time systems, properties of linear time-invariant systems, system described by differential and difference equations.

Unit-2

Fourier series representation of periodic signals: Representation of periodic signals by trigonometric and exponential series, properties of continuous time Fourier series, discrete time Fourier series and its properties, continuous and discrete time filtering.

Continuous time Fourier transforms: Definition of Fourier transform and its inverse, properties of the transform, common transform pairs, and convolution and multiplication theorems. Discrete time Fourier transform: Definition and properties, Convolution theorem, frequency response corresponding to difference equations.

Unit-3

Laplace Transform: Definition, region of convergence, properties, analysis of LTI systems, solution of differential equations, system functions, poles and zeros, stability. Z-Transform: Definition, region of convergence, inversion, basic properties, solution of difference equations, system functions, poles and zeros and stability.

Unit-4

Discrete Fourier transform: Properties of discrete Fourier transform relation between discrete Fourier transform, Z and Laplace transform. Convolution of sequences, circular convolution theorem, overlap add and overlap save methods of convolution. Sampling: Uniform sampling, sampling theorem, aliasing, decimation, interpolation.

Mathematical background: Representation of signals using ortho-normal basis functions..Power and Energy spectral density. Correlation functions. Hilbert transform and its properties.

Web link(s):

1. https://nptel.ac.in/courses/108/106/108106075/ (NPTEL Video by Prof. V.G.K.Murti from IIT Madras)
2. https://nptel.ac.in/courses/108/104/108104100/ (NPTEL Video by Prof. Aditya from IIT Kanpur)
3. https://nptel.ac.in/courses/10810410

Text Books:

1. Signals & Systems by Oppenheim, Willsky and Nawab, Pearson, PHI
2. Signal & systems by Simon Haykins; PHI
3. Signals and Systems by R. Anand,,Khanna Publishing House, 2019.

Reference Books:

1. "Fundamentals of Signal & Systems using the Web and Matlab", By Kamen : Pearson
2. Linear systems and signals by B.P.Lathi, Oxford Publication
3. Fundamentals of signals and systems, by Roberts, TMH
4. Digital Signal Processing, by Proakis : Pearson.
5. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.

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. Understanding of Laplace and Fourier transform.
6. Understanding of Correlation functions, Hilbert transform and its properties

Course code	[B.Tech. VLSI Design and Technology (3rd Semester)]			
Category				
Course title	**Computer Architecture and Organization**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Objectives:

1. To get the Overview of Digital Fundamentals.
2. To get the information of General internal architecture.
3. To understand the Quantitative evaluation of performance gain using memory.

Unit-1

Overview of Digital Fundamentals, Register Transfer and Micro operation: Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations.

Computer Organization and Design: 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.

Unit-2

Input-Output Organization: Peripheral devices, Input – Output interface, Asynchronous Data Transfer, Modes of Data Transfer, Priority Interrupt, Direct Memory Access.

Instruction Codes, Computer Registers, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Timing & Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt related instruction cycle and microprogramming.

Unit-3

Memory: Memory hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware, Quantitative evaluation of performance gain using memory, cache miss/hits.

Unit-4

Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating Point Arithmetic Operation, Decimal Arithmetic Unit, Decimal Arithmetic Operations. Introduction to Pipelining and Parallel processing.

Pipelining - Hazards, stalls, data dependencies - Extending the MIPS Pipeline.

Web link(s):

1. https://www.sciencedirect.com/topics/computer-science/computer-architecture (etext from Science direct).
2. https://www.intel.com/content/www/us/en/programmable/support/literature/lit-tutorials.html (Tutorials from intel)

Text books:

1."Computer System and Architecture" by PHI, Mano M.
2." Computer Systems Organization and Architecture" by Carpinelli; Pearson Education.
3."Computer Architecture and Organization" by Hayes. J.P.; TMH.

Reference books:

1. "Computer Organization & Design" by Pal Chaudhuri, P; PHI.
2. "Computer Organization & Architecture", by Stallings, W; PHI.
3. "Parallel Processing and Architecture", by K.Hwang and F.Briggs; McGraw Hill, 1984.
4. "Computer Architecture: A Quantitative Approach" by D. Patterson and J. Hennessy, Second Edition; Morgan

Course outcomes:

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

1. Overview of Digital Fundamentals and explain Computer Organization and Design.
2. Designing various components of computer
3. Design various levels of memories and optimize them.
4. Develop skills for computer arithmetic.
5. Introduction of Addition and Subtraction.
6. Introduction to Pipelining and Parallel processing.

Gurugram University Gurugram

Course code	[B.Tech. VLSI Design and Technology (3rd Semester)]			
Category				
Course title	CONSTITUTION OF INDIA			
Scheme and Credits	L	T	P	Credits
	2	0	0	0
Class work	30 Marks			
Exam	70 Marks			
Total	100* Marks			
Duration of Exam	02 Hours			

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments.

The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

Unit-I

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India, Scheme of the fundamental rights.

Unit-II

The scheme of the Fundamental Duties and its legal status , The Directive Principles of State Policy – Its importance and implementation, Federal structure and distribution of legislative and financial powers between the Union and the States, Parliamentary Form of Government in India – The constitution powers and status of the President of India

Unit-III

Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, Local Self Government – Constitutional Scheme in India

Unit-IV

Scheme of the Fundamental Right to Equality , Scheme of the Fundamental Right to certain Freedom under Article 19 , Scope of the Right to Life and Personal Liberty under Article 21.

Text/Reference books:

1. The constitution of India, BARE ACT; by Dr. P.K. Aggarwal.
2. Introduction to The Constitution Of India (24th Edition) by Durga Das Basu.

DIGITAL ELECTRONICS LAB

[B.Tech. VLSI Design and Technology (3rd Semester)]

L T P	Internal marks : 50
0 0 2	External marks : 50
	Total marks : 100

DIGITAL ELECTRONICS LAB

Objective: To understand the digital logic and create various systems by using these logics.

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, concept of Vcc and ground.
2. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
3. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
4. Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates.
5. Implementation of 4x1 multiplexer using logic gates.
6. Implementation of 4-bit parallel adder using 7483 IC.
7. Design, and verify the 4-bit synchronous counter.
8. Design, and verify the 4-bit asynchronous counter.
9. Static and Dynamic Characteristic of NAND and Schmitt-NAND gate (both TTL and MOS).

10 Micro Project.

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned institution as per the scope of the syllabus.

Gurugram University Gurugram

Network Analysis and Synthesis (LAB)

[B.Tech. VLSI Design and Technology (3rd Semester)]

L T P	Internal marks : 50
0 0 2	External marks : 50
	Total marks : 100

LIST OF EXPERIMENTS:

A: Simulation based

1. Introduction of circuit creation & simulation software like TINAPRO, P-Spice, Dr.-Spice/other relevant Software
2. Transient response of RC, RL circuit on any of above software.
3. To find the resonance frequency, Band width of RLC series circuit using any of above software.
4. To plot the frequency response of low pass filter and determine half-power frequency.
5. To plot the frequency response of high pass filter and determine the half-power frequency.
6. To plot the frequency response of band-pass filter and determine the band-width.

B: Hardware Based

7. To calculate and verify "Z" & “Y” parameters of a two port network.
8. To determine equivalent parameter of parallel connections of two port network and study loading effect.
9. To calculate and verify "ABCD" parameters of a two port network.
10. To synthesize a network of a given network function and verify its response.

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned institution as per the scope of the syllabus.

Gurugram University Gurugram

B.Tech. Electronics Engineering
(VLSI Design and Technology)
Scheme of Studies/Examination Semester 4

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		**Analog and Digital Communication**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
2	PCC		**Electromagnetic Waves and Field Theory**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
3	PCC		**Microprocessors and Interfacing**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
4	PCC		**Information Theory and Coding**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
5	PCC		**Digital System Design**	**3**	**1**		**3**	**30**	**70**	**100**
6	PCC		**Introduction to VLSI lifecycle**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
7	PCC		**Analog and Digital Communication _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
8	PCC		**Microprocessors _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
9	PCC		**Digital System Design using HDL_Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
10	PCC		**Introduction to VLSI lifecycle _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
11	MC		**Scientific & Technical writing Skills**	**2**	**0**	**0**	**2**	**30**	**70**	**100***
Total							**24**			**1000**

***Scientific & Technical writing Skills: Non-credit mandatory course, students have to attain pass marks (40%)**

Note: Exams duration will be as under

(a) Theory exams will be of 03 hours duration.

(b) Practical exams will be of 02 hours duration

Question paper Instructions: Attempt Five Questions in all; Question No.1 is compulsory and attempt four questions from the remaining selecting atleast one question from each Unit. Use of Non-programmable scientific calculator is allowed.

Note: For Labs: Hands-on experiments related to the respective course contents …

:: Students will do industrial /in-house project/training of duration 6 (six) weeks after the end of 4th semester. Further the marks/Credits will be considered in 5th semester.

Gurugram University Gurugram

Course code	[B.Tech. VLSI Design and Technology (4th Semester)]			
Category				
Course title	**Analog and Digital Communication**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

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.

Pulse modulation. Sampling process, Pulse Amplitude modulation (PAM), Pulse width modulation (PWM), Pulse position Modulation (PPM), Pulse code modulation (PCM),Differential pulse code modulation (DPCM). Delta modulation (DM), Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit-3

Elements of Detection Theory, Optimum detection of signals in noise,Coherent communication with waveforms- Probability of Error evaluations.BasebandPulse Transmission- Inter symbol Interference and Nyquist criterion.

Digital Modulation Scheme: Geometric Representation of signals, Binary baseband digital modulation, M-ary baseband digital modulation. Passband Modulation: Amplitude shift keying (ASK), Frequency shift keying (ASK), Phase shift keying (PSK), Quadrature phase shift keying (QPSK), Minimum Shift Keying (MSK), Passband waveforms for M-ary signalling.

Unit-4

Digital Modulation tradeoffs.Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver).Matched filters, Correlation Receivers, Coherent demodulation of binary waveforms, noncoherent demodulation of binary waveforms, Rayleigh and Ricean probability distributions, Error rates of non-coherent signaling,Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Web link(s):

1. http://www.nptelvideos.in/2012/11/communication-engineering.html (NPTEL Video by Prof.Surendra Prasad from IIT Delhi).
2. https://nptel.ac.in/courses/117/105/117105143/ (NPTEL Video by Prof.Goutam Das From IIT Kharagpur)

Text 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. Kennedy and Davis, “Electronic Communication systems”, Tata MacGraw-Hill 4th edition.

Reference Books:

1.Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.

2. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
3.Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.
4.R. Anand, Communication Systems, Khanna Book Publishing Company, 2011.

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.
5. Analyze Synchronization and Carrier Recovery for Digital modulation.
6. Minimization of noise.

Course code	[B.Tech. VLSI Design and Technology (4th Semester)]			
Category				
Course title	**Electromagnetic Wave and Field Theory**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Unit-1

Vector Analysis: Coordinate systems and Transformations – Cartesian, Circular and Spherical coordinates and Transformations. Vector Calculus – Differential length, Area and Volume; Line, Surface and Volume Integrals; Del Operator, Gradient of a Scalar, Divergence of a vector and Divergence theorem, Curl of a vector and Stokes theorem, Classification of vector fields.

Electrostatics: Coulomb's law and field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's law and its applications, Electric Potential, Relationship between E and V.

Unit-2

Electric fields in material space – Properties of materials, Convection and conduction currents, Conductors, Polarization in Dielectrics, Dielectric constant and strength, Continuity equations and Relaxation time, Electric Boundary conditions; Electrostatic Boundary value problems – Poisson's and Laplace equations, Uniqueness theorem.

Electromagnetic Wave Propagation: Waves in general, Wave propagation in lossy dielectrics, Plane waves in lossless dielectrics, Plane waves in free space, Plane waves in good conductors, Power and Poynting vector, Reflection of a plane wave at normal and oblique incidence.

Unit-3

Magnetostatics: Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Magnetostatics in a linear magnetic medium: Magnetization and associated bound currents; auxiliary magnetic field H; Boundary conditions on B and H., Maxwell's Equation: Faraday's law, Transformer and motional EMFs, Displacement current, Maxwell equations in final forms, Time varying potentials, Time-Harmonic Fields.

Unit-4

Transmission Lines: Transmission line parameters and equations; Input impedance, SWR, and Power; Smith Chart, Some applications of Transmission lines, Transients on transmission lines, Microstrip transmission lines.

Introduction to Waveguides: Rectangular waveguides, Transverse Magnetic modes,
Transverse Electric modes, Wave propagation in the guide.

Web link(s):

1. https://swayam.gov.in/nd1_noc20_ee93/preview (SWAYAM Video by Prof. Pradeep Kumar from IIT Kanpur)
2. https://www.coursera.org/learn/electrodynamics-introduction (Course from Coursera by Seungbum Hong from KAIST)

Text Books:

1.Elements of Electromagnetics by M. N. O. Sadiku, Oxford University Press (India).
2.Engineering Electromagnetics by Hayt and Buck, TMH.

3.E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems" PHI Learning, 2ndedition 2011

Reference Books:

1. Fields and Waves in Communications Electronics by Ramo, Whinnery and Van Duzer,John Wiley & Sons.
2. Field and Wave Electromagnetics by David K Cheng, Pearson Education (India).

Course outcomes:

1. Describe basic electrostatic theorems and laws and derive them.
2. Discuss the behavior of electric fields in matter.
3. Use Magnetostatics theorems and laws to infer the magnetic properties of matter.
4. Theory in the field of signal propagation.
5. Understanding of Time varying potentials, Time-Harmonic Fields.
6. To study the Displacement current, Maxwell equations in final forms.

Gurugram University Gurugram

Course code	[B.Tech. VLSI Design and Technology (4th Semester)]			
Category				
Course title	**Microprocessor and Interfacing**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Unit-1

Introduction to microprocessor, history of computers, timing and control, memory devices-semiconductor memory organization, category of memory, 8-bit microprocessor (8085):Architecture, Instruction set, Addressing mode, assembly language programming.

Unit-2

16-bit microprocessor (8086): architecture, physical address, segmentation, memory organization, bus cycle, addressing modes, assembly language programming of 8086.

Programmable interval timer/ counter (8253/8254): introduction, modes, interfacing of 8253, application.

Unit-3

Data transfer scheme: introduction, types of transmission, 8257(DMA), 8255(PPI), serial data transfer (USART 8251), keyboard- display controller (8279), programmable priority controller (8259).

ADC/DAC: introduction DAC methods, ADC converters, Types of ADC, ADC IC (0808/0809) , DAC and ADC interfacing and applications.

Unit-4

Advance microprocessor: Introduction to 32-bit and 64-bit microprocessors.

Alphanumeric displays, LCD, Graphic Displays, high power Devices. Communication Bus protocols:RS 232,RS 485,SPI, Inter integrated circuits interfacing I^2C standard.

Web link(s):

https://nptel.ac.in/courses/106102157

Text books:

1. D.V. Hall : Microprocessor interfacing, TMH second edition
2. Barry.B.Brey,"The Intel Microprocessor 8086/8088. 80186, 80286, 80386 and 80486 Architecture Programming and Interfacing ", PHI.

Reference books:

1. Y.C.Liu and G. A. Gibson: microcomputer systems : the 8086/ 8080A family architecture programming and design, PHI 2nd edition
2. John P. Hayes : digital system design and microprocessors, Mcgraw-Hill publication.

Course Outcomes:

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

1. Explain the functional units with respect to 8085 microprocessor
2. Develop simple programmes using 8085/8086 assembly language
3. Data transfer schemeand programmable timer/counter
4. Familiarization with advance microprocessors, Interface with peripherals using assembly language.
5. Study of assembly language programming of 8086.
6. DAC and ADC interfacing and applications.

Gurugram University Gurugram

Course code	**[B.Tech. VLSI Design and Technology (4th Semester)]**			
Category				
Course title	**Information Theory and Coding**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**0**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Unit-I

Entropy, Relative Entropy, and Mutual Information: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Chain Rules, DataProcessing Inequality, Fano‟s Inequality.

Shannon`s noiseless coding theorem; Encoding of discrete sources. Code length for Markov Sources, Shannon's IInd Theorem for calculation Probability of error.

Unit-2

Source Coding and Data Compression: Kraft Inequality, Huffman Codes, Optimality of Huffman Codes. Channel Capacity: Symmetric Channels, Properties of Channel Capacity, Jointly Typical Sequences, Channel Coding Theorem, Fano‟s Inequality and the Converse to the Coding Theorem.

Unit-3

Differential Entropy and Gaussian Channel: Differential Entropy, AEP for Continuous Random Variables, Properties of Differential Entropy, Relative Entropy, and Mutual Information, Coding Theorem for Gaussian Channels.

Unit-4

Linear Binary Block Codes: Introduction, Generator and Parity-Check Matrices, Repetition and Single-Parity-Check Codes, Binary Hamming Codes, Error Detection with Linear Block Codes, Weight Distribution and Minimum Hamming Distance of a Linear Block Code, Harddecision and Soft-decision Decoding of Linear Block Codes, Cyclic Codes, Parameters of BCH and RS Codes, Interleaved and Concatenated Codes, Convolutional Codes.

Web link(s):

1. https://nptel.ac.in/courses/108/108/108108168/ (NPTEL Video by Prof. Himanshu from IISC Bangalore).
2. https://nptel.ac.in/courses/117/106/117106031/ (NPTEL Video by Dr.AndrewThangaraj from IIT Madras).

Text Books:

1. Thomas Cover and Joy Thomas, "Elements of Information Theory", Second Edition, Wiley-Interscience publication, 2006.
2. William Ryan and Shu Lin, "Channel Codes: Classical and Modern", Cambridge University Press, 2009.

Reference Books:

1. Robert Gallager, "Information Theory and Reliable Communication", 1969 2 N. Abramson, "Information and Coding", McGraw Hill, 1963 3 M. Mansurpur, "Introduction to Information Theory", McGraw Hill, 1987

Course outcomes:

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

1. Design the channel performance using Information theory.
2. Construct efficient codes for data on imperfect communication channels.
3. Explain the properties of differential entropy and apply coding theorem for Gaussian channels.
4. Use linear block codes for error detection and correction.

5. Understanding of Coding Theorem for Gaussian Channels.
6. Interleaved and Concatenated Codes, Convolutional Codes.

Course code	[B.Tech. VLSI Design and Technology (4th Semester)]			
Category				
Course title	**Digital System Design**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

CONTENTS

Unit-1

Benefits of CAD, Integrated circuit design techniques, Hierarchical design, Design abstraction, Computer aided design, Concepts of CPLD, FPGA.

Implementation of following in VHDL decoders, encoders, three state devices, multiplexers, exclusive-OR gates and parity circuits, comparators, adders, combinational multipliers

Unit-2

Introduction to finite state machine: pulse and fundamental mode of operation, realization of state table from verbal description, state diagram & Transition matrix, Mealy and Moore model machine.

Unit-3

Reduction of flow tables of completely and incompletely specified sequential machines, concept of secondary state assignment and realization of circuits of FSM.

Decomposition of FSM & composite machine equivalence between Mealy and Moore model machine.Race and Hazard problems with asynchronous sequential machine.

Unit-4

Algorithmic state machine: ASM Chart, data and control subsystem and implementation of ASM. Introduction to ASM designing with microprogramming.

Web link(s):

1. https://nptel.ac.in/courses/108/105/108105132/ (NPTEL Video by Prof. GautamSaha from IIT Kharagpur)
2. https://nptel.ac.in/courses/108/105/108105113/ (NPTEL Video by Prof.Santanu from IIT Kharagpur)

Text Books:

1. J.Bhaskar, “A Verilog HDL Primer” ; BS Publication.
2. Z. Kohavi, “Switching And Finite Autometa Theory”; TMH.
3. Roth “Fundamental of Logic Design” ;Cengage learning.

Reference Books:

1. “Digital Design” by M.M. Mano; Pearson Edition.
2. “Digital Logic State Machine Design” by D.J. Comer; Oxford University Press.
3. “Contemporary Logic Design” by R.H.Katz, G.Borriello; PHI.
4. “Introduction To Digital Systems” by M.Ercegovac, T. Lang and J.H.Morcno; Wiley Int.

Course outcomes:

After completion of the course, student will be able to:

1. Introduction & Application of CAD, Develop HDL program for combinational and sequential logic Circuit.
2. Finite state machine

3. Modelling mealy and Moore machine
4. Algorithmic state machine

Analog and Digital Communication (LAB)

[B.Tech. VLSI Design and Technology (4th Semester)]

L T P Class Work marks : 50

0 0 2 Theory marks :50

Total marks : 100

LIST OF EXPERIMENTS: (Any ten experiments)

1. Generation of DSB-SC AM signal using balanced modulator.
2. Generation of SSB AM signal
3. To study envelop detector for demodulation of AM signal and observe diagonal peak clipping effect.
4. Frequency modulation using voltage controlled oscillator.
5. To generate a FM Signal using Varactor & reactance modulation.
6. Detection of FM Signal using PLL & foster seelay method..
7. To Study Super heterodyne AM receiver and measurement of receiver parameters viz. sensitivity, selectivity & fidelity.
8. To study the circuit of PAM/PWM/PPM modulator & Demodulator
9. Study of Frequency Division Multiplexing/Demultiplexing with sinusoidal & audio inputs.
10. Generation & study of Analog TDM at least 4 channels.
11. Study of 4 channel Time Division Multiplexing system.
12. Study of pulse code modulation and demodulation with parity & Hamming code .
13. Study pulse data coding & Decoding techniques for various formats .
14. Study of ASK, FSK modulator and demodulator.
15. Study of PSK & QPSK modulator and demodulator.

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned institution as per the scope of the syllabus.

Note: For Labs: Hands-on experiments related to the respective course contents …

Gurugram University Gurugram

B.Tech. Electronics Engineering (VLSI Design and Technology) Scheme of Studies/Examination Semester 5

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		**Digital Signal Processing**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
2	PCC		**Electronic Instruments and Measurements**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
3	PCC		**Digital VLSI Design**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
4	ESC		**Mathematical and Computational Techniques**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
5	PE-I		**Program Elective-I***	**3**	**1**	**0**	**3**	**30**	**70**	**100**
6	OE-I		**Open Elective-I****	**3**	**1**	**0**	**3**	**30**	**70**	**100**
7	PCC		**Digital Signal Processing _ Lab**	**0**	**0**	**2**	**1**	**30**	**70**	**100**
8	PCC		**Electronic Instruments and Measurements _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
9	PCC		**Digital VLSI Design _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
10	ESC		**Mathematical and Computational Techniques _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
11	PW		**Micro Poject/ Training- I**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
12	MC		**Economics for Engineers**	**2**	**0**	**0**	**2**	**30**	**70**	**100***
Total							**25**			**1100**

Note: Exams duration will be as under

(a) Theory exams will be of 03 hours duration.

(b) Practical exams will be of 02 hours duration

Question paper Instructions: Attempt Five Questions in all; Question No.1 is compulsory and

attempt four questions from the remaining selecting atleast one question from each Unit. Use of Non-programmable scientific calculator is allowed.

Note: For Labs: Hands-on experiments related to the respective course contents …

***Program Elective-I**

1. **Antenna and Wave Propagation**
2. **Optical Communication**
3. Wireless Sensor Networks
4. Organic Electronics

****Open Elective- I** (As Per Resource/infrastructure and faculty available)

1. Foreign Language
2. Gender sensitivity
3. Aptitude -1
4. Artificial Intelligence and Machine Learning

Course code	[B.Tech. VLSI Design and Technology (5th Semester)]			
Category				
Course title	**Digital Signal Processing**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

UNIT-I Discrete Fourier Transforms: Definitions, Relation between DTFT and DFT, Computational problem, Properties of the DFT, Circular Convolution, Linear Convolution Fast Fourier Transform Algorithms: Introduction, Radix-2 Decimation in Time (DIT) Algorithm, Radix-2Decimation in Frequency (DIF) Algorithm, Computational Efficiency of DIT and DIF algorithms.

UNIT-II IIR Filter Design: Analog filter design-Butterworth and Chebyshev filter; Discrete time IIR filter design techniques: Impulse Invariance, Bilinear transformation, Approximation of derivatives, (LPF, HPF, BPF, BRF) filter design using frequency translation technique

UNIT-III FIR Filter Design: Characteristics of FIR Digital Filters, Phase and Frequency Response; FIR Filter design using Fourier Series Method, Frequency Sampling Technique, Effect of Windowing, Windowing Techniques-Rectangular Window, Hamming Window, Hanning Window, Blackman Window, Kaiser Window

UNIT-IV Realization of Discrete Time Systems: FIR Systems: Direct form, cascade, parallel and lattice structures, Realization of Linear Phase FIR Systems; IIR systems: Direct form, cascade, parallel, Transposed Forms, ladder structure realization Finite Word length Effects: Rounding and Truncation Errors, Quantization Effects in Analog to-Digital Conversion of Signals, Quantization effect in filter coefficients

Text and Reference Books

1. John G Prokias, Dimitris G Manolakis, “Digital Signal Processing”, Pearson Education.
2. Oppenheim & Schafer, “Digital Signal Processing” PHI
3. Johnny R. Johnson, “Digital Signal Processing”, PHI Learning Pvt Ltd., 2009.
4. S. Salivahanan, ““Digital Signal Processing” Mc Graw Hill Education

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to analyse signals using the discrete Fourier transform (DFT).
2. Understand circular convolution, its relationship to linear convolution, and how circular convolution can be achieved via the discrete Fourier transform.
3. Able to understand the decimation in time and frequency FFT algorithms for efficient computation of the DFT.
4. Able to understand the characteristics of IIR and FIR filters and learn the design of infinite and finite impulse response filters for filtering undesired signals.
5. Able to implement digital filters in a variety of forms:-Direct form I &II, Parallel, Cascade and lattice structure.
6. Able to understand the finite word length effects.

Course code	**[B.Tech. VLSI Design and Technology (5th Semester)]**			
Category				
Course title	**Electronic Instruments and Measurements**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

UNIT-I Measuring Instruments: classification, absolute and secondary instruments, Performance Characteristics, Error in measurement, Sources of error, Arithmetic mean, Deviation from the mean, Average deviation, Standard deviation, Limiting errors. Ammeters and Voltmeters, PMMC, Moving Iron (MI) type, Expression for the deflecting torque and control torque, Extension of range using shunts and series resistance.

UNIT-II DC/AC Bridges: General equations for bridge balance, Self-inductance measurement by Maxwell's bridge, Hay's bridge, Capacitance measurement by Schering bridge, Method of measuring low, medium and high resistance: Kelvin's double bridge for measuring low resistance, Wheat-stone's bridge, measurement of high resistance, Basics of wattmeter and energy meter

UNIT-III Transducers: Introduction, Selection Parameters of Transducer, Type of Transducer, Resistive Transducer, Strain Gauges, Inductive Transducer: LVDT, Capacitive Transducer, Photoelectric Transducer, Photo-Voltaic Cell, Photo Transistors, Temperature Transducers, Digital Transducer.

UNIT-IV Data Acquisition and Conversion: Introduction, Objective of Data Acquisition System, Single and Multichannel DAS, A/D and D/A converters using Op-Amp, Data Loggers: Block diagram, principle of operation Digital Display Devices: LED, LCD, Incandescent Display, LVD (Liquid Vapour Display)

Text and Reference Books

1. H. S. Kalsi, "Electronic Instrumentation", 3rd Ed., McGraw Hill Education(India), 2015.

2. David A. Bell, "Electronic Instrumentation and Measurements", 3rd Ed., Oxford University Press, 2013.

3. A K Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Able to explain the quality measurements with electronic instruments.
2. Able to articulate the range of measuring instruments.
3. Able to solve and illustrate the numerical problem for DC/AC bridge-based circuits.
4. Able to illustrate the principles of various types of transducers and their applications.
5. Able to explain the construction, principle of operation, and applications of Data Acquisition System (DAS).
6. Able to use the digital display devices in practical applications

Course code	**[B.Tech. VLSI Design and Technology (5th Semester)]**			
Category				
Course title	**Digital VLSI Design**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**4**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

UNIT-I Introduction: Moore's law, Trends & Projections in VLSI Circuits, Flow diagram of VLSI Circuit Design, VLSI Design issues, Y-Chart, VLSI Design Styles, Full Custom and Semi Custom.

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-II MOS Inverter Design: NMOS and CMOS inverter design, noise margin, VTC curve, Calculation of delay time, power dissipation: static, dynamic, switching power, short circuit power dissipation in CMOS inverters, scaling in CMOS circuits, technology scaling and its impact on the inverter metrics.

UNIT-III Physical design: Design Rules, Stick Diagrams; Layout Designing; Euler's Rule for VLSI Physical Design, MOS logic circuits with depletion nMOS loads, CMOS logic circuits, complex logic circuits, Complementary CMOS, Ratioed Logic, CMOS Pass-Transistor Logic

UNIT-IV Dynamic CMOS circuits: Basic Principles of pass transistor and transmission gate,

CMOS Transmission-Gate and Pass-transistor logic circuits, Domino CMOS Logic, clocked CMOS, NOR CMOS Logic, Zipper CMOS circuits.

Text and Reference Books:

5. Principles of CMOS vlsi design: A system Perspective..Neil H.E. weste and Kamran Eshraghian.
6. Sneh Saurabh, "Introduction to VLSI Design flow", Cambridge University Press
7. CMOS Digital Integrated Circuits Analysis & Design, by Sung-Mo (Steve) Kang ,Yusuf Leblebici.
8. CMOS VLSI Design: A Circuits and Systems Perspective, 4e by Neil H.E. Weste and Harris.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Able to understand the fundamentals of CMOS VLSI and associated technologies.
2. Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption.
3. Able to acquire hands-on skills of using CAD tools in VLSI design.
4. Understand overall process of VLSI Design flow starting from system level all the way to the transistor level
5. Able to appreciate the design process in VLSI through a mini-project on the design of a CMOS sub-system.
6. Able to explain basic operation principles of diodes and MOS transistors and their circuits level models.

Course code	[B.Tech. VLSI Design and Technology (4th Semester)]			
Category				
Course title	**Mathematical and Computational Techniques**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

CONTENTS

Unit-1

Errors in Numerical Methods: Approximate numbers and Significant figures; Rouding-off numbers; Errors: Absolute, Relative and Percentage.

Solution of equations in one variable: Bisection method; Iteration method; Regula-Falsi method; Convergence of Regula-Falsi method; Secant method; Newton-Raphson method; Generalised Method for multiple roots; Rate of Convergence of Newton‘s square root formula; Newton‘s Inverse formula; Graffe‘s Root-Squaring method; Ramanujan‘s method; Rate of Convergence and. Computer Programmes for the above methods.

Unit-2

Numerical solution of system of equations: Gauss elimination method; Gauss-Jordan method; Jacobi‘s iteration method; Gauss Sidel method; Ill conditioned problems; Error analysis; Computer programs based for the above methods.

Operators and Difference Equations: Forward difference operator, Backward difference operator, Shift operator, Average operator, Central difference operator and their relations; Factorial Notation; Synthetic division; Missing Term Technique; Basic ideas of Difference Equations.

Unit-3

Interpolation: Newton‘s forward interpolation formula; Newton‘s backward interpolation formula; Gauss‘ Forward central Difference Formula; Gauss‘ Backward central Difference Formula; Computer Programs for the above formulas.

Numerical integration: A general quadrature formula for equidistant nodes; Trapezoidal rule; Simpson‘s one-third rule, Simpson‘s three-eight rule; Wedddle‘s rule; Inherent errors in numerical integrations; Euler-Maclaurin formula; Gaussian quadrature formula; Flow charts, Algorithms and Computer Programs to implement the above techniques.

Unit-4

Numerical Methods of Solution of ordinary differential equation (ODE): Picard‘s Method of Successive Approximations ; Picard‘s Method for Simultaneous First Order Differential Equations; Euler‘s Method;; Modified Euler‘s Method; Runge-Kutta method; Flow-charts, algorithms and computer programs for the above methods.

Text books:

1. Numerical Methods For Scientific And Engineering Computation M. K. Jain, S. R. K. Iyengar And R. K. Jain 4.

Reference Books:

1. An Introduction to Numerical Analysis, Kendall Atkinson

Course outcomes:

After completion of the course, student will be able to:

1 Introduction to mathematical & computational erros

2 Numerical solution of system of equations

3 Interpolation & numerical integration algorithms and related computer programs

4 Numerical Methods of Solution of O.D.E

Course code	**[B.Tech. VLSI Design and Technology (5th Semester)]**			
Category	OE-I			
Course title	**Artificial Intelligence & Machine Learning**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

CONTENTS

UNIT-I

Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems; Breadth first search and depth first search techniques. Heuristic search Techniques: Hill Climbing, Iterative deepening DFS, bidirectional search. Analysis of search methods. Introduction to Genetic Algorithms.

UNIT-II

Introduction to Machine Learning, Well Posed Problems, Machine Learning Process, Designing a Learning System, Types of Machine Learning, Application of Machine Learning, Features, Feature Vectors, Feature Selection and Visualization, Testing ML Algorithms (Overfitting, Training, Testing, And Validation Sets, Confusion Matrix, Accuracy Metrics, ROC Curve, Unbalanced Datasets, Measurement Precision), Discriminative Models: Least Square Regression, Gradient Descent Algorithm, Univariate and Multivariate Linear Regression, Prediction Model, probabilistic interpretation, Regularization, Logistic regression, multi class classification, Support Vector Machines.

UNIT-III

The Brain and The Neuron, Neural Networks, The Perceptron, Linear Separability, The MultiLayerPerceptron, Forward and Back-error propagation, The Curse of Dimensionality, Dimensionality.

Reduction, Principal Component Analysis, LDA, ICA. Learning With Decision Tree, ID3, CART,Ensemble Learning, Boosting, Bagging, Random Forest.

UNIT-IV

Unsupervised Learning, Clustering, K-Means Clustering, Hierarchical Clustering, Evaluation Parameters for Unsupervised Learning. Self-Organizing Maps. Reinforcement Learning: State and Action Spaces, Action, Policy, Markov Decision Processes, The Difference Between SARSA and Q-Learning, Uses of Reinforcement Learning. Active Learning, Inductive Learning.

Text and Reference Books:

1. Artificial Intelligence- A Modern Approach (3rd edition) by Peter Norvig and Stuart Russel.
2. M.C. Trivedi, A Classicial Approach to Artificial Intelligence, Khanna Book Publishing Company, 2020.
3. Artificial Intelligence and Machine Learning 1st Edition by Vinod Chandra.
4. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman and Hall/CRC; 2nd or latest Edition, 2014
5. Bishop, C.M., " Pattern recognition and machine learning", Springer,2nd or latest edition,2010
6. Tom Mitchell, " Machine Learning," , McGraw Hill, 2017
7. T. Hastie, R. Tibshirani, J. Friedman. "The Elements of Statistical Learning", 2nd or latest, 2008. 2Han, Jiawei, Jian Pei, and Micheline
8. Kamber. "Data mining: concepts and techniques.", Elsevier, 2011.

Course Outcomes:

After completion of the course, student will be able to:

1.Fundamental understanding of artificial intelligence

2.Gain a broad understanding of machine learning algorithms and their use in data-driven knowledge discovery and program synthesis.

3.Identify, formulate and solve machine learning problems that arise in practical applications .

4.Obtain an understanding of the current state of the art in machine learning and be able to begin to conduct original research in machine learning.

5. Understanding of multi class classification, Support Vector Machines.

6. Analyzing the Active Learning, Inductive Learning.

Note: For Labs: Hands-on experiments related to the respective course contents …

Gurugram University Gurugram

B.Tech. Electronics Engineering (VLSI Design and Technology) Scheme of Studies/Examination Semester 6

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		**VLSI Processing Technology**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
2	PCC		**Control System Engineering**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
3	PCC		**Embedded System Design**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
4	PE-II		***Program Elective-II**	**3**	**0**	**0**	**3**	**30**	**70**	**100**
5	PEIII		****Program Elective-III**	**3**	**0**	**0**	**3**	**30**	**70**	**100**
6	OEII		***Open Elective-II**	**3**	**0**	**0**	**3**	**30**	**70**	**100**
7	PCC		**Embedded System Design _LAB (P)**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
8	PCC		**VLSI Processing _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
9	ESC		**Computer Networks & Internet of Things _Lab**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
10	PW		**Mini Project/Training**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
11.	MC		**Renewable energy resources**	**2**	**0**	**0**	**2**	**30**	**70**	**100***
Total							**24**			**1000**

Note: Exams duration will be as under

(a) Theory exams will be of 03 hours duration.

(b) Practical exams will be of 02 hours duration

Question paper Instructions: Attempt Five Questions in all; Question No.1 is compulsory and

attempt four questions from the remaining selecting atleast one question from each Unit. Use of Non-programmable scientific calculator is allowed.

Note: For Labs: Hands-on experiments related to the respective course contents …

:: Students will do industrial /in-house project/training of duration 6 (six) weeks after the end of 6th semester. Further the marks/Credits will be considered in 7th semester.

***Program Elective-II**

1. **Analog IC Design**
2. **Semiconductor optoelectronics**
3. **Power Converters Design**
4. **Flexible Electronics.**

*****Program Elective-III**

1. **Computer Networks and Internet of Things**
2. **Introduction to MEMS**
3. **Quantum Computing**
4. **Nano Electronics**

****Open Elective- II** (As Per Resource/infrastructure and faculty available)

Vedic Mathematics
Material Science
Managerial Economics & Financial Analysis
Foundations Of Blockchain Technology

Gurugram University Gurugram

Course code	[B.Tech. VLSI Design and Technology (6th Semester)]			
Category				
Course title	**VLSI Processing Technology**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Able to understand the fundamentals of CMOS VLSI and associated technologies.
2. Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption.
3. Able to acquire hands-on skills of using CAD tools in VLSI design.
4. Able to appreciate the design process in VLSI through a mini-project on the design of a CMOS sub-system.

UNIT-I Fundamentals of VLSI Technology: Introduction, Trends & Projections in microelectronics. Semiconductor materials and their merits and demerits. Monolithic chips trends. Advantages, limitations & classification of ICs. Source of silicon; EGS and MGS, Single crystalline and Poly-crystalline crystal, SGS

UNIT-II Fabrication Techniques: float zone method, Czocharalski method, Refining, Silicon Wafer Preparation & Crystal Defects. Epitaxial Process: Need of epitaxial layer; VPE, MBE, merits and demerits of various epitaxial processes. Oxidation Techniques: Importance of oxidation, types of oxidation techniques, growth mechanism, factors affecting the growth mechanisms, silicon oxidation model, dry & wet oxidation. Diffusion and Ion Implantation: Diffusion mechanisms; diffusion reactor; diffusion profile; diffusion kinetics; parameters affecting diffusion profile; Dopants and their behaviors, choice of dopants; Ion Implantation- reactor design, impurity distribution profile, properties of ion implantation, low energy and high energy ion implantation.

UNIT-III Lithography: Basic steps in lithography; lithography techniques-optical lithography, electron beam lithography, x-ray lithography, ion beam lithography; resists and mask preparation of respective lithographies, printing techniques-contact, proximity printing and projection printing. Etching: Performance metrics of etching; types of etching- wet and dry etching; dry etching techniques-ion beam or ion-milling, sputter ion plasma etching and reactive ion etching (RIE). Metallization: Desired properties of metallization for VLSI; metallization choices; metallization techniques –vacuum evaporation, sputtering.

UNIT-IV Fundamental considerations for I.C processing, PMOS and NMOS IC Technology, CMOS I.C technology, Packaging design considerations, Special package considerations, Yield loss in VLSI, Reliability requirements for VLSI.

Text and Reference Books

1. S.M. Sze, "VLSI Technology",TMH

2. S.K. Gandhi, "VLSI Fabrication Principles", John Willey &Sons

3. D. Nagchoudhuri, "Principles of Microelectronics Technology"PHI Botkar, "Integrated Circuits", KhannaPublishers

Course code	[B.Tech. VLSI Design and Technology (6th Semester)]			
Category				
Course title	**Control System Engineering**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Describe the response characteristic and differentiate between the open loop and closed loop control system.
2. Measure and evaluate the performance of basic control systems in time domain.
3. Determine the response of a control system using poles and zeros to determine the response of a control system.
4. Determine the stability of a control system using Routh-Hurwitz method.

UNIT-I Basic Components of a control system, Feedback and its effect, Types of feedback control Systems, Block diagrams: representation and reduction, Signal Flow Graphs, Modeling of Physical Systems: Electrical Networks and Mechanical Systems, Force-voltage analogy, Force current analogy.

UNIT-II Time response of continuous data systems, Different test Signals for the time response, Unit step response and Time-Domain Specifications, Time response of a first-order and second order systems for different test signals, Steady State Error and Error constants, Sensitivity, Control Actions: Proportional, Derivative, Integral and PID control. Introduction to Process Control Systems, Pneumatic hydraulics, Actuators.

UNIT-III Stability: Methods of determining stability, Routh Hurwitz Criterion, Root Locus, Frequency Domain Analysis: Resonant Peak, Resonant frequency and Bandwidth of the second order system, Effect of adding a zero and a pole to the forward path, Nyquist Stability Criterion, Relative Stability: Gain Margin and Phase Margin, Bode Plot

UNIT-IV State-Space Analysis of Control System: Vector matrix representation of state equation, State transition matrix, Relationship between state equations and high-order differential equations, Relationship between state equations and transfer functions, Block diagram representation of state

equations, Decomposition Transfer Function, Kalman's Test for controllability and observability

Text and Reference books

1. B.C. Kuo& Farid Golnaraghi, "Automatic Control Systems", 8e, John Wiley India, 2008.
2. I.J. Nagrath & M.Gopal, "Control System Engineering", New Age International Publishers.
3. William A. Wolovich, "Automatic Control Systems", Oxford University Press, 2010.
4. Katsuhiko Ogata, "Modern Control Engineering", 3e, PHI Publication,200

Course code	**[B.Tech. VLSI Design and Technology (6th Semester)]**			
Category				
Course title	COMPUTER NETWORKS and Internet of things			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Contents:

COURSE OVERVIEW: The course introduces main concepts of networking; application areas; classification; reference models; transmission environment; technologies; routing algorithms; IP, UDP and TCP protocols; reliable data transferring methods; application protocols; network security; management systems; perspectives of communication networks. The course structure consists of lectures, tutorials, laboratory works in computer classroom and individual work.

SYLLABUS

UNIT – I

INTRODUCTION: Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet, Connection oriented network - X.25, frame relay. THE PHYSICAL LAYER: Theoretical basis for communication, guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system.

UNIT – II

THE DATA LINK LAYER: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet. THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth.

UNIT – III

Introduction to Internet of Things- Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

UNIT – IV

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C) Controlling Hardware- Connecting LED, Buzzer, Switching High

Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors

TEXT BOOKS: 1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

REFERENCE BOOKS:

1. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.

2. Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India

3. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.
4. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly
5. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

Gurugram University Gurugram

Course code	**[B.Tech. VLSI Design and Technology (6th Semester)]**			
Category				
Course title	**Embedded System Design**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**4**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Outcomes:

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

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.
4. Able to appreciate the Semiconductor Equipment Design and Technology through a mini-project

CONTENTS

Unit I

Introduction to Embedded Systems: Definition, Processor embedded into a system, embedded hardware units and devices into a system, embedded software in a system, examples of Embedded systems, Embedded SOC and Use of VLSI Circuit Design Technology, Complex Systems Design and Processes, Design Process in Embedded System, Formalization of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills Required for an Embedded System Design.

Unit II

Difference between Microprocessor and Microcontroller.

8051 Microcontroller: Architecture: CPU Block diagram, Memory Organization, Program memory, Data Memory, Interrupts, Peripherals: Timers, Serial Port, I/O Port Programming: Addressing Modes, Instruction Set, Programming. *Microcontroller based System Design:* Introduction, A microcontroller specification, microcontroller design, testing the design, timing subroutines and lookup tables. Interfacing of LCD and A/D to 8051.

Unit III

Modeling of Embedded system: Mathematical modeling of physical systems to fit into embedded systems, Continuous Dynamics, Discrete Dynamics, Hybrid Systems, actor models, Composition of State Machines Microcontrollers, Sensors, Actuators, Basics of Microcontrollers, 8951, Arduino microcontroller development board, I/Os, Sensors, Actuator

Unit IV

Interfacing between analog and digital blocks, signal conditioning, digital signal processing. subsystem interfacing, interfacing with external systems, user interfacing. Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

References:

1. Embedded Systems: Architecture, Programming and Design ,2nd Edition, Raj Kamal, Tata-McGraw Hill, 2011.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C Second Edition, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, Pearson.
3. Advanced Microprocessors and Peripherals, 3rd Edition, Ray and Bhurchandi, Tata McGraw Hill, 2006.
4. The 8051 Micro controller 3rd Edition, Keneth Ayala, Cengage Publishers.
5. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
6. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
7. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
8. David Simon, "An Embedded Software Primer", Addison Wesley, 2000..

Note: For Labs: Hands-on experiments related to the respective course contents …

Gurugram University Gurugram

B.Tech. Electronics Engineering (VLSI Design and Technology) Scheme of Studies/Examination Semester 7

S.No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC		**VLSI Verification and Testing**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
2	PCC		**Semiconductor Materials Synthesis and Characterization**	**3**	**1**	**0**	**3**	**30**	**70**	**100**
3	PEIV		**Program Elective-IV***	**3**	**1**	**0**	**3**	**30**	**70**	**100**
4	OEIII		**Open Elective-III****	**3**	**1**	**0**	**3**	**30**	**70**	**100**
	OEIV		**Open Elective-IV*****	**3**	**1**	**0**	**3**	**30**	**70**	**100**
5	PCC		**VLSI Verification and Testing (Lab)**			**2**	**1**	**50**	**50**	**100**
6	PCC		**Semiconductor Materials Synthesis and Characterization (Lab)**			**2**	**1**	**50**	**50**	**100**
7	PW		**Major Project-I**			**4**	**2**	**100**	**100**	**200**
8	PW		**Project/Training/Seminar-II**			**2**	**1**	**0**	**100**	**100**
Total							**20**			**1000**

Note: Exams duration will be as under

(a) Theory exams will be of 03 hours duration.

(b) Practical exams will be of 02 hours duration

Question paper Instructions: Attempt Five Questions in all; Question No.1 is compulsory and attempt four questions from the remaining selecting atleast one question from each Unit. Use of Non-programmable scientific calculator is allowed.

Note: For Labs: Hands-on experiments related to the respective course contents …

Program Elective-IV*

1. Semiconductor Device Modelling
2. Low power VLSI
3. Semiconductor Equipment Design and Technology
4. Semiconductor Packaging and Testing

****Open Elective- III** (As Per Resource/infrastructure and faculty available).
*****Open Elective- IV** (As Per Resource/infrastructure and faculty available)

****Open Elective- III**
Robotics and automation
Cloud computing
Indian knowledge system (IKS)
Cyber Law

*****Open Elective- IV**

Real Time Operating System
Digital Image Processing
Soft Computing
Wireless communication

Course code	[B.Tech. VLSI Design and Technology (7th Semester)]			
Category				
Course title	**VLSI Verification and Testing**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Outcomes:

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

1. Extend knowledge of the requirement of fault modeling in VLSI circuits.
2. Generate test vectors to test a circuit efficiently covering maximum faults.
3. Demonstrate the concept of Memory testing techniques
4. Discuss about Built-in-Self Test and its application in modern digital design 5. Use modern tools for testing and verification.

Contents

UNIT 1

Physical faults and their modeling. Fault equivalence and dominance; fault collapsing, Fault simulation: parallel, deductive and concurrent techniques; critical path tracing.

UNIT 2

Test generation for combinational circuits: Boolean difference, D-algorithm, Podem, random etc. Exhaustive, random and weighted test pattern generation; aliasing and its effect on fault coverage.

PLA testing: cross-point fault model, test generation, easily testable designs. Memory testing: permanent, intermittent and pattern-sensitive faults; test generation.

UNIT 3

Delay faults and hazards; test pattern generation techniques, ATPG and its different types Test pattern generation for sequential circuits: ad-hoc and structures techniques scan path and LSSD, boundary scan

UNIT 4

Built-in self-test techniques: LBIST and MBIST. Verification: logic level (combinational and sequential circuits), RTL-level (data path and control path). Verification of embedded systems. Use of formal techniques: decision diagrams, logic-based approaches. ASIC/IP Verification, direct and random testing, Error detection and correction codes.

Text/Reference Books:

1. Essentials of Electronic Testing, M. L. Bushnell and V. D. Agrawal,3rd Kluwer Academic Publishers 2002
2. Delay Fault Testing for VLSI Circuits,A. Krstic and K-T Cheng,3rd Kluwer Academic Publishers. 2003
3. Testing of Digital Systems, N. K. Jha and S. Gupta, 2nd, Cambridge University Press. 2003
4. Digital Systems Testing and Testable Design, M. Abramovici, M. A. Breuer and A. D. Friedman, 3rd, Wiley-IEEE Press. 1994
5. Fault Tolerant and Fault Testable P. K. Lala, 4th, Hardware Design, Prentice-Hall. 6. All-in-One Electronics Simplified, A.K. Maini & Nakul Maini, Khanna Book Publishing.

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Course code	B.Tech. VLSI Design and Technology (7th Semester)]			
Category				
Course title	**Semiconductor Materials Synthesis and Characterization**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Outcome:

1. Understand the Silicon extraction and purification process
2. Understand Crystallography of Si and various methods of growth
3. Understand key methods of physicochemical, morphological and analytical characterization techniques
4. Able to appreciate the materials synthesis and characterization process in VLSI through a mini-project.

Course Contents:

Principles of extraction, pyrometallurgical processes, material and heat balance of processes, thermodynamics of processes; introduction to laws, thermodynamic equilibrium, thermochemistry, Ellingham diagram. Process kinetics; introduction to chemical kinetics and rate processes, heterogeneous kinetics, kinetics of liquid-liquid reactions, concepts of reactor design. Structure & properties of molten liquids.

Production of metallurgical grade (MG) Si: Carbothermic reduction, principle, operation and practice of sub-merged arc furnace, energy and process calculation, refining & impurities control in molten MG Si.Production of electronic grade (EG) Si: Concept of fluidized bed reactor, Siemens Process.

Crystal Growth: Crystal growth processes (Bridgman and its variants, Czochralski), heat and species transfer during non-steady and steady state plane-front growth, interface instability and effect of convection on interface stability.

XRD (Bulk and thin film), Microscopy (Optical, SEM, TEM, SPM, AFM), UV-Visible spectroscopy, Photoluminescence, Raman spectroscopy.

Text/Reference Books:

1. Principles of Extractive Metallurgy, Terkel Rosenqvist, McGraw-Hill Book Company, 1973
2. Stoichiometry and Thermodynamics of Metallurgical Processes: Y K Rao, Cambridge University Press,

2009

3. Handbook of Extractive Metallurgy: Fathi Habashi; Wiley-VCH , 1997

4. Solar-Grade Silicon: Refining and Recycling: L Zhang et al, CRC Press, 2013

5. Scheel and Capper: Crystal Growth Technology: From Fundamentals and Simulation to Large- scale Production, John Wiley & Sons, 2008

6. Nakajima and Usami: Crystal Growth of Si for Solar Cell, Springer, 2009 7. Essentials of Metallurgical Thermodynamics, R.H. Tupkary, Khanna Book Publishing, 2016.

Note: For Labs: Hands-on experiments related to the respective course contents …

Gurugram University Gurugram

B.Tech. Electronics Engineering (VLSI Design and Technology) Scheme of Studies/Examination Semester 8

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PW		**Major Project –II/ Industrial Training**			**5**	**10**	**100**	**300**	**400**
2	MC		**MOOC-I***				**3**	**25**	**75**	**100**
3	MC		**MOOC-II***				3	25	75	100
4										
5										
6										
7										
8										
9										
Total							**16**			**600**

Note: Project/Traing Reports to be examined and evaluated by external examiner followed by external viva-voce.

MOOC-I* As per students choice with consent of department.
MOOC-II* As per students choice with consent of department.

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Bridge Courses:

A After First Year:

The candidate should pass following two additional courses (ITI Level) to qualify for Certification.

1. Electronic Measurements and Instrumentation
2. Clean Room Technologies

B After Second Year:

The candidate should pass following two additional courses in either design stream or manufacturing stream (Diploma Level) to qualify for Diploma.

1. Embedded Systems
2. VLSI Design

OR

1. Semiconductor Equipment Design and Technology
2. Semiconductor Materials Synthesis and Characterization

C After Third Year:

The candidate should pass following additional courses in either design stream or manufacturing stream (Diploma Level) to qualify for B.Voc.

1. Analog IC Design
2. Power Converter Design

OR

1. Semiconductor Packaging and Testing
2. Introduction to MEMS

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Syllabus of Bridge and Elective courses

Course code				
Category				
Course title	**Antenna and Wave Propagation**			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

UNIT-I Fundamental Concepts: Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT-II Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Aperture Antennas: Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Fourier transform method in aperture antenna theory

UNIT-III Horn and Reflector Antennas: Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. Microstrip Antennas: Basic characteristics, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT-IV Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Fourier transform method, and Woodward-Lawson method.

Text and Reference Books

1. Balanis, C.A., "Antenna Theory and Design", 3e., John Wiley & Sons.
2. Jordan, E.C. and Balmain, K.G., "Electromagnetic Waves and Radiating Systems", 2e, Prentice-Hall of India.
3. Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2e, John Wiley & Sons.
4. Elliot, R.S., "Antenna Theory and Design", Revised edition, WileyIEEE Press.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. To understand different antenna parameters.
2. To understand and analyze the radiation mechanism of antenna.
3. To have insight into the derivation of field quantities of various antennas and there by deducing the other quantities like gain, directivity, impedance etc.
4.To understand basic characteristics and feeding mechanisms of microstrip antenna
5. To understand and analyze antenna array.
6. To design, antennas for given applications.

Semiconductor Device Modelling

Course Outcomes:

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

1. Explain the equations, approximations, and techniques available for deriving a model with specified properties, for a general device characteristic with known qualitative theory.

2. Apply suitable approximations and techniques to derive the model starting from drift-diffusion transport equations (assuming these equations hold).

3. Offer clues to a qualitative understanding of the physics of a new device and conversion of this understanding into equations.

4. Simulate characteristics of a simple device using MATLAB, and SPICE tools.

Course Contents:

Semiconductors in Equilibrium and Carrier Transport, Semiconductor Materials, Carrier Concentration, Carrier Drift, Carrier Diffusion, Generation and Recombination Process, Continuity Equation, Thermionic Emission, Tunnelling, Ballistic Transport, High Field Effects, Physics of Junction Devices: Thermal Equilibrium Condition, Depletion region, Depletion, and Diffusion Capacitances, Current-Voltage characteristics, Charge Storage and Transient behavior, Junction Breakdown, Metal Semiconductor Contacts, forward and reverse-biased junctions, reverse-bias breakdown, transient, and a-c conditions.

Physics of Bipolar devices: Transistor action, Static Characteristics, minority carrier distribution and terminal currents, generalized biasing, secondary effects, Frequency Response and Switching, Semiconductor Heterojunctions.

Field-Effect Transistors: JFET- current-voltage characteristics, effects in real devices, high-frequency and high-speed issues, Metal Insulator Semiconductor FET.

MOSFET- basic operation and fabrication, ideal MOS capacitor, Energy band diagram in equilibrium and under bias, Flat band voltage, Potential Balance and charge balance, Effect of gate body voltage on surface condition, Accumulation and depletion, Inversion, CV Characteristics, Frequency response, threshold voltages, output and transfer characteristics of MOSFET, short channel and Narrow width effects, MOSFET scaling.

Optoelectronics Devices: Light emitting diodes, Lasers, Photoconductors, Junction Photodiodes, Avalanche Photodiodes, Solar Cells, SPICE Models for Semiconductor Devices: MOSFET Level 1, Level 2 and level 3 model, Model parameters; SPICE models of p-n diode and BJT.

Text/Reference Books:

1. B. G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th Edition, PHI Private Limited, 2011.

2. T. A. Fjeldly, T. Ytterdal, and M. Shur, “Introduction to Device Modelling and Circuit Simulation”, John Wiley, 1998.

3. Introduction to Semiconductor Materials and devices by M.S Tyagi, John Wiley & Sons, 5th Edition, 2005.

4. G. Massobrio and P. Antognetti, Semiconductor Device Modelling with SPICE, 2nd Edition, TMH, 2010.

5. C. C. Hu, Modern Semiconductor Devices for Integrated Circuits, Pearson Education, 2010.

6. P. Bhattacharya, Semiconductor Optoelectronics Devices, 2nd Edition, PHI, 2009.

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

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

Course code	**[B.Tech. VLSI Design and Technology (6th Semester)]**			
Category				
Course title	Analog IC Design			
Scheme and Credits	**L**	**T**	**P**	**Credits**
	3	**1**	**0**	**3**
Class work	**30 Marks**			
Exam	**70 Marks**			
Total	**100 Marks**			
Duration of Exam	**03 Hours**			

Course Outcomes:

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

1. Realize the concepts of Analog MOS devices and current mirror circuits.
2. Design different configurations of Amplifiers and feedback circuits.
3. Analyze the characteristics of the frequency response of the amplifier and its noise.
4. Analyze the performance of the stability and frequency compensation techniques of Op- Amp Circuits.

Course Contents:

UNIT-I

Introduction to MOSFETS, Simple MOSFET circuits, Threshold voltage model, Capacitance model, Mobility model, MOSFET basics, Basic current mirrors, Cascode current mirrors, Active current mirrors with large and small signal analysis, MOSFET in integrated circuits, Common mode properties.

UNIT-II

Noise- Statistical characteristics of noise- Types of noise: significance of flicker and thermal. Analysis and representation of noise in single-stage amplifiers: CG, CS, CD (source follower) and cascode stage and noise in differential pairs. Representation of noise in circuits- Noise in singlestage amplifiers- Noise in differential pairs- Noise Bandwidth.

UNIT-III

Feedback topologies (voltage-voltage, current-voltage, voltage-current, current-voltage) and the noise and the loading effect analysis, Negative feedback, Stability of negative feedback systems, Stability and frequency compensation: Specification analysis, multi-pole system, three-stage opamp, phase margin Frequency compensation, pole-zero doublet analysis.

UNIT-IV

Design of the CMOS operational amplifiers: One-stage opamps and two-stage opamps, Gain boosting techniques, folded cascode, telescopic amplifier, common mode feedback (CMFB) amplifier, Three-stage opamp architectures, opamp specifications analysis, Design of high-speed and high-gain amplifiers.

CMOS amplifier Frequency response: Miller effect, common source (CS), common gate (CG), common drain (CD) stages, and cascode stage Analog layout techniques for MIM, MOM and fringe capacitor.

NPTEL course (if any): https://nptel.ac.in/courses/108106105.

Text/Reference Books:

1. “Design of Analog CMOS Integrated Circuits” by Behzad Razavi, McGraw Hill Education (1 September 2000).

2. CMOS Analog Circuit Design” by Phillip Allen and Douglas R. Holberg, OUP USA; Third Edition edition (1 September 2011).

3. “Operation and Modeling of the MOS Transistor” by Yannis Tsividis, Oxford University Press; 2 edition, June 26, 2003.

4. “Microelectronic Circuits-Theory & Applications” by A.S. Sedra and K.C. Smith, Adapted by A.N. Chandorkar, 6th Edition, Oxford, 2013.

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

Low power VLSI

Course outcome:

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

1. Capability to recognize advanced issues in VLSI systems, specific to the deep-submicron silicon technologies.
2. Students able to understand deep submicron CMOS technology and digital CMOS design styles.
3. To design chips used for battery-powered systems and high-performance circuits.
4. Able to appreciate the **Low power VLSI** through a mini-project

Course Contents:

Basics of MOS circuits: MOS Transistor structure and device modeling MOS Inverters MOS Combinational Circuits - Different Logic Families.

Sources of Power dissipation: Dynamic Power Dissipation Short Circuit Power Switching Power Gliching Power Static Power Dissipation Degrees of Freedom.

Supply Voltage Scaling Approaches: Device feature size scaling Multi-Vdd Circuits Architectural level approaches: Parallelism, Pipelining Voltage scaling using high-level transformations Dynamic voltage scaling Power Management

Switched Capacitance Minimization Approaches: Hardware Software Tradeoff Bus Encoding Two's complement Vs Sign Magnitude Architectural Optimization Clock Gating Logic styles.

Leakage Power minimization Approaches: Variable-threshold-voltage CMOS (VTCMOS) approach multi-threshold-voltage CMOS (MTCMOS) approach Power gating Transistor stacking Dual-Vt assignment approach (DTCMOS)

NPTEL Course (if any): https://nptel.ac.in/courses/106105034.

Text/Reference Books:

1. Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata Mcgrag Hill.

2. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).

3. A. Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995.

4. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.

5. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-Interscience, 2000.

Semiconductor Optoelectronics

Course Outcomes:

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

1. Acquire a fundamental understanding of the basic physics behind optoelectronic devices.
2. Develop a basic understanding of light-emitting diodes.
3. Develop detailed knowledge of laser operating principles and structures.
4. Acquire a depth understanding of photodetectors.
5. Acquire detailed knowledge of solar cells and optoelectronic modulation and switching devices.
6. Develop a basic understanding of optoelectronic integrated circuits.

Course Contents:

Review of Semiconductor Device Physics: Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level, and quasi-Fermi levels, p-n junctions, Schottky junction, and

Ohmic contacts. Semiconductor optoelectronic materials, Bandgap modification, Heterostructures, and Quantum Wells.

Interaction of photons with electrons and holes in a semiconductor: Rates of emission and absorption, Condition for amplification by stimulated emission, the laser amplifier.

Semiconductor Photon Sources: Electroluminescence. The LED: Device structure, materials and characteristics. The Semiconductor Laser: Basic structure, theory, and device characteristics, direct current modulation, Quantum-well lasers; DFB-, DBR- and vertical-cavity surface-emitting lasers (VCSEL), Laser diode arrays, Device packages, and handling.

Semiconductor Optical Amplifiers & Modulators: Semiconductor optical amplifiers (SOA), SOA, characteristics and some applications, Quantum-confined Stark Effect and Electro-Absorption Modulators.

Semiconductor Photodetectors: Types of photodetectors, Photoconductors, Single junction under illumination: photon and carrier-loss mechanisms, Noise in photodetection; Photodiodes, PIN diodes, and APDs: structure, materials, characteristics, and device performance. Photo-transistors, solar cells, and CCDs. Optoelectronic integrated circuits - OEICs.

NPTEL course (if any): https://nptel.ac.in/courses/115102026.

Text/Reference Books:

1. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2nd Ed. (2007), Ch.16, 17, and 18.

2. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).

3. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).

4. G. Keiser, Optical Fiber Communications, McGraw-Hill Inc., 3rd Ed. (2000),Ch.4, 6.

5. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007), 6th Ed. Ch.15-17.

6. J. M. Senior, Optical Fiber Communication: Principles and Practice, Prentice Hall of India, 2nd Ed. (1994), Ch.6-8.

Semiconductor Equipment Design and Technology

Course Outcome:

1. Understand Basics of Vacuum Technology
2. Understand Basics of Plasma Technology
3. Ability to analyze vacuum and plasma based semiconductor equipment.
4. Able to appreciate the Semiconductor Equipment Design and Technology through a mini-project

Course Contents:

Fundamentals of vacuum technology- nomenclature and definition, pressure regions, gas properties and laws, molecular processes and kinetic theory, gas flow calculations, technology of vacuum pumps-throughput, pumping speed, forevacuum and high vacuum pumping, pump system design, diaphragm pumps, vacuum blowers, diffusion pumps, cryogenic pumps, turbomolecular pumps, pumps for ultra-high vacuum,

vacuum measurements, types of gauges, mass analysis and spectrometry, mass flow control and measurement, vacuum valves, flanges and components, vacuum feedthroughs, vacuum seals, vacuum leak detectors, vacuum chambers and viewports, outgassing, vacuum applications such as sputtering, plasma etching, CVD, epitaxy, electron spectroscopies

Plasma Science and Technology Plasma physics- Motion of individual electrons and ions in electric and magnetic fields- Single, collisionless, particles in DC and AC electric fields, Particle orbits in magnetic fields, Space charge and collective effects, Debye shielding, Plasma oscillations and plasma frequency, Plasma shielding and plasma sheaths, Response to DC, RF and microwave fields, Plasma potential, Characteristic electron and ion transit times

Introduction to Plasma Reactors- Chamber pump systems, load locks, mass flow control, hazardouns gas handling, effluent control, Pressure gauges / control (Piranhi, thermocouple, ionization, baratron, convectron) Wafer chucks (Clamps/Electrostatic chucks) RF and microwave power sources and coupling- Power sources, matching networks, feedthroughs and coupling

RF Capacitively and Inductively coupled plasmas- Spatial variations of plasma potential, electric field, charge density and energy, optical emission, Sheaths at powered, grounded and floating surfaces, parameters, models, matching networks, Ion bombardment - energy / time / frequency/ power dependencies Applications in processes- etching, deposition, sputtering, ashing.

Text/Reference Books:

1. V.V. Rao, T.B. Ghosh, K.L. Chopra,, Vacuum Science and Technology, Allied Publishers Ltd., New Delhi

2. Handbook of Vacuum Science and Technology- Dorothy M. Hoffman, Bawa Singh, John H. Thomas, III, Academic Press

3. Handbook of Vacuum Technology: Karl Jousten, Wiley

4. Plasma Etching: Fundamentals and Applications: 7 (Series on Semiconductor Science and Technology)- M. Sugawara, OUP Oxford

5. Plasma Etching in Semiconductor Fabrication- Russ Morgan, Elsevier

6. Fundamentals of Plasma Physics- J. A. Bittencourt, Springer India

7. Plasma Physics and Engineering- Alexander Fridman, Lawrence Kennedy, CRC Press

Power Converters Design

Course outcomes:

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

1. Understanding of power electronics concepts, be able to classify DC-DC and AC/DC power electronic converters as per the performance requirement of Power Supplies.
2. Analyse and design conventional DC-DC converter topologies and be capable of developing their mathematical models aiding the steady state and transient analysis.
3. Develop understanding of conventional AC/DC converter topologies and be able to classify and design them based on their power stages, control aspects and other issues like source current quality control etc.
4. Able to classify the different layouts of uninterruptible power supplies, compare the applicable control strategies and identify the various standards followed in this area.

Course Contents:

Review of basic power electronics principles, Introduction to various power electronics supplies. Performance parameters for power electronics supplies and their measurement.

DC to DC converters: Analysis and design of cuk converters, two quadrant and full bridge Non isolated converters, Isolated converters, i.e., flyback, forward, push-pull, half- bridge, full bridge Zeta, and SEPIC topology, block diagram of converter control, modeling such as averaged model, linearized and state space model Design of DC inductor, Concept of integrated magnetic.

Soft switching DC to DC converters, zero current switching topologies, zero voltage switching topologies, generalized switch cell, ZCT and ZVT DC converters, design, and simulation.

Pulse width modulation rectifiers, properties of ideal rectifiers, Realization of near deal rectifiers, CCM boost converter, DCM flyback converters, control of current waveforms, AC Choppers: Modeling and analysis of AC choppers, harmonics control using symmetrical and asymmetrical waveform pattern, design, and simulation.

Static un-interruptible power supply, on-line, off-line and line interactive UPS, modes of operation, batteries and converters selection and design for UPS, performance evaluation of UPS, power factor correction techniques, control of UPS.

Text/Reference Books:

1. P.S. Bimbhra, Power Electronics, Khanna Book Publishing Company, 2022.

2. Issa Batarseh, “Power Electronics Circuits”, John Wiley & Sons Inc 2004.

3. Ned Mohan, “Power Electronics: Converters, Applications, and Design”, John Wiley; Sons Inc 2003.

4. M. H. Rashid, “Power Electronics Circuits, Devices and Applications”, third edition Pearson Education India, 2009. 4. L. Umanand, “Power Electronics Essential and Applications”, Wiley India 2009.

5. R. W. erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2013.

6. Y.S Lee, “Computer Aided Analysis and Design of Switch Mode Power Supplies”, Marcel Dekker, New York 1993.

7. D. C. Griffith, “Uninterruptible Power Supplies”, Marcel Dekker Inc, New York 1993.

8. K. Billing, “Switch Mode Power Supply Handbook”, third edition McGraw Hill, Boston 2010.

9. Madhukar Waware, D. S. More, Vijay Mohale, Abhay Wagh, Power Electronics and Its Applications, Khanna Publishing House, 2022.

Flexible Electronics

Course Outcomes:

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

1. Identify the advantages, drawbacks, performances, complementarity, and uniqueness of large-area manufacturing vs. silicon technology.
2. Integrate the operation principles, architectures, and processing of main devices and systems fabricated for flexible electronics.
3. Predict systems integration issues and propose methods for integration and encapsulation of printed devices and systems.

Detailed Contents:

Introduction to Flexible and Printed Electronics: Evolution of Flexible Electronics, review of cutting-edge research on electronics that can be flexible, plastic, stretchable, conformable or printed. Electronic materials, components, and systems, applications for IoT.

Materials, Processing, and Manufacturing: Various semiconductors, dielectric, and conducting materials, Organic semiconductors, from chemical bonds to bands, Charge injection and transport, Examples of printable functional materials, Thin-film Deposition and Processing Methods for Flexible Devices, Solution-based Patterning Processes; Ink-jet printing, gravure, and other processes, surface energy effects, multilayer patterning.

Flexible Thin-Film Transistors and Circuits: Thin-Film Transistor; Device structure and performance, Electrical characteristics, parameter extraction, characterization methods for rigid and flexible devices, electrical stability, printed transistors; organic/polymer, metal-oxide, electrolyte gated, Case studies; sub micrometer OTFTs and gravure printed OTFTs, From transistors to circuits.

Circuits on flexible and non-silicon substrates, Contacts, and Interfaces to Organic and Inorganic Electronic Devices: Schottky contacts, defects, carrier recombination, the effect of applied mechanical strain.

Other Flexible Devices and System Integration: Organic Light Emitting Diodes, Organic Solar Cells, thin flexible OLED displays, OLED lighting, smart wallpaper, sensors, logic, and memory, RFID tags, Latest applications of printed electronics, Encapsulation, Roll to roll printing processes, Integration Issues, and Designs for the Future.

Text/Reference Books:

1. G. Nisato, D. Lupo, S. Ganz (Editors) (2016), Organic and Printed Electronics: Fundamentals and Applications, CRC Press.

2. M. M. Hussain and N. El-Atab, *Handbook of Flexible and Stretchable Electronics*, CRC Press, 2020.

3. Sabrie Soloman, 3D Bioprinting Revolution, Khanna Publishing House, 2020.

4. Large Area and Flexible Electronics, Mario Caironi & Yong-Young Noh (Editors (2015), WILEY-VCH.

5. Wong, William S., and Alberto Salleo, (Eds.) (2009) Flexible electronics: materials and applications. Vol. 11. Springer

6. Recent Journal Papers form Flexible and Printed Electronics, IOP, and Organic Electronics, Elsevier.

Semiconductor Packaging and Testing

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

1. Give a comprehensive introduction to the various packaging types used along with the associated thermal, speed, signal, and integrity power issues.
2. Enable the design of packages that can withstand higher temperatures, vibrations, and shock.
3. Design of PCBs that minimize the EMI and operate at a higher frequency
4. Analyze the concepts of Testing and testing methods.

Course Contents:

Overview of electronic systems packaging: Introduction and Objectives of the course definition of a system

and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Case studies in the application. Semiconductor Packaging Overview: Basics of Semiconductor and Process flowchart; Video on "Sand-to-Silicon", Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution, Chip connection choices, Wire bonding, TAB and flipchip-1, TAB and flipchip-2, Need for packaging & Single chip packages or modules (SCM), Commonly used packages and advanced packages, Materials in packages, Thermal mismatch in packages, Current trends in packaging, Multichip modules (MCM)-type, System-in- package (SIP), Packaging roadmaps, Hybrid circuits.

Electrical Design considerations in systems packaging (L. Umanand): Electrical Issues – I Resistive Parasitic, Electrical Issues – II; Capacitive and Inductive Parasitic, Electrical Issues – III; Layout guidelines and the Reflection problem, Electrical Issues – IV; Interconnection, CAD for Printed Wiring Boards: Benefits from CAD; Introduction to DFM, DFR & DFT, Components of a CAD package and its highlights, Design Flow considerations; Beginning a circuit design with schematic work and component layout, Demo and examples of layout and routing; Technology file generation from CAD; DFM checklist and design rules; Design for Reliability.

Printed Wiring Board Technologies: Board-level packaging aspects, Review of CAD output files for PCB fabrication, Photo plotting, and mask generation, Process flow-chart; Vias; PWB substrates, Surface preparation, Photoresist and application methods, UV exposure and developing, Printing technologies for PWBs, PWB etching, Resist stripping, Screen-printing technology, Through-hole manufacture process steps, Panel and pattern plating methods, Solder mask for PWBs, Multilayer PWBs; Introduction to microvias, Microvia technology, and Sequential build-up technology process flow for high-density interconnects, Conventional Vs HDI technologies; Flexible circuits.

Surface Mount Technology: SMD benefits; Design issues; Introduction to soldering, Reflow, and Wave Soldering methods to attach SMDs, Solders: Wetting of solders; Flux and its properties, Defects in wave soldering, Vapor phase soldering, BGA soldering, and desoldering/ Repair, SMT failures, SMT failure library, Tin Whiskers, Tin-lead, and lead-free solders; Phase diagrams, Thermal profiles for reflow soldering, Lead-free alloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling issues. Thermal Design considerations in systems packaging, Introduction to embedded passives: Need for embedded passives, Design Library, Embedded resistor processes, Embedded capacitors; Processes for embedding capacitors.

NPTEL course (if any): http:/nptel/courses/108108031

Text/Reference Books:

1. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw Hill, NY, 2001.

2. William D. Brown, Advanced Electronic Packaging, IEEE Press, 1999.

3. Bosshart, Printed Circuit Boards Design and Technology, TataMcGraw Hill, 1988.

4. Blackwell (Ed), The electronic packaging handbook, CRC Press, 2000.

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

1. Give a comprehensive introduction to the various packaging types used along with the associated thermal, speed, signal, and integrity power issues.

2. Enable the design of packages that can withstand higher temperatures, vibrations, and shock.

3. Design of PCBs that minimize the EMI and operate at a higher frequency

4. Analyze the concepts of Testing and testing methods.

Introduction to MEMS

Course Outcomes:

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

1. Understand fundamental principles of sensing and actuation and corresponding scaling laws in MEMS.

2. Gain a comprehensive perspective of various fabrication processes and materials used in microfabrication.

3. Understand the principle, design, and fabrication techniques of leading exemplary devices in the MEMS industry.

4. Design basic MEMS devices using relevant mechanical/electrical/fluidic engineering principles.

Course Contents:

Introduction to MEMS: Historical Background, Scaling Effects. Micro/Nano Sensors, Review of Basic MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction, Bulk Micromachining, Isotropic Etching, and Anisotropic Etching, Wafer Bonding, Mechanics of solids in MEMS/NEMS.

Micro-actuators and Micro-sensors: Micro-sensors, acoustic wave sensors, biomedical and nanosensors, chemical sensors, optical sensors, pressure sensors, thermal sensors, micro-actuation through thermal forces, SMA-Piezo electric crystals, and electrostatic forces, magnetic actuation, micro-grippers, micro-motors, micro-valves,micropumps, micro-accelerometers.

Materials, Mechanics and design of micro-systems: Silicon as a substrate, compounds, piezoresistors, polymers, and packaging materials, micro-fabrication and micro-etching: static bending of thin plates, thermo mechanics and thin film mechanics.

Case studies of MEMS Products: Micro-fluidic devices, micro/nano transducers, blood pressure sensors, microphone-acceleration sensors, gyroscope, an overview of micro-system packaging.

NPTEL course (if any): https://nptel.ac.in/courses/117105082.

Text/Reference Books: 1. Marc Madou, Fundamentals of Microfabrication and Nanotechnology (3 rd edition);

2. Stephen D. Senturia, Microsystem Design.

3. Gregory T.A. Kovacs, Micromachined Transducers.

4. Guozhong Cao,Ying, Nanostructure and Nano materials, synthesis, properties and applications, World Scientific Publishing Co. 2011.

5. Chang Liu, Foundation of MEMS, Pearson Education, ISBN (978-81-317-6475-6).

Quantum Computing

Detailed Contents:

Review of Quantum Mechanics and Motivation for Quantum Computation Qubit: The qubit state - matrix and Bloch sphere representation - computational basis unitary evolution.

Multi-qubit states - No-cloning theorem - Superdense coding - Pure states to Bell states – Bell inequalities. Protocols with multi-qubits: Swapping - Teleportation - gates: CNOT - Toffoli gate -NAND - FANOUT - Walsh Hadamard.

Measurement: Projective operators - General, Projective and POVM measure, Ensemble: Density operators - pure and mixed ensemble - time evolution – post measurement density operator. Composite systems: Partial trace - Reduced density operator - Schmidt decomposition, Purification- bipartite entanglement.

Quantum computing: Classical computing using qubits - Quantum parallelism - Deutsch's algorithm - Deutsch Josza algorithm.

Quantum circuits: Basic gates - ABC decomposition - Gray codes - Universal gates - Principle of deferred and implicit measurements - Quantum Fourier transform - applications: phase estimation, order finding - factoring, discrete logarithm and hidden subgroup problems - Role of prime factoring in classical cryptography - search algorithms.

Quantum error correcting codes, Physical realization of qubits.

Text/Reference Books:

1. Quantum Computation and Quantum Information, M. A. Nielsen and I. L. Chuang, Cambridge University Press

2. Quantum Information and Computation, CIT Lecture Notes by J. Preskill.

3. Quantum Theory: Concepts and Methods, Asher Peres, Kluwer Academic Publishers.

Course Outcomes:

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

1. Students would learn the framework of quantum computation, and how that may be useful for future quantum technologies.

Nanoelectronics

Course outcomes:

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

1. Understand the fundamentals of classical CMOS technology and the issues in scaling MOSFET in the sub-100nm regime.

2. Students are able to analyze the non-classical transistors with new device structures and nanomaterials.

3. Understand the issues in realizing Germanium and compound semiconductor MOSFET and extensive materials characterization techniques that help in designing high-performance transistors.

Course Contents:

Overview: Nanodevices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, MOS Scaling theory, Issues in scaling MOS transistors: short channel effects, Description of a typical 65 nm CMOS technology.

Requirements for Nonclassical MOS transistor, MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k Interface states, bulk charge, band offset, stability, reliability – Qbd high field, possible candidates, CV and IV techniques.

Metal gate transistor: Motivation, requirements, Integration Issues, Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot.

SOI - PDSOI and FDSOI, Ultrathin body SOI – double gate transistors, integration issues, Vertical transistors - FinFET and Surround gate FET, Metal source/drain junctions – Properties of Schottky junctions on Silicon, Germanium, and compound semiconductors-Work function pinning. Germanium Nano MOSFETs: strain, quantization, Advantages of Germanium over Silicon, PMOS versus NMOS.

Compound semiconductors – material properties, MESFETs Compound semiconductors MOSFETs in the context of channel quantization and strain, Heterostructure MOSFETs exploiting novel materials, strain, quantization.

Synthesis of Nanomaterials: CVD, Nucleation and Growth, ALD, Epitaxy, MBE. Compound semiconductor hetero-structure growth and characterization: Quantum wells and Thickness measurement techniques: Contact - step height, Optical - reflectance and ellipsometry. AFM. Characterization techniques for nanomaterials: FTIR, XRD, AFM, SEM, TEM, EDAX etc. Applications and interpretation of results. Emerging nano materials: Nanotubes, nanorods and other nano structures, LB technique, soft lithography etc. Microwave-assisted synthesis, Self-assembly etc.

Text/Reference Books:

1. Fundamentals of Modern VLSI Devices, Y. Taur and T. Ning, Cambridge University Press.

2. Silicon VLSI Technology, Plummer, Deal, Griffin Pearson Education India.

3. Encyclopedia of Materials Characterization, Edited by: Brundle, C.Richard; Evans, Charles A. Jr.;Wilson, Shaun ; Elsevier.