GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

M.E. –VLSI DESIGN

(Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

THADAGAM ROAD, COIMBATORE – 641 013

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION OF THE ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT

VISION

The vision of ECE department is to become pioneer in higher learning and research and to produce creative solution to societal needs.

MISSION

1. To provide excellence in education, research and public service.
2. To provide quality education and to make the students entrepreneur and employable.
3. Continuous upgradation of techniques for reaching heights of excellence in a Global Perspective.

CHOICE BASED CREDIT SYSTEM
BRANCH : M.E.(VLSI DESIGN)- FULL TIME

PROGRAM OUTCOMES

Ability to

PO1: Acquire in-depth knowledge in the field of VLSI Design with an ability to evaluate and analyse the existing knowledge for enhancement

PO2: Analyse critical complex engineering problems and provide solutions through research

PO3: Identity the areas for the development of Electronic hardware design for the benefit of the society

PO4: Extract information pertinent to challenging problems through literature survey and by applying appropriate research methodologies, techniques and tools to the development of technological knowledge

PO5: Select, learn and apply appropriate techniques, resources and modern engineering tools to complex engineering activities with an understanding of limitations

PO6: Understand group dynamics, recognise opportunities and contribute positively to multidisciplinary work to achieve common goals for further learning

PO7: Demonstrate engineering principles and apply the same to manage projects efficiently as a team after considering economical and financial factors

PO8: Communicate with engineering community and society regarding complex engineering activities effectively through reports, design documentation and presentations

PO9: Engage with commitment in life-long learning independently to improve knowledge and competence

PO10: Acquire professional and intellectual integrity, professional code and conduct, ethics of research and scholarship by considering the research outcomes to the community for sustainable development of society

PO11: Observe and examine critically the outcomes and make corrective measures, and learn from mistakes without depending on external feedback

CHOICE BASED CREDIT SYSTEM
BRANCH : M.E.(VLSI DESIGN)- FULL TIME

PROGRAMME SPECIFIC OUTCOME:

PSO 1: To design and develop VLSI circuits to optimise power and area requirements, free from faults and dependencies by modelling, simulation and testing.

PSO 2: To develop VLSI systems by learning advanced algorithms, architectures and software – hardware co – design.

PSO 3: To integrate numerous sub-systems inadvancedconcepts or/and modern computational toolsto attain employabilityin sectors associated to VLSI domain.

CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR CANDIDATES ADMITTED
DURING 2018 ONWARDS
BRANCH: M.E. (VLSI DESIGN) - FULL TIME

M.E. VLSI DESIGN 2018 REGULATIONS

FIRST SEMESTER

SL. No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	CREDITS			
								L	T	P	C
THEORY											
1.	18VLFCZ1	Research methodology and IPR	FC	50	50	100	3	3	0	0	3
2.	18VLPC01	Digital CMOS VLSI design	PC	50	50	100	3	3	0	0	3
3.	18VLPC02	VLSI Signal Processing	PC	50	50	100	5	3	0	2	4
4.	18VLPEXX	Professional Elective I	PE	50	50	100	3	3	0	0	3
5.	18VLPEXX	Professional Elective II	PE	50	50	100	3	3	0	0	3
6.	18VLACXX	Audit course I	AC	50	50	100	2	2*	0	0	0
PRACTICAL											
7.	18VLPC03	Digital CMOS Design VLSI Laboratory	PC	50	50	100	3	0	0	3	1.5
		Total		**350**	**350**	**700**	**22**	**17**	**0**	**5**	**17.5**

SECOND SEMESTER

SL. No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	CREDITS			
								L	T	P	C
THEORY											
1	18VLPC04	Analog VLSI Design	PC	50	50	100	3	3	0	0	3
2	18VLPC05	VLSI Design Verification and Testing	PC	50	50	100	5	3	0	2	4
3	18VLPEXX	Professional Elective III	PE	50	50	100	3	3	0	0	3
4	18VLPEXX	Professional Elective IV	PE	50	50	100	3	3	0	0	3
5	18VLACXX	Audit course II	AC	50	50	100	2	2*	0	0	0
PRACTICAL											
6	18VLPC06	Analog VLSI Design Laboratory	PC	50	50	100	3	0	0	3	1.5
7	18VLEE01	Mini project	EEC	50	50	100	4	0	0	4	2
		Total		**350**	**350**	**700**	**23**	**14**	**0**	**9**	**16.5**

THIRD SEMESTER

SL. No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	CREDITS			
								L	T	P	C
THEORY											
1	18VLPEXX	Professional Elective V	PE	50	50	100	3	3	0	0	3
2	18$OEXX	Open Elective	OE	50	50	100	3	3	0	0	3
PRACTICAL											
3	18VLEE02	Project Phase I	EEC	100	100	200	20	0	0	20	10
		Total		**200**	**200**	**400**	**26**	**6**	**0**	**20**	**16**

FOURTH SEMESTER

SL. No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total marks	Contact periods	CREDITS			
								L	T	P	C
PRACTICAL											
1	18VLEE03	Project Phase II	EEC	200	200	400	32	0	0	32	16
		Total		**200**	**200**	**400**	**32**	**0**	**0**	**32**	**16**

Note: * - No credit courses

Total Credits: 66

LIST OF PROFESSIONAL ELECTIVES FOR M.E. VLSI DESIGN

SL. No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	CREDITS			
								L	T	P	C
Semester I Professional Elective I											
1	18VLPE01	Applied Mathematics	PE	50	50	100	3	3	0	0	3
2	18VLPE02	Advanced Digital System Design	PE	50	50	100	3	3	0	0	3
3	18VLPE03	VLSI Design Automation	PE	50	50	100	3	3	0	0	3
4	18VLPE04	Programming FPGA using HDLs	PE	50	50	100	3	3	0	0	3
Semester I Professional Elective II											
5	18VLPE05	RTL Simulation and Synthesis	PE	50	50	100	3	3	0	0	3
6	18VLPE06	Image and Video processing	PE	50	50	100	3	3	0	0	3
7	18VLPE07	Design of Semiconductor Memories	PE	50	50	100	3	3	0	0	3
8	18VLPE08	Microsensors and MEMS	PE	50	50	100	3	3	0	0	3
Semester II Professional Elective III											
9	18VLPE09	Low Power VLSI Design	PE	50	50	100	3	3	0	0	3
10	18VLPE10	VLSI Interconnects and Design Techniques	PE	50	50	100	3	3	0	0	3
11	18VLPE11	DSP Integrated Circuits	PE	50	50	100	3	3	0	0	3
12	18VLPE12	Electronic Packaging Technologies	PE	50	50	100	3	3	0	0	3
Semester II Professional Elective IV											
13	18VLPE13	ASIC Design	PE	50	50	100	3	3	0	0	3
14	18VLPE14	Analysis and Design of Analog Integrated Circuits	PE	50	50	100	3	3	0	0	3
15	18VLPE15	Mixed Signal Circuits and Interfacing	PE	50	50	100	3	3	0	0	3
16	18VLPE16	RF IC Design	PE	50	50	100	3	3	0	0	3
Semester III Professional Elective V											
17	18VLPE17	Reconfigurable Architecture for VLSI	PE	50	50	100	3	3	0	0	3
18	18VLPE18	VLSI Technology	PE	50	50	100	3	3	0	0	3
19	18VLPE19	System on Chip	PE	50	50	100	3	3	0	0	3
20	18VLPE20	VLSI for Wireless Communication System	PE	50	50	100	3	3	0	0	3

LIST OF OPEN ELECTIVES

SL.No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contacts Periods	CREDITS			
								L	T	P	C
1	18SEOE01	Vastu Science For Building Construction	OE	50	50	100	3	3	0	0	3
2	18SEOE02	Planning of Smart Cities	OE	50	50	100	3	3	0	0	3
3	18SEOE03	Green Building	OE	50	50	100	3	3	0	0	3
4	18EEOE04	Environment, Health and Safety in Industries	OE	50	50	100	3	3	0	0	3
5	18EEOE05	Climate Change and Adaptation	OE	50	50	100	3	3	0	0	3
6	18EEOE06	Waste to Energy	OE	50	50	100	3	3	0	0	3
7	18GEOE07	Energy in built Environment	OE	50	50	100	3	3	0	0	3
8	18GEOE08	Earth and its environment	OE	50	50	100	3	3	0	0	3
9	18GEOE09	Natural hazards and mitigation	OE	50	50	100	3	3	0	0	3
10	18EDOE10	Business Analytics	OE	50	50	100	3	3	0	0	3
11	18EDOE11	Cost Management of Engineering Projects	OE	50	50	100	3	3	0	0	3
12	18EDOE12	Introduction to Industrial Engineering	OE	50	50	100	3	3	0	0	3
13	18MFOE13	Industrial Safety	OE	50	50	100	3	3	0	0	3
14	18MFOE14	Operations Research	OE	50	50	100	3	3	0	0	3
15	18MFOE15	Composite Materials	OE	50	50	100	3	3	0	0	3
16	18TEOE16	Global Warming Science	OE	50	50	100	3	3	0	0	3
17	18TEOE17	Introduction to Nano Electronics	OE	50	50	100	3	3	0	0	3
18	18TEOE18	Green Supply Chain Management	OE	50	50	100	3	3	0	0	3
19	18PSOE19	Distribution Automation System	OE	50	50	100	3	3	0	0	3

20	18PSOE20	Power Quality Assessment And Mitigation	OE	50	50	100	3	3	0	0	3
21	18PSOE21	Modern Automotive Systems	OE	50	50	100	3	3	0	0	3
22	18PEOE22	Virtual Instrumentation	OE	50	50	100	3	3	0	0	3
23	18PEOE23	Energy Auditing	OE	50	50	100	3	3	0	0	3
24	18PEOE24	Advanced Energy Storage Technology	OE	50	50	100	3	3	0	0	3
25	18AEOE25	Design of Digital Systems	OE	50	50	100	3	3	0	0	3
26	18AEOE26	Advanced Processors	OE	50	50	100	3	3	0	0	3
27	18AEOE27	Pattern Recognition	OE	50	50	100	3	3	0	0	3
28	18VLOE28	VLSI Design	OE	50	50	100	3	3	0	0	3
29	18VLOE29	Analog & Mixed Mode VLSI Circuits	OE	50	50	100	3	3	0	0	3
30	18VLOE30	Hardware Description Languages	OE	50	50	100	3	3	0	0	3
31	18CSOE31	Artificial Intelligence and Machine Learning	OE	50	50	100	3	3	0	0	3
32	18CSOE32	Computer Network Engineering	OE	50	50	100	3	3	0	0	3
33	18CSOE33	Big Data Analytics	OE	50	50	100	3	3	0	0	3

LIST OF AUDIT COURCES (AC)

S. No.	Course code	Course Name	Category	CA Marks	End Sem Marks	Total Marks	Contact Periods	Hours/Week			
								L	T	P	C
1	18VLACZ1	ENGLISH FOR RESEARCH PAPER WRITING	AC	50	50	100	2	2	0	0	0
2	18VLACZ2	DISASTER MANAGEMENT	AC	50	50	100	2	2	0	0	0
3	18VLACZ3	VALUE EDUCATION	AC	50	50	100	2	2	0	0	0
4	18VLACZ4	CONSTITUTION OF INDIA	AC	50	50	100	2	2	0	0	0
5	18VLACZ5	PEDAGOGY STUDIES	AC	50	50	100	2	2	0	0	0
6	18VLACZ6	STRESS MANAGEMENT BY YOGA	AC	50	50	100	2	2	0	0	0
7	18VLACZ7	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	AC	50	50	100	2	2	0	0	0
8	18VLACZ8	SANSKRIT FOR TECHNICAL KNOWLEDGE	AC	50	50	100	2	2	0	0	0

CURRICULUM DESIGN

SL.NO.	SUBJECT AREA	CREDITS TOTAL	% OF TOTAL CREDITS
1.	Professional Core (PC)	17	25.75
2.	Program Elective (PE)	15	22.72
3.	Fundamental Core (FC)	3	4.54
4.	Open Elective (OE)	3	4.54
5.	Employment Enhancement Course (EEC)	28	42.42
	TOTAL	66	100

18VLFCZ1 RESEARCH METHODOLOGY AND IPR

(Common to All Branches)

Category: FC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES*: *Upon completion of this course, the students will be familiar with:

- Definition and Objectives of Research
- Quantitative methods for problem solving
- Data description and report writing

INTRODUCTION (9)

Definition and objectives of Research – Types of research, various steps in research process, Mathematical tools for analysis, Developing a research question, Choice of a problem, Literature Review, Surveying, Synthesizing, Critical Analysis, Reading Materials, Reviewing, Rethinking, Critical Evaluation, Interpretion, Research purposes, Ethics in Research – APA Ethics code.

QUANTITATIVE METHODS FOR PROBLEM SOLVING (9)

Statistical modeling and analysis, Time series analysis, Probability Distributions, Fundamentals of Statistical analysis and inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of time series analysis and spectral analysis, error analysis, applications of spectral analysis.

DATA DESCRIPTION AND REPORT WRITING (9)

Tabular and graphical description of data: Tables and graphs of frequency data of one variable, tables and graphs that show the relationship between two variables, relation between frequency distribution and other graphs, preparing data for analysis – structure and components of research report, types of report, layout of research report, mechanism of writing a research report, referencing in academic writing.

INTELLECTUAL PROPERTY (9)

Nature of intellectual property: Patents, designs, trade and copyright, process of patenting and development: technological research, innovation, patenting, development, and International scenario: International corporation on Intellectual property, procedure for grants of patents, patenting under PCT.

PATENT RIGHTS (9)

Patent rights: scope of patent rights, licensing and transfer of technology, patent information and databases, geographical indications.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Stuart Melville and Wayne Goddard, "**Research Methodology: an introduction for science and & engineering students"**, Juta Academic 1996.*
2. *Donald. H. McBurney and Theresa White, "**Research methods"**, 9th edition, Cengage Learning, 2013.*
3. *Ranjithkumar, "**Research Methodology: A step by step guide for beginners"**, 4th edition, 2014.*
4. *Dr. C. R. Kotharia and Garuav Garg, "**Research methodology: Methods and Trends**", New age International publishers, 3rd edition, 2014.*

***COURSE OUTCOMES*:**

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

CO1: Develop research question
CO2: Perform Exhaustive literature survey
CO3: Apply the right problem solving methods
CO4: Prepare data for analysis
CO5: Write Research report

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	H	-	H	-	-	-	-	-	-	-
CO2	-	H	-	H	-	-	-	-	-	-	-
CO3	M	-	H	-	H	-	-	M	M	-	M
CO4	L	-	H	-	H	-	L	M	M	-	M
CO5	-	-	-	-	-	-	M	-	-	H	-

L→ Low M→ Medium H→ High

18VLPC01 DIGITAL CMOS VLSI DESIGN

(Common to Applied Electronics)

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able to:*

- Learn basic concepts of MOS transistor and inverters
- Design combinational and sequential logic circuits
- Gain knowledge in arithmetic building blocks and memory architecture

MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER (9)

MOSFET Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy, and Energy Delay parameters.

COMBINATIONAL LOGIC CIRCUITS (9)

Static CMOS Design – Complementary CMOS, Ratioed Logic, Pass-Transistor Logic. Dynamic CMOS Design – Dynamic Logic: Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates.

SEQUENTIAL LOGIC CIRCUITS (9)

Timing metrics for sequential circuits, Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Pulse and sense amplifier based Registers, Non-Bistable Sequential Circuits.

ARITHMETIC BUILDING BLOCKS AND MEMORY ARCHITECTURES (9)

Data path circuits, Architectures for Adders, Multipliers, Shifters, Speed and Area Tradeoffs, Array Subsystems: SRAM, DRAM, ROM.

ARCHITECTURE DESCRIPTION (9)

Introduction, Power distribution, Input/Output, Clock, Hardware Description Languages, Verilog HDL: Behavioral modeling, Structural gate modeling, Switch modeling, Basic constructs, FSM, High-level synthesis.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Jan M Rabaey, AnanthaChandrakasan, B Nikolic, "**Digital Integrated Circuits: A Design Perspective"**, Second Edition, 2003, Prentice Hall of India.*
2. *Neil H.E. Weste, David Harris, Ayan Banerjee**, "CMOS VLSI Design- A circuits and Systems Perspective"**, Third Edition, 2013, Pearson education.*
3. *Chris Spear, "**System verilog for Verification"**, Springer, 2006.*
4. *Wayne Wolf, "**Modern VLSI Design"**, PHI Learning Private Limited, New Delhi, 2011.*
5. *Sung-Mo Kang and Yusuf Leblebici, "**CMOS Digital Integrated Circuits"**, McGraw Hill, 3rd Edition, 2011.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will be able:*

CO1: To understand basic concepts of MOS transistor and CMOS logic

CO2: To design CMOS combinational sequential logic circuits

CO3: To gain knowledge in arithmetic building blocks and memory architectures

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	M	M	L	-	-	L	-	-
CO2	H	M	H	M	L	-	L	-	-	-	L
CO3	H	H	M	M	M	L	L	-	L	-	L

L→ Low M→ Medium H→ High

18VLPC02 VLSI SIGNAL PROCESSING

Category : PC

L	T	P	C
3	0	2	4

PREREQUISITES: *NIL*

COURSE OBJECTIVE: *Upon the completion of this course, the students will be able*

- To understand the DSP algorithms and implement the FIR filter VLSI architectures
- To implement the algorithmic strength reduction techniques in filter structures
- To understand the clocking styles, synchronous and Asynchronous protocols suitable for VLSI Architectures

INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS (9)

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

RETIMING, ALGORITHMIC STRENGTH REDUCTION (9)

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS (9)

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with power-of-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

BIT-LEVEL ARITHMETIC ARCHITECTURES (9)

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon's bit-serial multipliers using Horner's rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner's rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters.

NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING (9)

Numerical strength reduction – subexpression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining, Asynchronous pipelining, bundled data versus dual rail protocol.

LIST OF EXPERIMENTS:

The following experiments should be realized with hardware architecture suitable for FPGA/CPLDs:

1. Butterworth Low pass and High pass Filter Design
2. Chebychev Type I, II Filter
3. State Space Matrix from Differential Equation
4. Decimation and Interpolation Using Rationale Factors
5. Maximally Decimated Analysis DFT Filter
6. Cascade Digital IIR Filter Realization
7. Convolution and M Fold Decimation & PSD Estimator
8. Inverse Z Transform
9. Parallel Realization of IIR filter

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 30 Periods** **Total: 75 Periods**

***Reference Books*:**

1. *Keshab K. Parhi, "**VLSI Digital Signal Processing Systems, Design and implementation"**, Wiley, Interscience, 2007.*
2. *U. Meyer – Baese, "**Digital Signal Processing with Field Programmable Gate Arrays",** Springer, Second Edition, 2004.*
3. *Kung S. Y, H. J. While House, T. Kailath, "**VLSI and Modern Signal Processing"**, Prentice Hall,1985.*
4. *Jose E. France, YannisTsividis, "**Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing"**, Prentice Hall, 1994.*
5. J.G. Proakis, Manolakis, "**Digital Signal Processing"**, Prentice-Hall, 4th Edition, 2006.
6. S. K. Mitra. "**Digital Signal Processing – A Computer based Approach**", TMH, 3rd Edition, 2006.
7. *Samir Palnitkar, "**Verilog HDL-A guide to Digital Design and synthesis second edition Pearson**", Education in South Asia 2013.*
8. *Medisetti V. K, "**VLSI Digital Signal Processing**", IEEE Press (NY), USA, 1995.*

COURSE OUTCOMES: *Upon completion of this course the students will have an:*

CO1 : Ability to understand the DSP algorithms and implement the FIR filter VLSI architectures

CO2 : Ability to implement the algorithmic strength reduction techniques in filter structures

CO3 : Ability to understand the clocking styles, synchronous and Asynchronous protocols suitable for VLSI Architectures

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	-	H	-	H	H	-	H	H	-	-
CO2	M	-	H	-	H	H	H	-	-	-	H
CO3	M	-	H	-	H	H	-	H	-	-	H

L→ Low M→ Medium H→ High

18VLPC03 DIGITAL CMOS VLSI DESIGN LABORATORY

Category : PC

L	T	P	C
0	0	3	1.5

PREREQUISITES: *NIL*

COURSE OBJECTIVE: *Upon the completion of this course, the students will be able*

- To Identify, formulate, solve and implement problems in digital systems on application level using RTL design tools
- To Implement the design using FPGA/CPLD devices
- To use EDA tools like Cadence, Xilinx and Quartus

LIST OF EXPERIMENTS:

1. Verilog implementation of 8:1 Mux/Demux, Full Adder, 8-bit Magnitude comparator, Encoder/decoder, Priority encoder, D-FF, 4-bit Shift registers (SISO, SIPO, PISO, bidirectional), 3-bit Synchronous Counters, Binary to Gray converter, Parity generator.
2. Sequence generator/detectors, Synchronous FSM – Mealy and Moore machines.
3. Vending machines, Traffic Light controller, ATM, Elevator control.
4. PCI Bus & arbiter and downloading on FPGA.
5. UART/ USART implementation in Verilog.
6. Realization of single port SRAM in Verilog.
7. Verilog implementation of Arithmetic circuits like serial adder/ subtractor, parallel adder/subtractor, serial/parallel multiplier.
8. Discrete Fourier transform/Fast Fourier Transform algorithm in Verilog.

Lecture : 0 Periods **Tutorial : 0 Periods** **Practical : 45 Periods** **Total: 45 Periods**

***Reference Books*:**

1. *Charles Roth Jr.H., "**Fundamentals of Logic Design"**, Australia cengage learning, 2014, 7th edition.*
2. *Samir Palnitkar, "**Verilog HDL-A guide to Digital Design and synthesis second edition Pearson"**, Education in South Asia 2013.*
3. *Clive Maxfield, **"The design warrior guide to FPGA's, devices, Tools and flows"**, 2011.*
4. *Altera Corporation- **"Standard Cell ASIC to FPGA Design Methodology and Guidelines",** April 2009.*

COURSE OUTCOMES: *Upon completion of this course the students will be able to/have an:*

CO1: Identify, formulate, solve and implement problems in digital systems on application level using RTL design tools

CO2: Ability to design using FPGA/CPLD devices

CO3: Use EDA tools like Cadence, Xilinx and Quartus

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	L	H	M	-	L	H	H	-	-
CO2	H	H	M	H	M	-	L	H	H	-	-
CO3	H	H	L	M	M	-	L	H	H	-	-

L→ Low M→ Medium H→ High

18VLPC04 ANALOG VLSI DESIGN

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: *18VLPC01*- DIGITAL CMOS VLSI DESIGN

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To understand analog transistor fundamentals, circuits and amplifiers of CMOS FET
- To gain knowledge analog filters and converters
- To test the analog circuits and to apply the knowledge to build common analog blocks

BASIC MOS DEVICE PHYSICS **(9)**

MOS Device Models- Review of Small Signal MOS Transistor Models-basic CMOS circuits-basic gain stage –super MOS transistor –Primitive analog cells - BICMOS Technology- fabrication, layout, design rules-Passive IC components: capacitor, resistor, inductor, transformer.

BASIC ANALOG CIRCUITS AND AMPLIFIERS: **(9)**

Current sources and sinks - Current mirrors/amplifiers - Voltage and current references, Comparator, Multiplier. AMPLIFIERS- MOS and BJT inverting amplifier - Improving performance of inverting amplifier - CMOS and BJT differential amplifiers - Characterization of Op-Amp - The BJT two stage op-amp - The CMOS two stage op-amp -Op-amps with output stage, Folded cascode op-amp, Transconductance Amplifier- Instrumentation amplifier.

NOISE AND FILTERS: **(9)**

Noise Spectrum, Sources, Types, Thermal and Flicker noise, Representation in circuits, Noise Bandwidth, Noise Figure. Low pass filters - High pass filters – Band Pass filters – Switched capacitor filters - Phase Locked Loops.

D/A AND A/D CONVERTERS: **(9)**

Ideal A/D and D/A converters, Quantization noise, Signed codes, Performance limitations. D/A converter: Current scaling, Voltage scaling and Charge scaling D/A converters - Serial D/A converters - Serial A/D converters, Parallel - High performance A/D converters.

ANALOG VLSI TESTING AND SYSTEMS: **(9)**

FAULT modelling and simulation - BIST – Analog VLSI for Vision - System Design Issues - An Integrated Image Acquisition, Smoothing and Segmentation Focal Plane Processor.

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total: 45 Periods**

Reference Books:

1. *Behzad Razavi, "**Design of Analog CMOS Integrated Circuits"**, McGraw Hill, 2nd Edition 2017.*
2. *Gray, P.R., Hurst, P.J., Lewis, S.H., and Meyer, R.G., "**Analysis and Design of Analog Integrated Circuits"**, John Wiley, 5th Edition, 2001.*
3. *Mohammed Ismail, "**Analog VLSI signal and Information processing"**, McGraw-Hill, 1994.*
4. *John L. Wyatt et.al, "**Analog VLSI Systems for Image Acquisition and Fast Early Vision Processing"**, International Journal of Computer Vision, 1992.*

***COURSE OUTCOMES*:** *Upon completion of this course, the students will be able to:*

CO1: Understand analog transistor fundamentals, circuits and amplifiers of CMOS FET

CO2: Gain knowledge analog filters and converters

CO3: Test the analog circuits and to apply the knowledge to build common analog blocks

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	M	L	M	L	M	H	-	-	M	-
CO2	L	L	M	L	M	H	M	-	-	H	-
CO3	L	L	L	M	H	H	H	-	-	M	-

L → LOW M → MEDIUM H→HIGH

18VLPC05 VLSI DESIGN VERIFICATION AND TESTING

Category : PC

L	T	P	C
3	0	2	4

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To gain the Basic knowledge on fault modeling , testing and test generation in logic circuits
- To get exposure to testability approaches and test vector generation algorithms for memory and logic circuits
- To Understand the various fault diagnosis methods in logic systems

BASICS OF TESTING AND FAULT MODELLING (9)

Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models – Fault detection - Fault location - Fault dominance - Logic Simulation - Types of simulation - Delay models - Gate level Event-driven simulation.

TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS (9)

Test generation for combinational logic circuits - Testable combinational logic circuit design – Test generation for sequential circuits - design of testable sequential circuits.

TESTABILITY (9)

Design for Testability - Ad-hoc design - Generic scan based design - Classical scan based design – System level DFT approach.

SELF-TEST AND TEST ALGORITHMS (9)

Built-In Self Test - Test pattern generation for BIST - Circular BIST - BIST Architectures – Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.

FAULT DIAGNOSIS (9)

Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

LIST OF EXPERIMENTS:

1. Functional Verification Tools Bus functional model (BFM)
2. Test Bench generation using HDL based simulators
3. PLI / FLI
4. TCL / Tk
5. Test Pattern Generator
6. Scan-Chain Insertion
7. DFT and BIST software Tools
8. Code coverage and functional coverage
9. Timing Verification

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 30 Periods** **Total: 75 Periods**

Reference Books:

1. *M. Abramovici, M.A. Breuer and A.D. Friedman, "**Digital Systems and Testable Design**", Jaico Publishing House, 11th edition, 2011.*
2. *P.K. Lala, "**Digital Circuit Testing and Testability**", Academic Press, 2002.*
3. *M.L. Bushnell and V.D. Agrawal, "**Essentials of Electronic Testing for Digital, Memory and Mixed- Signal VLSI Circuits**", Springer, 2014.*
4. *A.L. Crouch, "**Design Test for Digital IC's and Embedded Core Systems**", Beijing China Electric Power Press, 2010.*
5. *M. Bushnell and V. D. Agrawal, "**Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits**", Kluwer Academic Publishers, 2002.*

***COURSE OUTCOMES*:** *Upon completion of this course students will have:*

CO1: Basic knowledge on fault modeling, testing and test generation in logic circuits

CO2: Exposure on testability approaches and test vector generation algorithms for memory and logic circuits

CO3: Understanding of the various fault diagnosis methods in logic systems

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	H	-	L	-	L	-	L
CO2	M	M	-	M	M	-	-	-	-	-	
CO3	H	M	-	H	M	-	-	-	-	-	-

L → LOW M→ MEDIUM H→HIGH

18VLPC06 ANALOG VLSI DESIGN LABORATORY

Category : PC

L	T	P	C
0	0	3	1.5

PREREQUISITES:*NIL*

***COURSE OBJECTIVES*:** *Upon completion of this course, the students will be able:*

- To analyze analog circuits
- To gain knowledge on different facets of analogVLSI design using CAD tools
- Hands on experience on VLSI based experiments using simulation and synthesis tools

LIST OF EXPERIMENTS:

- Design, characterization and layout verification of the following analog circuits
  - common source amplifier with Resistive/diode/current source load :
    - Transfer Characteristics (Vin vs Vout)
    - Frequency Response (Vin vs Frequency)
  - common gate amplifier :
    - Transfer Characteristics (Vin vs Vout)
    - Frequency Response (Vin vs Frequency)
  - differential amplifier & differential to single-ended circuit :
    - Transfer Characteristics (Vin vs Vout)
    - Frequency Response (Vin vs Frequency)
  - basic/cascode current mirror
  - voltage mode buffer :
    - Transfer Characteristics (Vin vs Vout)
    - Frequency Response (Vin vs Frequency)
- Design of operational amplifier
- Mixed Signal Circuits
  - A/D & D/A Circuits
  - Sample & Hold
  - PLL
- Hardware software co-design

Lecture : 0 Periods **Tutorial : 0 Periods** **Practical : 45 Periods** **Total: 45 Periods**

References Books:

1. *BehzadRazavi, "**Design of Analog CMOS Integrated Circuits", McGraw Hill, 2nd Edition 2017.*
2. *Gray, P.R., Hurst, P.J., Lewis, S.H., and Meyer, R.G., "**Analysis and Design of Analog Integrated Circuits", John Wiley, 5th Edition, 2001.*
3. *Samir Palnitkar, "**Verilog HDL-A Guide to digital design and synthesis", 2nd Edition, Pearson Education, 2013.*
4. *Paul R. Gray and Robert G. Meyer, "**Analysis and Design of Analog Integrated circuits", Wiley, 5th edition, 2009.*

***COURSE OUTCOMES*:** *At the end of this course the student will be able to/ have:*

CO1: Analyze analog circuits
CO2: Gain knowledge on different facets of analog VLSI design using CAD tools
CO3: Hands on experience on VLSI based experiments using simulation and synthesis tools

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	-	L	-	-	-	L
CO2	M	H	M	L	H	-	-	-	-	-	-
CO3	M	L	M	H	H	-	-	L	-	-	-

L→ LOW M→MEDIUM H→HIGH

18VLEE01 MINI PROJECT

Category : EEC

L	T	P	C
0	0	4	2

***COURSE OBJECTIVES*:** *Upon completion of this course, the students will be able:*

- To acquire practical knowledge within the chosen area of technology for project development
- To identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach.
- To contribute as an individual or in a team in development of technical projects

Lecture : 0 Periods **Tutorial : 0 Periods** **Practical : 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES: *Upon completion of this course, the students will have/able to:*

CO1: Acquire practical knowledge within the chosen area of technology for project development

CO2: Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach

CO3:Contribute as an individual or in a team in development of technical projects

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	L	L	L	H	H	-	-	H	M
CO2	L	M	L	H	H	H	H	-	-	H	H
CO3	L	L	H	L	L	H	H	-	-	H	M

L→ Low M→ Medium H→ High

18VLEE02 PROJECT PHASE I

Category : EEC

L	T	P	C
0	0	20	10

***COURSE OBJECTIVES*:** *Upon completion of this course, the students will be able:*

- To expose the students to take up problems and challenges.
- To develop confidence to take up a project independently.
- To develop an understanding of technical dissertation presentation and writing

Lecture : 0 Periods **Tutorial : 0 Periods** **Practical : 300 Periods** **Total: 300 Periods**

COURSE OUTCOMES:*Upon completion of this course, the students will have:*

CO1: An exposure to take up real time problems and challenges.
CO2: Confidence to take up a project independently.
CO3: An understanding of technical dissertation presentation and writing.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	L	-	M	M	L	M	L	L	M	M
CO2	-	H	H	L	H	M	L	M	M	-	M
CO3	M	M	M	L	H	M	-	M	M	M	M

L→ Low M→ Medium H→ High

18VLEE03 PROJECT PHASE II

Category : EEC

L	T	P	C
0	0	32	16

***COURSE OBJECTIVES*:** *Upon completion of this course, the students will be able:*

- To expose the students to take up real time problems and challenges.
- To develop confidence to take up a project independently.
- To develop an understanding of technical dissertation presentation and writing

Lecture : 0 Periods Tutorial : 0 Periods Practical : 480 Periods Total: 480 Periods

COURSE OUTCOMES: *Upon completion of this course, the students will have:*

CO1: An exposure to take up real time problems and challenges.
CO2: Confidence to take up a project independently.
CO3: An understanding of technical dissertation presentation and writing.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	L	-	M	M	L	M	L	L	M	M
CO2	-	H	H	L	H	M	L	M	M	-	M
CO3	M	M	M	L	H	M	-	M	M	M	M

L→ Low M→ Medium H→ High

18VLPE01 APPLIED MATHEMATICS

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To acquire knowledge of solving problems on matrix theory, discrete and continuous distributions
- To develop an understanding of discrete and continuous random processes
- To acquire knowledge of linear programming problems
- To familiarize with queuing models

LINEAR ALGEBRA **(9)**

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization - generalized eigenvectors – singular value decomposition and applications - pseudo inverse – least square approximations –Toeplitz matrices and some applications.

ONE DIMENSIONAL RANDOM VARIABLES **(9)**

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

RANDOM PROCESSES **(9)**

Classification – Auto correlation - Cross correlation - Stationary random process – Markov process – Markov chain - Poisson process – Gaussian process.

LINEAR PROGRAMMING **(9)**

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models.

QUEUEING MODELS **(9)**

Characteristic and representation of queuing models- Model I:[(M/M/1): (“/FIFO)], Model II: [(M/M/S):(“/FIFO)],Model III:[(M/M/1): (N/FIFO)], Model IV: [(M/M/S):(N/FIFO)].

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total: 45 Periods**

Reference Books*:*

1. *Bronson, R., “**Matrix Operation”**, Schaum’s outline series, McGraw Hill, New york (1989).*
2. *Oliver C. Ibe, “**Fundamentals of Applied Probability and Random Processes”**, Academic Press, (An imprint of Elsevier), 2010.*
3. *Taha H.A., “**Operations Research: An introduction”**, Ninth Edition, Pearson Education, Asia, New Delhi 2012.*
4. *Sankara Rao, K., “ **Introduction to partial differential equations”,** Prentice Hall of India, pvt, Ltd, New Delhi, 1997.*
5. *Andrews, L.C. and Philips. R. L., “ **Mathematical Techniques for engineering and scientists”**, Prentice Hall of India, 2006.*
6. *O’Neil P.V., “ **Advanced Engineering Mathematics”**, (Thomson Asia pvt ltd, Singapore) 2007, cengage learning India private limited.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have an ability to:*

CO1: Gain the skill of finding eigen values using QR algorithm and the knowledge of discrete and continuous distributions along with functions of random variables

CO2: Develop discrete and continuous random processes including Markov processes and also solutions of Linear Programming problems

CO3: Understand probability values for various queuing models in situations of single or many service terminals available

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	-	-	L	M	-	-	-	L	-	-
CO2	-	H	-	L	-	-	-	-	L	-	-
CO3	L	-	-	L	M	-	-	-	L	-	-

L→ Low M→ Medium H→ High

18VLPE02 ADVANCED DIGITAL SYSTEM DESIGN

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To get knowledge on Verilog HDL programming and ability to design digital systems
- To design and analyze the clocked synchronous and asynchronous sequential Circuits
- To get knowledge on Fault diagnosis and Testability algorithms

SYSTEM DESIGN USING VERILOG HDL (9)

Hardware Modeling with Verilog HDL – Logic System, Data Types and Operators for Modeling in Verilog HDL - Behavioral Descriptions in Verilog HDL – HDL Based Synthesis – Synthesis of Finite State Machines – Structural modeling – Compilation and Simulation of Verilog code –Test bench - Realization of combinational and sequential circuits using Verilog HDL.

SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9)

Analysis of clocked synchronous sequential circuits and modeling - State diagram, state table, state assignment and reduction - Design of synchronous sequential circuits - Design of Iterative circuits - ASM chart and realization using ASM.

ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9)

Analysis of asynchronous sequential circuit – flow table reduction – Races - state assignment-transition table and problems in transition table- Design of asynchronous sequential circuit - Static, dynamic and essential Hazards – Data synchronizers – Mixed operating mode asynchronous circuits.

FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS (9)

Fault table method- Path sensitization method – Boolean difference method - D algorithm - Tolerance techniques – The compact algorithm – Fault in PLA – Test generation - DFT schemes – Built in self test.

SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES (9)

Programming logic device families – Designing a synchronous sequential circuit using PLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA-Xilinx 4000.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Charles H.Roth J, "**Fundamentals of Logic Design"**, Thomson Learning 2004, 7th edition 2014.*
2. *Nripendra N Biswas, "**Logic Design Theory",** Prentice Hall of India, 2010.*
3. *Parag K. Lala, "**Fault Tolerant and Fault Testable Hardware Design",** B SPublications, 2002.*
4. *Parag K. Lala, "**Digital system Design using PLD"**, B S Publications, 2003.*
5. *M.D.Ciletti, "**Modeling, Synthesis and Rapid Prototyping with the Verilog HDL"**, Prentice Hall, 1999.*
6. *M.G. Arnold, "**Verilog Digital – Computer Design"**, Prentice Hall (PTR), 1999.*
7. *S. Palnitkar, "**Verilog HDL – A Guide to Digital Design and Synthesis"**, Pearson, 2003.*

COURSE OUTCOMES**:** *Upon completion of the course, the students will have:*

CO1: Knowledge on Verilog HDL programming and ability to design digital systems

CO2: Ability to design and analyze the clocked synchronous and asynchronous sequential circuits

CO3: Knowledge on Fault diagnosis and Testability algorithms

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	L	H	L	L	L	L	M	-	-	L
CO2	M	L	L	L	L	-	L	M	-	-	L
CO3	L	L	L	L	H	-	H	L	-	-	L

L→ Low M→ Medium H→ High

18VLPE03 VLSI DESIGN AUTOMATION

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To acquire knowledge on VLSI Design methodologies & CAD tools
- To analyze the design trade off in various partitioning, placement and floor planning in VLSI Design Automation
- To analyze the different global routing Algorithm and acquire knowledge about logical synthesis

VLSI DESIGN METHODOLOGIES (9)

Introduction to VLSI Design Methodologies: VLSI Design Cycle - New trends in VLSI design Cycle- Physical Design – New trends in physical design cycle – Design styles - VLSI Design Automation Tools - Algorithmic graph theory and computational complexity - Tractable and intractable problems.

PARTITIONING & PLACEMENT (9)

Partitioning – Problem formulation – Group migration Algorithms – KL,FM Algorithms, Placement – Simulation based algorithm – Simulated annealing, Force directed algorithm, Partition based algorithms – Breuer's Algorithm, Terminal propagation Algorithm, Floor planning – Slicing floor plan, Constrained Based Floor planning – Pin assignment.

ROUTING (9)

Routing - Grid routing – Maze routing Algorithms, Global routing – Shortest path based Algorithm, Steiner free based Algorithm, Detailed routing – Left edge Algorithm, Greedy channel Routing – Over the cell routing, clock routing.

SIMULATION (9)

Simulation – Gate level modeling and Simulation – Switch level modeling and simulation – Switch level modeling and simulation - Combinational Logic Synthesis – Binary decision diagrams – Two level logic Synthesis.

MODELING AND SYNTHESIS (9)

High level synthesis – Hardware models – Internal representation – Allocation assignment and scheduling – High level transformation.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *N.A Sherwani, "**Algorithms for VLSI Physical Design Automation"**, Kluwer Academic Publishers, 2007.*
2. *S.H. Gerez, "**Algorithms for VLSI Design Automation"**, John Wiley & Sons, 2008.*
3. *S. K. Lim, "**Practical Problems in VLSI Physical Design Automation"**, Springer, 2008.*
4. *A. B. Kahng, J. Lienig, I. L. Markov, J. Hu, "**VLSI Physical Design: From Graph Partitioning to Timing Closure"**, Springer 2011.*
5. *C. J. Alpert, D. P. Mehta, S. S. Sapatnekar, "**Handbook of Algorithms for Physical Design Automation"**, Auerbach Publications, 2008.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1: Knowledge on VLSI Design methodologies & CAD tools

CO2: An ability to analyze the design trade off in various partitioning, placement and floor planning in VLSI Design Automation

CO3: An ability to analyze the different global routing Algorithm and acquire knowledge about logical synthesis

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	H	L	M	H	-	-	L	-	-	-
CO2	M	H	L	M	H	-	-	L	-	-	-
CO3	M	H	L	M	H	-	-	M	-	-	-

L→ Low M→ Medium H→ High

18VLPE04 PROGRAMMING FPGA USING HDLs

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To code and simulate any digital function in Verilog HDL
- To know the difference between synthesizable and non-synthesizable code
- To learn good coding techniques on current industrial practices

VERILOG INTRODUCTION AND MODELING (9)

Introductionto Verilog HDL, Language Constructs and Conventions, Gate Level Modeling, Modeling at Dataflow Level, Behavioral Modeling, Switch Level Modeling, System Tasks, Functions and Compiler Directives.

SEQUENTIAL MODELING AND TESTING (9)

Sequential Models - Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis. Test Bench - Combinational Circuits Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.

SYSTEM VERILOG INTRODUCTION (9)

Introduction, System Verilog declaration spaces, System Verilog Literal Values and Built-in Data Types, SystemVerilog User-Defined and Enumerated Types, system Verilog Arrays, Structures and Unions, system Verilog Procedural Blocks, Tasks and Functions.

SYSTEM VERILOG MODELING (9)

SystemVerilog Procedural Statements, Modeling Finite State Machines with SystemVerilog,SystemVerilog Design Hierarchy, SystemVerilog Interfaces, A Complete Design Modeled with SystemVerilog,Behavioral and Transaction Level Modeling.

FPGA APPLICATIONS (9)

FPGA Board Features, Features of Digital Input/output Board, Problem on FPGA Boards and its Solution, Automotive Electronics, Avionics, Cameras, Communication Systems, Computers and Peripherals, Control Systems, Image/Video Processing Systems, Measuring Instruments, Medical Applications, Miscellaneous Applications, Music, Office Equipments, Phones, Security Systems, Toys and Games, Embedded Systems Design, Electrostatic Precipitator Controller.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *T.R. Padmanabhan, B Bala Tripura Sundari, "**Design through Verilog HDL"**, Wiley 2009.*
2. *ZainalabdienNavabi, "**Verilog Digital System Design"**, TMH, 2nd Edition, 2005.*
3. *Stuart Sutherland, Simon Davidmann, Peter Flake, Foreword by Phil Moorby, "**SystemVerilog For Design Second Edition A Guide to Using SystemVerilog for Hardware Design and Modelling"**, Springer 2006.*
4. *Dr. S Ramachandran, "**Digital VLSI Systems Design A Design Manual for Implementation of Projects on FPGAs and ASICs Using Verilog",** Springer 2007.*

COURSE OUTCOMES**:** *Upon completion of the course, the students will have:*

CO1: Knowledge on coding and simulating any digital function in Verilog HDL

CO2: An ability to differentiate between synthesizable and non-synthesizable code

CO3: An ability to apply good coding techniques on current industrial practices

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	H	H		H	L	-	-	H	L	M
CO2	H	H	H	M	M	-	-	-	M	L	L
CO3	**L**	H	H	L	L	L	-	-	H	M	M

L→ Low M→ Medium H→ High

18VLPE05 RTL SIMULATION AND SYNTHESIS
(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To acquire knowledge on Finite State Machines, RTL design using reconfigurable logic
- To design and develop IP cores and Prototypes with performance guarantees
- To use EDA tools like Cadence, Mentor Graphics and Xilinx

FSM AND CLOCK **(9)**

Top down approach to design, Design of FSMs (Synchronous and asynchronous), Static timing analysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs.

HDL **(9)**

Design entry by Verilog/VHDL/FSM, Verilog AMS.

LOGIC DEVICES **(9)**

Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection.

VLSI TESTING **(9)**

Design for performance, Low power VLSI design techniques. Design for testability.

VLSI IP AND PROTOTYPING **(9)**

IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, Use of external hard IP during prototyping CASE STUDIES: Case studies and Speed issues.

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total: 45 Periods**

Reference Books:

1. *Richard S. Sandige, "**Modern Digital Design"**, MGH, International Editions, 1990.*
2. *Donald D Givone, "**Digital Principles and Design"**, TMH, 2002.*
3. *Charles Roth, Jr. and Lizy K John, "**Digital System Design using VHDL"**, Cengage Learning, 2016.*
4. *Samir Palnitkar, Verilog HDL, "**A Guide to Digital Design and Synthesis"**, Prentice Hall, 2003.*
5. *Doug Amos, Austin Lesea, Rene Richter, "**FPGA based prototyping methodology manual"**, Xilinx, 2011.*
6. *Bob Zeidman, "**Designing with FPGAs & CPLDs"**, CMP Books, 2002.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have/able to:*

CO1: Familiarity of Finite State Machines, RTL design using reconfigurable logic
CO2: Design and develop IP cores and Prototypes with performance guarantees
CO3: Use EDA tools like Cadence, Mentor Graphics and Xilinx

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	L	-	M	-	-	-	L	-	-
CO2	H	H	L	-	M	-	-	-	L	-	-
CO3	L	L	L	-	M	-	-	-	L	-	-

L→ Low M→ Medium H→ High

18VLPE06 IMAGE AND VIDEO PROCESSING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To gain knowledge on the basics of digital imaging.
- To get exposure to various image processing techniques.
- To get exposure to video processing.

DIGITAL IMAGE PROCESSING FUNDAMENTALS (9)

Image Processing Systems- Elements of visual perception- Image sensing and acquisition- Image sampling and quantization. Pixel relationships- Statistical properties- Histogram, mean, Standard deviation-. Color Image Fundamentals, Chromaticity diagram. Color models- Image file formats, Image transforms, Discrete fourier transform- Discrete cosine transform- wavelet transform.

IMAGE ENHANCEMENT AND RESTORATION (9)

Enhancement in spatial domain- Basic gray level transforms- Histogram processing- Spatial Filtering- Enhancement in frequency domain- Image restoration- Degradation model- Noise models- Spatial Filters- Frequency domain filters.

IMAGE SEGMENTATION AND REPRESENTATION (9)

Detection of discontinuities- Point, Line and Edge detection- Gradient operators- Thresholding- Region based segmentation- Representation schemes- Chain codes- Polygon approximation- Boundary descriptors- Simple descriptors- Shape number- Fourier descriptors.

VIDEO FUNDAMENTALS (9)

Basic concepts and Terminology-Monochrome Analog video – Color in Video – Analog video standards – Digital video basics – Analog-to Digital conversion – Color representation and chroma sub sampling – Digital video formats and standards Video sampling rate and standards conversion.

VIDEO OBJECT EXTRACTION (9)

Back ground subtraction – Frame difference – Static and dynamic background modeling – Optical flow techniques – Handling occlusion – Scale and appearance changes – Shadow removal.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books :

1. *Rafael C. Gonzalez, Richard E. Woods, "**Digital Image Processing",** Pearson Education, Inc., Second Edition, 2004.*
2. *Anil K. Jain, "**Fundamentals of Digital Image Processing",** Prentice Hall of India, 2002.*
3. *Oges Marques, "**Practical Image and Video Processing Using MATLAB"**, Wiley-IEEE Press, 2011.*
4. *A.Bovik, "**Handbook of Image and Video processing"**, 2nd Edition, Academic press, 2005.*
5. *Mark Nixon and Alberto Aguado, **"Feature Extraction and Image Processing"**, Academic Press, 2008.*
6. *Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "**Digital Image Processing using MATLAB",** Pearson Education, Inc., 2004.*
7. *Jayaraman S, Esakkirajan S and Veerakumar J, "**Digital Image Processing",** Tata McGraw Hill Education pvt ltd, 2010.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*
CO1: Knowledge on the basics of digital imaging
CO2: Exposure to various image processing techniques
CO3: Exposure to video processing

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	H	M	M	H	M	L	L	L	H	-
CO2	H	H	M	M	H	H	L	L	H	H	-
CO3	H	H	M	M	H	H	L	L	H	H	-

L→ Low M→ Medium H→ High

18VLPE07 DESIGN OF SEMICONDUCTOR MEMORIES

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To study the architectures for SRAM and DRAM and various non-volatile memories
- To study the fault modeling and testing of memories for fault detection
- To learn the radiation hardening process and issues for memory

RANDOM ACCESS MEMORY TECHNOLOGIES (9)

Static Random Access Memories (SRAMs): SRAM Cell Structures - MOS SRAM Architecture –MOS SRAM Cell and Peripheral Circuit Operation - Bipolar SRAM Technologies - Silicon On Insulator (SOI) Technology - Advanced SRAM Architectures and Technologies - Application Specific SRAMs. Dynamic Random Access Memories (DRAMs): DRAM Technology Development - CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Structures - BiCMOS, DRAMs - Soft Error Failures in DRAMs - Advanced DRAM Designs and Architecture - Application Specific DRAMs.

NON VOLATILE MEMORIES (9)

Masked Read-Only Memories (ROMs) - High Density ROMs - Programmable Read-Only Memories (PROMs) - Bipolar PROMs - CMOS PROMs - Erasable (UV) - Programmable Read-Only Memories (EPROMs) - Floating-Gate EPROM Cell-One-Time Programmable (OTP) EPROMs-Electrically Erasable PROMs (EEPROMs) - EEPROM Technology and Architecture - Nonvolatile SRAM -Flash Memories (EPROMs or EEPROM) - Advanced Flash Memory Architecture.

MEMORY FAULT MODELING, TESTING, MEMORY DESIGN FOR TESTABILITY AND FAULT TOLERANCE (9)

RAM Fault Modeling, Electrical Testing, Pseudo Random Testing - Megabit DRAM Testing Nonvolatile Memory Modeling and Testing - IDDQ Fault Modeling and Testing - Application Specific Memory Testing. General Design for Testability Techniques – Ad Hoc Design Techniques, Structured Design Techniques – RAM Built-In Self – Test (BIST).

RELIABILITY AND RADIATION EFFECTS (9)

General Reliability Issues - RAM Failure Modes and Mechanism - Nonvolatile Memory Reliability - Reliability Modeling and Failure Rate Prediction - Design for Reliability - Reliability Test Structures - Reliability Screening and Qualification. Radiation Effects - Single Event Phenomenon (SEP)

PACKAGING TECHNOLOGIES (9)

Random Access Memories (MRAMs) - Experimental Memory Devices. Memory Hybrids and MCMs (2D) - Memory Stacks and MCMs (3D) - Memory MCM Testing and Reliability Issues - Memory Cards -High Density Memory Packaging Future Directions.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Ashok K. Sharma,* ***"Semiconductor Memories Technology, Testing and Reliability",*** *Prentice Hall of India Private Limited, New Delhi,2003.*
2. *Tegze P. Haraszti, "****CMOS Memory Circuits",*** *Kluwer Academic publishers, 2002.*
3. *Betty Prince****, "Emerging Memories: Technologies and Trends",*** *Kluwer Academic publishers, 2002.*
4. *Said Hamdioui, "****Semiconductor Memory Architecture"****, Springer, 2004.*
5. *Santosh K. Kurinec, Krzysztof Iniewski, "****Nanoscale Semiconductor Memories: Technology and Applications"****, 1st Edition, CRC Press, 2017.*

***COURSE OUTCOMES*:** *Upon completion of the course, the students will have:*

CO1: Knowledge on the architectures for SRAM, DRAM and various non-volatile memories

CO2: Knowledge on fault modeling and testing of memories for fault detection

CO3: Exposure on the radiation hardening process and issues for memory

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	L	H	H	M	L	M	-	-	L
CO2	H	M	-	H	H	M	-	M	-	-	L
CO3	M	M	-	H	H	M	-	L	-	-	L

L→ Low M→ Medium H→ High

18VLPE08 MICROSENSORS AND MEMS

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To understand the microfabrication process, MEMS materials and various system issues
- To acquire knowledge on electrical and mechanical concepts of MEMS and on various types of microsensors
- To introduce the concepts of optical and RF MEMS and various case studies

MICROFABRICATION AND MATERIALS (9)

Introduction – Evolution of MEMS – Microsensors and actuators – Microfabrication – Lithography, Etching, Deposition, Oxidation, Diffusion - MEMS materials – Metals – Physical and chemical properties, Metallization – Semiconductors – Electrical and chemical properties, Growth and Deposition – Bulk and Surface micromachining.

ELECTRICAL AND MECHANICAL CONCEPTS (9)

Conductivity and resistivity – Elasticity – Stress and strain – Isotropic and Anisotropic materials – Bending of beams – types, Deflection – Pure bending – Torsional deflections – intrinsic stress – Resonance – Viscosity - Surface tension.

MEMS ISSUES AND CASE STUDIES (9)

Circuit and System issues – Electronics, Feedback systems and Noises. Case studies – Commercial pressure sensor, MEMS magnetic actuators, Capacitive accelerometer.

TYPES OF MICROSENSORS (9)

Introduction – Thermal sensors, Radiation sensors, Mechanical sensors – Pressure microsensors and Flow microsensors, Magnetic sensors, Bio(Chemical) sensors – SAW-IDT microsensor – fabrication – applications – Strain, Temperature, Pressure and Humidity sensor.

OPTICAL AND RF MEMS (9)

Optical MEMS – Passive MEMS optical components – Lenses, Mirrors – Active actuators for optical MEMS – Translation and rotation motion – RF MEMS – Basics - Sample case studies of optical and RF MEMS.

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total: 45 Periods**

Reference Books:

1. *Stephen Santuria, "**Microsystems Design"**, Kluwer publishers, 2000.*
2. *Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "**Micro Sensors MEMS and Smart Devices"**, John Wiley & Son LTD, 2002.*
3. *Chang Liu, "**Foundations of MEMS"**, Pearson Education Inc., 2006.*
4. *NadimMaluf, "**An introduction to Micro electro mechanical system design"**, Artech House, 2000.*
5. *Mohamed Gad-el-Hak, editor, "**The MEMS Handbook"**, CRC press Baco Raton, 2000.*
6. *Tai Ran Hsu, "**MEMS& Micro systems Design and Manufacture",** Tata McGraw Hill, New Delhi, 2002.*
7. *James J.Allen, "**Micro Electro Mechanical System Design"**, CRC Press Publisher, 2010.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1: Knowledge on microfabrication process, MEMS materials and various system issues

CO2: Knowledge on electrical and mechanical concepts of MEMS and on various types of microsensors

CO3: Introduction to optical and RF MEMS and various case studies

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	M	-	-	-	-	-	-	-	-	-	-
CO3	H	-	-	-	-	-	-	-	M	-	-

L→ Low M→ Medium H→ High

18VLPE09 LOW POWER VLSI DESIGN

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *18VLPC01-DIGITAL CMOS VLSI DESIGN*

***COURSE OBJECTIVES*:** *Upon completion of this course, the students will be able:*

- To be aware of power consumption, power dissipation in CMOS device and get exposed to logic level power optimization
- To gain Knowledge on low power design and power estimation techniques in CMOS circuits
- To Understandthe synthesis and software design for low power

POWER DISSIPATION IN CMOS (9)

Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices- Basic principle of low power design.

POWER OPTIMIZATION (9)

Logical level power optimization – Circuit level low power design – Circuit techniques for reducing power consumption in adders and multipliers.

DESIGN OF LOW POWER CMOS CIRCUITS (9)

Computer Arithmetic techniques for low power systems – Reducing power consumption in memories – Low power clock, Interconnect and layout design – Advanced techniques – Special techniques.

POWER ESTIMATION (9)

Power estimation techniques – Logic level power estimation – Simulation power analysis – Probabilistic power analysis.

SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER (9)

Synthesis for low power –Behavioral level transforms- Software design for low power.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *K.Roy and S.C. Prasad, **"Low Power CMOS VLSI Circuit Design"**, Wiley, 2009.*
2. *DimitriosSoudris, ChirstianPignet, Costas Goutis, "**Designing CMOS circuits for low power"**, Springer US 2010.*
3. *B. Kuo and J.H Lou**, "Low voltage CMOS VLSI Circuits"**, Wiley 2014.*
4. *Gary K.Yeap, "**Practical Low Power Digital VLSI Design**", Springer Science and business media, 2012.*
5. *James B. Kuo, Shin – chia Lin, "**Low voltage SOI CMOS VLSI Devices and Circuits"**, John Wiley and sons, inc 2004.*

COURSE OUTCOMES: *Upon completion of the course, the students will have:*

CO1: Awareness of power consumption , power dissipation in CMOS device and get exposed to logic level power optimization

CO2: Knowledge on low power design and power estimation techniques in CMOS circuits

CO3: Understanding of the synthesis and software design for low power

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	-	-	-	M	-	-
CO2	H	M	-	M	M	-	-	-	M	-	-
CO3	M	M	M	-	H	-	M	L	M	-	-

L→ Low M→ Medium H→ High

18VLPE10 VLSI INTERCONNECTS AND DESIGN TECHNIQUES

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To gain knowledge on VLSI Interconnects
- To get an insight on Transmission line parameters of VLSI interconnects
- To understand the novel solutions on interconnects

PRELIMINARY CONCEPTS OF VLSI INTERCONNECTS (9)

Interconnects for VLSI applications-copper interconnections –method of images- method of moments- even and odd capacitances- transmission line equations- miller's theorem- Resistive interconnects as ladder network Propagation modes in micro strip interconnects- slow wave propagations Propagation delay.

PARASITIC RESISTANCES, CAPACITANCE AND INDUCTANCES (9)

Parasitic resistances, capacitances and inductances- approximate formulas for inductances- green's function method: using method of images and Fourier integral approach- network Analog method- Inductance extraction using fast Henry- copper interconnections for resistance modeling .

INTERCONNECTION DELAYS (9)

Metal insulator semiconductor micro strip line- transmission line analysis for single level interconnections- transmission line analysis for parallel multilevel interconnections- analysis of crossing interconnections- parallel interconnection models for micro strip line- modeling of lossy parallel and crossing interconnects- high frequency losses in micro strip line- Expressions for interconnection delays- Active interconnects.

CROSS TALK ANALYSIS (9)

Lumped capacitance approximation- coupled multi conductor MIS micro strip line model for single level interconnects- frequency domain level for single level interconnects- transmission line level analysis of parallel multi level interconnections.

NOVEL SOLUTIONS FOR PROBLEMS IN INTERCONNECTS (9)

Optical interconnects – carbon Nano tubes, Graphenes, Copper wires.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *H B Bakog Lu, Circuits, **"Interconnections and packaging for VLSI**", Addison Wesley publishing company.*
2. *J A Davis, J D Meindl, **"Interconnect technology and design for Gigascale integration",** Kluwer academic publishers.*
3. *Nurmi J, Tenhumen H, Isoaho J, Jantsch A, **"Interconnect Centric design for advanced SOC and NOC",** Springer.*
4. *C K Cheng, J Lillis, S Lin, N Chang, **"Interconnect analysis and synthesis",** Wiley inter-science.*
5. *Hall S H, G W Hall and J McCall, "**High speed digital system design**", Wiley inter-science.*
6. *Askok K Goel, **"High speed VLSI interconnections",** Wiley interscience, second edition, 2007.*

COURSE OUTCOMES**:** *Upon completion of this course the students will have:*

CO1: Basic knowledge on VLSI Interconnects
CO2: Exposure to Transmission line parameters of VLSI interconnects
CO3: To create Novel solutions on Interconnects

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	L	H	H	M	L	M	-	-	L
CO2	H	M	-	H	H	M	-	M	-	-	L
CO3	M	M	-	H	H	M	-	L	-	-	L

L→ Low M→ Medium H→ High

18VLPE11 DSP INTEGRATED CIRCUITS

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To gain Basic knowledge of Digital Signal Processing, Discrete Time Transforms and VLSI circuit technologies
- To get exposure to digital filters, multi rate signal processing and finite word length effects
- To Understand the principle of state of art DSP architectures and design of arithmetic units

NUMBER SYSTEMS, ARITHMETIC UNITS AND INTEGRATED CIRCUITS (9)

Conventional number system - Redundant Number system - Residue Number System.Bit-parallel and Bit-Serial arithmetic - Distributed Arithmetic - Basic shift accumulator - Reducing the memory size - Complex multipliers - Improved shift-Accumulator.

DIGITAL SIGNAL PROCESSING (9)

Digital signal processing - Sampling of analog signals - Selection of sample frequency – Signalprocessing systems - Frequency response - Transfer functions - Signal flow graphs - Filter structures - Adaptive DSP algorithms - FFT-The Fast Fourier Transform Algorithm - Image coding - Discrete cosine transforms.

DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS (9)

FIR filters - FIR filter structures - FIR chips - IIR filters - Specifications of IIR filters - Multirate systems - Interpolation with an integer factor L - Sampling rate change with a ratio L/M - Multirate filters. Finite word length effects -Parasitic oscillations - Scaling of signal levels - Round-off noise - Measuring round-off noise - Coefficient sensitivity - Sensitivity and noise.

DSP INTEGRATED CIRCUITS AND VLSI CIRCUIT TEHNOLOGIES (9)

Standard digital signal processors - Application specific IC's for DSP - DSP systems - DSP system design - Integrated circuit design. MOS transistor - MOS logic - VLSI process technologies - Trends in CMOS technologies.

DSP ARCHITECTURES AND SYNTHESIS (9)

DSP system architectures - Standard and Ideal DSP architecture - Multiprocessors and multi computers - Systolic and Wave front arrays - Mapping of DSP algorithms onto hardware - Implementation based on complex PEs - Shared memory architecture with Bit – serial PEs - Layout of VLSI circuits - FFT processor - DCT processor and Interpolator as case studies.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Lars Wanhammer, "**DSP Integrated Circuits", Academic press, New York 2001.*
2. *A.V.Oppenheim et.al, "**Discrete-time Signal Processing", Pearson education, 2014.*
3. *Emmanuel C. Ifeachor, Barrie W. Jervis, "**Digital signal processing–A practical approach",** 2nd edition, Harlow Prentice Hall, 2011.*
4. *KeshabK.Parhi, "**VLSI digital Signal Processing Systems design and Implementation",** JohnWiley& Sons, 2007.*

COURSE OUTCOMES**:** *Upon completion of the course students will have:*

CO1: Basic knowledge of Digital Signal Processing, Discrete Time Transforms and VLSI circuit technologies

CO2: Exposure to digital filters, multi rate signal processing and finite word length effects

CO3: Understanding of the principle of state of art DSP architectures and design of arithmetic units.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	-	M	M	-	-	-	-	-	-
CO2	H	M	-	M	M	-	-	-	-	-	-
CO3	H	M	-	M	H	-	-	-	-	-	-

L→ Low M→ Medium H→ High

18VLPE12 ELECTRONIC PACKAGING TECHNOLOGIES

Category : PE

PREREQUISITES:NIL

L	T	P	C
3	0	0	3

***COURSE OBJECTIVES*:** *Upon completion of this course, the students will be able:*

- To Exposure on IC Packaging with the associated issues like thermal, speed, signal and integrity power
- To Knowledge on the appropriate packaging styles and design procedures
- To Knowledge on CAD used in designing wiring boards

OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING (9)

Introduction of an Electronic system and history of semiconductors - Products and levels of packaging - Packaging aspects of handheld products - Definition of PWB - Basics of Semiconductor and Process flowchart - Wafer fabrication, inspection and testing - Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding - TAB and flip chip.

SEMICONDUCTOR PACKAGES (9)

Single chip packages or modules (SCM) - Commonly used packages and advanced packages - Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Electrical Design considerations in systems packaging, Resistive, Capacitive and Inductive Parasitics - Layout guidelines and the Reflection problem - Interconnection.

CAD FOR PRINTED WIRING BOARDS (9)

Benefits from CAD; Introduction to DFM, DFR & DFT, Components of a CAD package and its highlights - Beginning a circuit design with schematic work and component, layout, DFM check, list 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; 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.

SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS (9)

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, Vapour phase soldering, BGA soldering and De-soldering/Repair; SMT failures, SMT failure library and Tin Whisker, Tin-lead and lead-free solders; Phase diagrams; Thermal profiles for reflow soldering; Lead freevAlloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling, Issues, Thermal Design considerations in systems packaging (L. Umanand, Thermal Design considerations in systems packaging.

EMBEDDED PASSIVES TECHNOLOGY (9)

Introduction to embedded passives - Need for embedded passives - Design Library; Embedded resistor processes - Embedded capacitors - Processes for embedding capacitors.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Tummala, Rao R., "**Fundamentals of Microsystems Packaging"**, McGraw Hill Reference Book 2001.*
2. *Blackwell (Ed), "**The electronic packaging handbook"**, CRC Press1999.*
3. *Tummala, Rao R, "**Microelectronics packaging handbook"**, McGraw Hill 1997.*
4. *Bosshart, "**Printed Circuit Boards Design and Technology"**, Tata McGraw Hill 2002.*
5. *William D. Brown, **"Advanced Electronic Packaging"**, IEEE Press, 1999.*

COURSE OUTCOMES**:** *Upon completion of the course students will have*

CO1: Exposure on IC Packaging with associated issues like thermal, speed, signal and integrity power

CO2: Knowledge on the appropriate packaging styles and design procedures

CO3: Knowledge on CAD used in designing wiring boards

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	L	L	M	M	L	M	M	-	-	L
CO2	M	L	L	M	M	-	M	M	-	-	L
CO3	L	L	L	M	H	-	H	L	-	-	L

L→ Low M→ Medium H→ High

18VLPE13 ASIC DESIGN

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISTES:*NIL*

COURSE OBJECTIVES: *Upon completion of this course, the students will be able:*

- To Gain the fundamentals of ASIC design
- To Gain Knowledge on programmable ASIC's
- To Gain Knowledge in the logical synthesis, simulation and testing aspects of ASIC

OVERVIEW OF ASIC AND PLD (9)

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGA.

PROGRAMMABLE ASICs (9)

Programmable ASIC logic cells for ACTEL and XILNX -DC & AC inputs and outputs- Clock and Power inputs – I/O blocks, Programmable ASIC architecture - -Xilinx 4000- ACTEL's ACT-1,2,3 and their speed performance, Altera MAX 5000 and 7000 - Altera MAX 9000 –Altera Flex 8000/1000 - Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs.

ASIC PHYSICAL DESIGN (9)

System partition Partitioning - Partitioning methods – Interconnect delay models and measurement of delay - Floor planning - Placement – Routing: Global routing - Detailed routing - Special routing.

LOGIC SYNTHESIS, SIMULATION AND TESTING (9)

Design systems - Logic Synthesis - Verilog and VHDL synthesis - Types of simulation -Boundary scan test - Fault simulation - Automatic test pattern generation.

HIGH PERFORMANCE ALGORITHMS FOR ASICS/ SOCS. (9)

DAA and computation of FFT and DCT. High performance filters using delta-sigma modulators. Case Studies: Digital camera, SDRAM, High speed data standards.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *M.J.S.Smith , "**Application - Specific Integrated Circuits"**, Pearson,2002*
2. *Steve Kilts, "**Advanced FPGA Design"**, Wiley Inter-Science, 2007.*
3. *Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, "**FPGA-based Implementation of Signal Processing Systems"**, Wiley, 2008.*
4. *Mohammed Ismail and Terri Fiez, "**Analog VLSI Signal and Information Processing"**, Mc Graw Hill, 1994.*
5. *Douglas J. Smith, "**HDL Chip Design"**, Madison, AL, USA: Doone Publications, 1996.*
6. *Jose E. France, YannisTsividis, "**Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing"**, Prentice Hall,1994.*

COURSE OUTCOMES**:** *After completing this course, the students will have:*

CO1: Sufficient theoretical knowledge for carrying out the ASIC design

CO2: Knowledge about programmable ASIC's

CO3: Knowledge in the logical synthesis , simulation and testing aspects of ASIC

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	-	-	-	-	-	M	M	M	M	H
CO2	H	M	M	L	L	-	-	M	M	M	H
CO3	L	H	-	-	-	-	M	M	M	M	H

L→ Low M→ Medium H→ High

18VLPE14 ANALYSIS AND DESIGN OF ANALOG INTEGRATED CIRCUITS

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

***COURSE OBJECTIVES*:** *Upon completion of this course, the students will be able:*

- To acquire knowledge on circuit configuration for linear integrated circuits and multiple transistor amplifier
- To analyze nonlinear analog circuits
- To analyze and design Operational amplifier

CIRCUIT CONFIGURATION FOR LINEAR IC (9)

Current Sources-General Properties-Simple Current Mirror with beta helper-Simple current mirror with degeneration-Cascode Current Mirror-Wilson Current MIRROR- Widlar current source-Supply Insensitive Biasing-Temperature Insensitive Biasing. Output Stages - Emitter and source followers, Push pull output stages.

SINGLE TRANSISTOR AND MULTIPLE TRANSISTOR AMPLIFIER (9)

Basic single transistor amplifier stages -CE, CB, CC configuration- Multiple transistor amplifier stage – active cascode configuration, differential pairs – Emitter coupled pair.

OPERATIONAL AMPLIFIER (9)

Analysis of operational amplifier circuit, Slew rate model and High Frequency Analysis - Operational Amplifier noise.

NON LINEAR ANALOG CIRCUITS (9)

Precision Rectification-Analysis of four quadrant and variable trans conductance multiplier-Application of Gilbert cell. Balanced Modulator - Closed loop analysis of PLL - Voltage Controlled Oscillator.

ANALOG DESIGN WITH MOS TECHNOLOGY (9)

MOS Current Mirror-Simple, Cascode, Widlar and Wilson Current source-MOS Supply Insensitive Biasing. MOS amplifier, source coupled pair and basic two stage MOS opamps.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Paul R. Gray and Robert G. Meyer, "**Analysis and Design of Analog Integrated circuits**", Wiley, 5th edition, 2009.*
2. *David Johns, Ken Martin, "**Analog Integrated circuit design**", John Wiley & Sons Inc, 1997.*
3. *Behzad Razavi, "**Design of Analog CMOS Integrated circuits**", Tata McGraw Hill Education, 2002.*
4. *Phillip E Allen, Douglas R Holberg, "**CMOS Analog circuit design**", OUP USA, 3rd Edition, 2012.*
5. Grebene, "**Bipolar and MOS Analog Integrated Circuits design**", John Wiley and sons Inc 2003.
6. Rowbik Gregorian and Gabor C. Temes, "**Analog Integrated Circuits for Signal Processing**", John Wiley International 1986.

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1: Knowledge on circuit configuration for linear integrated circuits and multiple transistor amplifiers

CO2: Ability to analyze nonlinear analog circuits

CO3: Ability to analyze and design Operational amplifier

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	M	-	L	M	L	-
CO2	H	M	M	M	M	M	-	L	M	L	-
CO3	H	M	M	M	M	M	-	L	M	L	-

L→ Low M→ Medium H→ High

18VLPE15 MIXED SIGNAL CIRCUITS AND INTERFACING

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To gain basic knowledge on Sample and Hold Architecture
- To acquire knowledge on various A-D and D-A converters Architecture
- To gain Knowledge on Building Blocks and Precision Techniques

SAMPLE ANDHOLD ARCHITECTURES (9)

Introduction to Data conversion and Processing- Sampling Switches-MOS, Diode Switches-Improvements in MOS Switch Performance-Conventional Open-Loop and Closed-Loop Architecture, Open-Loop Architecture with Miller Capacitance, Multiplexed-Input Architectures, Recycling Architecture, Switched-Capacitor Architecture, Current-Mode Architecture.

DIGITAL TO ANALOG CONVERTER ARCHITECTURES (9)

Basic principles-General Considerations-Performance Metrics-Reference Multiplication and Division-Switching and Logical Functions in DACs-Resistor-Ladder DAC Architectures, Current-Steering Architectures.

ANALOG TO DIGITAL CONVERTER ARCHITECTURES (9)

General Considerations- Performance Metrics- Flash Architectures, Two-Step Architectures, Interpolative and Folding Architectures, Pipelined Architectures, Successive Approximation Architectures, Interleaved Architectures.

BUILDING BLOCKS OF DATA CONVERSION SYSTEMS (9)

Amplifiers- Open-Loop Amplifiers, Closed-Loop Amplifiers, Operational Amplifiers, Gain Boosting Techniques, Common-Mode Feedback. Comparators- Bipolar Comparators, CMOS Comparators, BiCMOS Comparators.

PRECISION TECHNIQUES (9)

Comparator Offset Cancellation- Input, Output and multistage Offset Storage, Comparators Using Offset-Cancelled Latches- Op Amp Offset Cancellation- Calibration Techniques- DAC and ADC Calibration Techniques.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books**:**

1. *Behzad Razavi, "**Principles of Data Conversion System Design**", John Wiley & Sons, 2011.*
2. *Sundaram Natarajan, "**Microelectronics Analysis & design**", McGraw Hill, 2006.*
3. *R.J Baker, "**CMOS Mixed Signal Circuit Design**", Wiley Interscience, 2nd Edition, 2009.*
4. *B.Razavi, "**Design of Analog CMOS Integrated Circuits**", McGraw Hill, 2005.*
5. *David A. Johns and Ken Martin, "**Analog Integrated Circuit Design**", Wiley India, 2008.*

COURSE OUTCOMES: *Upon completion of this course the students will have:*

CO1: Basic knowledge on Sample and Hold Architecture

CO2: Knowledge on various A-D and D-A converters Architecture

CO3: Knowledge on Building Blocks & Precision Techniques

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	M	M	M	-	M	L	L	M	M
CO2	H	-	M	-	-	-	-	-	-	-	-
CO3	H	H	L	-	M	-	L	-	L	-	-

L→ Low M→ Medium H→ High

18VLPE16 RF IC DESIGN

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To gain knowledge on issues in designing RFIC and concepts of transistors
- To gain knowledge on integrated circuits design using Passive components
- To gain knowledge on RF Amplifiers and RF Mixers designs

ISSUES IN RFIC DESIGN (9)

Lower frequency analog design and microwave design versus radio frequency integrated circuit design - Impedance levels for microwave and low-frequency analog design- noise - linearity and distortion in RF Circuits - dynamic range - filtering issue.

REVIEW OF TECHNOLOGY (9)

Small -signal model of bipolar transistor - high frequency effects - noise in bipolar transistors - base shot noise-noise sources in the transistor model - bipolar transistor design considerations-CMOS transistor.- impedance matching - tapped capacitors and inductors - the concept of mutual inductance - tuning a transformer - bandwidth of an impedance transformation network-quality factor of an LC resonator.

DESIGN OF PASSIVE CIRCUIT ELEMENTS IN IC TECHNOLOGIES (9)

Technology backend and metallization in IC technologies - sheet resistance and skin effect -parasitic capacitance and inductance -current handling in metal lines-design of inductors and transformers - characterization of inductor-layout of spiral inductors - on-chip transmission lines - high frequency measurements of on-chip passives and common De-Embedding techniques-packaging.

LNA AND POWER AMPLIFIER (9)

Basic amplifiers - amplifiers with feedback - noise in amplifiers - linearity in amplifiers - differential pair and other differential amplifiers-low-voltage topologies for LNAs and the use of on-chip transformers - DC bias networks - temperature effects - broad band LNA design. Power amplifier: power capability - efficiency calculations - matching considerations - Class A,B,C.D.E.F,G,H and S amplifiers -summary of amplifier classes for RF Integrated circuits - AC load line - matching to achieve desired power - packaging -effects and implications of non linearity - linearization techniques - CMOS power amplifier example.

MIXERS (9)

Mixing with nonlinearity - basic mixer operation - controlled transconductance mixer - double-balancedmixer - mixer with switching of upper quad - analysis of switching modulator-mixer noise - linearity - improving isolation - image reject and single -sideband mixers-alternative mixer designs - general design comments-CMOS mixers.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *John Rogers and Calvin Plett, "**Radio Frequency Integrated Circuit Design",** Artech House, 2002.*
2. *Stephan A Mass, "**Non-Linear Microwave and RF circuits"**, Artech House, 2003.*
3. *FerriLosee, "**RF Systems, Components and Circuits handbook",** Artech house, 2002.*
4. *Larson LE, "**RF and Microwave Circuit for Wireless Applications",** Artech House, 1997.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1: Detailed Knowledge on issues in designing RFIC and concepts of transistors

CO2: An ability to design integrated circuits using Passive components

CO3: Detailed Knowledge on RF Amplifiers and RF Mixers designs

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	-	-	L	L	L	L	-	-	L
CO2	M	H	-	-	L	-	-	L	-	-	L
CO3	L	-	L	L	L	L	-	L	L	-	-

L→ Low M→ Medium H→ High

18VLPE17 RECONFIGURABLE ARCHITECTURES

(Common to Applied Electronics)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To gain knowledge on run time computing and its applications to VLSI
- To learn optical reconfigurable models
- To understand various multi core architecture

RECONFIGURABLE COMPUTING HARDWARE (9)

Logic- computational fabric, Array and interconnect-Extended logic Configuration-Reconfigurable processing fabric architectures-RPF integration into traditional computing systems- operating system support for reconfigurable computing- Evolvable FPGA.

MAPPING DESIGNS INTO RECONFIGURABLE PLATFORMS (9)

Structural mapping- integrated mapping- mapping for heterogeneous resources-Placement problem – clustering- simulated annealing – partition based placement – analytical placement- partitioning for granularity partitioning of parallel programs- instance specific design.

COMPUTATIONAL ARCHITECTURES FOR FPGA (9)

Precision analysis for fixed point computation- Distributed arithmetic for FPGA – CORDIC architectures for FPGA- Boolean satisfiability – SAT solvers.

OPTICAL RECONFIGURATION MODELS (9)

Simulation and scalability- Models, Basic algorithmic techniques- optical models – complexities of optical models- run time reconfigurability- Design and implementation.

MULTI CORE ARCHITECTURES (9)

Multi core and many core architectures-state of the art multi core operating systems-parallelism and performance analysis.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Scott Hauck, André Dehon, "**Reconfigurable computing: the theory and practice of FPGA-based computation"**, Morgan Kaufmann publishers, 2008.*
2. *Ramachandran Vaidhyanathan and Jerry. L. Trahan, "**Dynamic Reconfiguration: Architectures and Algorithms",** Kluwer Academic publishers, 2003.*
3. *C. Bobda, "**Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications"**, Springer, 2007.*
4. *Andras Vajda**, "Programming many core chips",** Springer, 2011.*

COURSE OUTCOMES**:** *Upon completion of this course the students will have ability to:*

CO1: Gain knowledge on run time computing and its applications to VLSI

CO2: Learn optical reconfigurable models

CO3: Understand various multi core architectures

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	H	M	M	L	L	-	-	-
CO2	H	H	H	M	M	L	-	-	L	-	-
CO3	H	M	M	M	L	L	L	-	-	-	L

L→ Low M→ Medium H→ High

18VLPE18 VLSI TECHNOLOGY

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To provide rigorous foundation in MOS and CMOS fabrication process
- To analyse the fabrication of NMOS,CMOS memory and bipolar devices
- To understand the nuances of assembly and packaging of VLSI devices

VLSI FABRICATION PROCESS **(9)**

Electron grade silicon. Crystal growth. Wafer preparation. Vapour phase and molecular beam epitaxy. SOI.Epitaxial evaluation. Oxidation techniques, systems and properties. Oxidation defects.

FABRICATION STEPS **(9)**

Optical, electron, X-ray and ion lithography methods. Plasma properties, size, control, etch mechanism, etch techniques and equipments.

DIFFUSION METHODS **(9)**

Deposition process and methods. Diffusion in solids. Diffusion equation and diffusion mechanisms.

ION PROCESS **(9)**

Ion implantation and metallization. Process simulation of ion implementation, diffusion, oxidation, epitaxy, lithography, etching and deposition. NMOS, CMOS, MOS memory and bipolar IC technologies. IC fabrication.

TECHNIQUES AND PACKAGING **(9)**

Analytical and assembly techniques. Packaging of VLSI devices.

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total: 45 Periods**

Reference Books:

1. *S.M.Sze, "**VLSI Technology", (2/e)**, McGraw Hill, 1988*
2. *W. Wolf, "**Modern VLSI Design"**, (3/e), Pearson,2002*
3. *Yasuo Tarui, "**VLSI Technology: fundamentals and applications",** Springer Series, 2011.*
4. *J.D.Plummer, M.Deal and P.D.Griffin, "**Silicon VLSI Technology"**, Pearson Education, 2003*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have ability:*

CO1: Understand the various techniques involved in the VLSI fabrication process
CO2: analyse the fabrication of NMOS, CMOS memory and bipolar devices
CO3: understand the nuances of assembly and packaging of VLSI devices

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	L	H	-	L	-	-	-	-	-	-
CO2	M	M	H	-	M	-	-	-	-	-	-
CO3	M	H	H	L	M	-	-	-	-	-	-

L→ Low M→ Medium H→ High

18VLPE19 SYSTEM ON CHIP

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able/have an:*

- Ability to design combinational and sequential logic networks
- To gain knowledge on optimization of power in combinational and sequential logic machines
- Ability to design FPGA and PLA and Knowledge on floor planning methods for system design

LOGIC GATES (9)

Introduction. Combinational Logic Functions. Static Complementary Gates. Switch Logic. Alternative Gate Circuits. Low-Power Gates. Delay Through Resistive Interconnect. Delay Through Inductive Interconnect.

COMBINATIONAL LOGIC NETWORKS (9)

Introduction. Standard Cell-Based Layout. Simulation. Combinational Network Delay. Logic and interconnect Design. Power Optimization. Switch Logic Networks. Combinational Logic Testing.

SEQUENTIAL MAC (9)

Introduction. Latches and Flip-Flops. Sequential Systems and Clocking Disciplines. SequentialSystem Design. Power Optimization. Design Validation. Sequential Testing.

SUBSYSTEM DESIGN (9)

Introduction. Subsystem Design Principles. Combinational Shifters. Adders. ALUs. Multipliers. High-Density Memory. FieldProgrammable Gate Arrays. Programmable Logic Arrays. References.Problems.

FLOOR-PLANNING (9)

Introduction, Floor-planning Methods – Block Placement & Channel Definition, Global Routing,switchbox Routing, Power Distribution, Clock Distributions, Floor-planning Tips, Design Validation. Off-Chip Connections – Packages, The I/O Architecture, PAD Design.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Wayne Wolf, "**Modern VLSI Design – System – on – Chip Design",** Prentice Hall, 3rd Edition 2008.*
2. *Wayne Wolf, "**Modern VLSI Design – IP based Design",** Prentice Hall, 4th Edition, 2008.*
3. *Youn-Long Steve Lin, "**Essential Issues in SOC Design: Designing complex systems-on-chip"**, Springer, 2006.*
4. *Prakash Rashinkar, Peter Paterson, Lenna Singa, "**System on a chip verification methodology & Techniques"**, Springer, 2002.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1*:* Ability to design combinational and sequential logic networks

CO2: Knowledge on optimization of power in combinational and sequential logic machines

CO3: Ability to design FPGA and PLA and Knowledge on floor planning methods for system design

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	-	M	M	-	-	L	-	L	-
CO2	H	M	-	M	M	-	-	L	-	L	-
CO3	M	M	-	M	H	-	-	L	-	L	-

L→ Low M→ Medium H→ High

18VLPE20 VLSI FOR WIRELESS COMMUNICATION SYSTEM

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able:*

- To study the design concepts of low noise amplifiers
- To study and design frequency synthesis and subsystems
- To understand the concepts of CDMA in wireless communication

COMPONENTS AND DEVICES **(9)**

Integrated inductors, resistors, MOSFET and BJT AMPLIFIER DESIGN: Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers.

MIXERS **(9)**

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion – Low Frequency Case: Analysis of Gilbert Mixer – Distortion - HighFrequency Case – Noise – A Complete Active Mixer. Switching Mixer - Distortion in Unbalanced Switching Mixer – Conversion Gain in Unbalanced Switching Mixer - Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.

FREQUENCY SYNTHESIZERS **(9)**

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example (DECT Application).

SUB SYSTEMS **(9)**

Data converters in communications, adaptive Filters, equalizers and transceivers

IMPLEMENTATIONS **(9)**

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System.

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total: 45 Periods**

Reference Books:

*1. B.Razavi**, "RF Microelectronics",** Prentice-Hall, 1998.*

*2. Bosco H Leung, "**VLSI for Wireless Communication",** Pearson Education, 2002.*

*3. Thomas H.Lee, "**The Design of CMOS Radio –Frequency Integrated Circuits"**, Cambridge University Press, 2003.*

*4. Emad N Farag and Mohamed I Elmasry, "**Mixed Signal VLSI Wireless Design - Circuits and Systems",** Kluwer Academic Publishers, 2000.*

*5. Behzad Razavi, "**Design of Analog CMOS Integrated Circuits"** McGraw-Hill, 1999.*

*6. J. Crols and M. Steyaert, "**CMOS Wireless Transceiver Design",** Boston, Kluwer Academic Pub.1997.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have ability:*

CO1: To study the design concepts of low noise amplifiers

CO2: To study and design frequency synthesis and subsystems

CO3: To understand the concepts of CDMA in wireless communication

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	-	H	-	M	-	-	-	L	-	-
CO2	L	-	H	L	M	-	-	-	L	-	-
CO3	M	L	-	L	M	-	-	-	L	-	-

L→ Low M→ Medium H→ High

18SEOE01- VASTU SCIENCE FOR BUILDING CONSTRUCTION
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:
To impart basic knowledge of vastu science and its impact on human well being.

UNIT I - INTRODUCTION (9)
Traditional definition - Meaning of Vastu and Vaastu -its classification -Relationship to earth - concept of existence and manifestation – planatory influence on earth.

UNIT II - SPACE THEORY IN VASTU (9)
Features of good building site -good building shapes -macro, micro, enclosed and material spaces - relationship between built space, living organism and universe -impact of built space on human psyche. Flow of energy within built space and outside -zoning of functional areas -fitting of components in the building -significance of water bodies and energy -The cube as the basic structure.

UNIT III - COSMOGRAM & SETTLEMENT CONCEPTS (9)
Orientation of building, site, layout and settlement -positive and negative energies -importance of cardinal and ordinal directions -The celestial grid or-mandala and its type.The Vaastu Purusha Mandala and its significance in creation of patterns, and lay-outs, extension of this to aural and visual fields -Types of Lay-Outs

UNIT IV - INTERFACE OF TIME, VIBRATION AND RHYTHM (9)
Theory of vibration and energy transfer – equation of time and space – manifestation in living organism – human beings – measurement of the energy– Kirlian energy of various forms-documentation of objects – filaments and streamers.

UNIT V - MEASUREMENTS & MATERIALS (9)
Units of measurement -Mana shastra -Ayadi techniques -Tala system and Hasta system of measures - Musical measurements compared to space measurements -resultant ambience in built space.Use of wood, stone, metal, brick and time- making technology, corbelling technology,jointing technology - foundations for heavy and light structures -Landscaping in and around buildings -Aesthetic in Indian Architecture.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Dr.Prasanna Kumar Acharya-"**Manasara"** -Ox ford1 University Press1927 - (English version)*
2. *K.S.Subramanya Sastri –**"Maya Matam"** -Thanjavur Maharaja Sarjoji saraswathil Mahal Library – Thanjavur-1966.*
3. *Stella Kramresh –**"The Hindu Temple"** Vol.1 & II Motital Banarsidass Publishers Pvt. Ltd., Delhi – 1994.*
4. *Bruno Dagens –**"Mayamatam"**, Vol.1 & III GNCA and Motilal Bamarsidars, .Publishers Pvt. Ltd-Delhi -1994.*
5. *George Birdsall –**"Feng Shui"**: The Key Concepts -January 2011*

COURSE OUTCOMES:

The students are able to

CO 1: Obtain exposure on various concepts of vastu

CO 2: Understand the theories in Vastu.

CO 3: familiarize with the Cosmogram and settlement concepts of vastu

CO 4: Understand the role of vasthu in energy flow manifestation in living beings.

CO 5: Plan a structure considering various vastu techniques.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	-	-	-	-	-	-	-	-	-
CO2	H	-	-	-	-	-	-	-	-	-	-
CO3	H	-	-	-	-	-	-	-	-	-	-
CO4	H	-	-	-	-	-	-	-	M	-	-
CO5	M	-	-	-	M	-	-	-	-	-	-

L→ Low M→ Medium H→ High

18SEOE02 - PLANNING OF SMART CITIES
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

To have an exposure on development of smart cities considering various fields related and their challenges.

UNIT I – SMART CITIES DEVELOPMENT POTENTIALS AND CHALLENGES (9)

Perspectives of Smart Cities: Introduction and Overview - Implementation Challenges - Methodological issues - Spatial distribution of start up cities – Re imagining post industrial cities - Implementation Challenges for Establishing Smart Urban Information and Knowledge Management System

UNIT II – ROLE OF ICT, REMOTE SENSING, AND GEOGRAPHICAL INFORMATION SYSTEM (9)

Optimising Green Spaces for Sustainable Urban Planning - 3D City Models for Extracting Urban Environmental Quality Indicators - Assessing the Rainwater Harvesting Potential - The Strategic Role of Green Spaces - Monitoring Urban Expansion

UNIT III – ENVIRONMENT, ENERGY, DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT (9)

Alternatives for Energy Stressed Cities - Social Acceptability of Energy-Efficient Lighting - Energy Management - Urban Dynamics and Resource Consumption - Issues and Challenges of Sustainable Tourism - Green Buildings: Eco-friendly Technique for Modern Cities

UNIT IV– MULTIFARIOUS MANAGEMENT FOR SMART CITIES (9)

An Assessment of Domestic Water Use Practices - An Issue of Governance in Urban Water Supply - Assessment of Water Consumption at Urban Household Level - Water Sustainability - Socio-economic Determinants and Reproductive Healthcare System - Problems and Development of Slums.

UNIT V – INTELLIGENT TRANSPORT SYSTEM (9)

Introduction to Intelligent Transportation Systems (ITS)- The Range of ITS Applications -Network Optimization-Sensing Traffic using Virtual Detectors- In-Vehicle Routing, and Personal route information-The Smart Car-Commercial Routing and Delivery-Electronic Toll Collection-The Smart Card-Dynamic Assignment- Traffic Enforcement. Urban Mobility and Economic Development

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Poonam Sharma, Swati Rajput,* ***"Sustainable Smart Cities in India_ Challenges and Future Perspectives"*** *Springer 2017 Co.(P) Ltd. 2013*
2. *Ivan Nunes Da Silva, Rogerio Andrade Flauzino-****"Smart Cities Technologies"****-ExLi4EvA (2016)*
3. *Stan McClellan, Jesus A. Jimenez, George Koutitas (eds.)-****"Smart Cities_Applications, Technologies, Standards, and Driving Factors"****-Springer International Publishing (2018)*
4. *Stan Geertman, Joseph Ferreira, Jr., Robert Goodspeed, John Stillwell,* ***"Planning Support Systems and Smart Cities"*** *, Springer, 2015*

COURSE OUTCOME:

CO 1: Identify the potential and challenges in smart city development.

CO 2: Apply the different tools for sustainable urban planning.

CO 3: Understand the concepts of environment, energy and disaster management.

CO 4: Identify the proper methods for water and waste water management.

CO 5: Familiarize with the intelligent transport systems.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	M	M	-
CO4	-	-	-	-	-	M	-	-	-	-	-
CO5	L	H	-	-	-	L	-	-	-	-	-

L→ Low M→ Medium H→ High

18SEOE03 - GREEN BUILDING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project.

UNIT I - INTRODUCTION (9)

Life Cycle impacts of materials and products – sustainable design concepts – strategies of Design for the Environment -The sun-earth relationship and the energy balance on the earth's surface, climate, wind – Solar radiation and solar temperature – Sun shading and solar radiation on surfaces – Energy impact on the shape and orientation of buildings – Thermal properties of building materials.

UNIT II - ENERGY EFFICIENT BUILDINGS (9)

Passive cooling and day lighting – Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency – Energy audit and energy targeting- Technological options for energy management.

UNIT III - INDOOR ENVIRONMENTAL QUALITY MANAGEMENT (9)

Psychrometry- Comfort conditions- Thermal comfort- Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination requirement- Auditory requirement- Energy management options- -Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines- Heat rejection equipment- Energy efficient motors- Insulation.

UNIT IV - GREEN BUILDING CONCEPTS (9)

Green building concept- Green building rating tools- Leeds and IGBC codes. – Material selection Embodied energy- Operating energy- Façade systems- Ventilation systems- Transportation- Water treatment systems- Water efficiency- Building economics

UNIT V - GREEN BUILDING DESIGN CASE STUDY (9)

Students to work through a controlled process of analysis and design to produce drawings and models of their own personal green building project. Topics include building form, orientation and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget-Case Study on green construction and design.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Kibert, C.* ***"Sustainable Construction: Green Building Design and Delivery"****, John Wiley & Sons, 2005*
2. *Edward G Pita,* ***"An Energy Approach- Air-conditioning Principles and Systems"****, Pearson Education, 2003.*
3. *Colin Porteous,* ***"The New Eco-Architecture"****, Spon Press, 2002.*
4. ***"Energy Conservation Building Codes"****: www.bee-india.nic.in*
5. *Lever More G J,* ***"Building Energy Management Systems"****, E and FN Spon, London, 2000.*
6. *Ganesan T P,* ***"Energy Conservation in Buildings"****, ISTE Professional Center, Chennai, 1999.*
7. *John Littler and Randall Thomas,* ***"Design with Energy: The Conservation and Use of Energy in Buildings"****, Cambridge University Press, 1984.*

COURSE OUTCOMES:

The students are able to

CO 1: Describe the concepts of sustainable design

CO 2: Familiarize with green building techniques including energy efficiency management.

CO 3: Understand the indoor environmental quality management in green building.

CO 4: Perform the green building rating using various tools.

CO 5: Create drawings and models of their own personal green building project.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	M	M	-	-	-	-	-
CO3	-	-	-	-	-	M	-	-	-	-	-
CO4	-	-	-	-	-	M	-	-	-	-	-
CO5	M	-	-	-	-	-	-	-	L	M	M

L→ Low M→ Medium H→ High

18EEOE04 - ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES

(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

- Get knowledge about occupational health hazard and safety measures at work place
- Learn about accident prevention and safety management
- Learn about general safety measures in industries

UNIT I OCCUPATIONAL HEALTH AND HAZARDS (8)

Occupation, Health and Hazards - Safety Health and Management: Occupational Health Hazards - Ergonomics - Importance of Industrial SafetyRadiation and Industrial Hazards : Types and effects - Vibration - Industrial Hygiene - Different air pollutants in industries and their effectsElectrical, fire and Other Hazards - General causes, Machine Guards and its types, Automation.

UNIT II SAFETY A WORKPLACE (10)

Safety at Workplace - Safe use of Machines and Tools: Safety in use of different types of unit operations - Ergonomics of Machine guarding - working in different workplaces - Operation, Inspection and maintenance Plant Design and Housekeeping, Industrial lighting, Vibration and Noise.

UNIT III ACCIDENT PREVENTION (9)

Accident Prevention Techniques - Principles of accident prevention - Definitions, Theories, Principles - Hazard identification and analysis, Event tree analysis, Hazop studies, Job safety analysis - Theories and Principles of Accident causation - First Aid : Body structure and functions - Fracture and Dislocation, Injuries to various body parts.

UNIT IV SAFETY MANAGEMENT (9)

Safety Management System and Law - Legislative measures in Industrial Safety: Various acts involved in Detail- Occupational safety, Health and Environment Management : Bureau of Indian Standards on Health and Safety, 14489, 15001 - OSHA, Process safety management (PSM) and its principles - EPA standards- Safety Management : Organisational& Safety Committee - its structure and functions.

UNIT V GENERAL SAFETY MEASURES (9)

Plant Layout for Safety -design and location, distance between hazardous units, lighting, colour coding, pilot plant studies, Housekeeping - Accidents Related with Maintenance of Machines - Work Permit System : Significance of Documentation Directing Safety : Definition, Process, Principles and Techniques Leadership : Role, function and attribution of a leader Case studies - involving implementation of health and safety measures in Industries.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS :

1. *R.K. Jain and Sunil S. Rao,* ***"Industrial safety, Health and Environment Management"****, Khanna publishers, New Delhi (2006).*
2. *Frank P. Lees –* ***"Loss of Prevention in Process Industries"****, Vol 1 and 2, Butterworth - Heinamann Ltd., London (1991)*
3. *Industrial Safety - National Council of India*
4. *Factories Act with Amendments 1987, Govt. of India Publications DGFASLI, Mumbai*

COURSE OUTCOMES:

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

CO1 : Gain the knowledge about occupational health hazard and safety measures at work place

CO2 : be Able to learn about accident prevention and safety management

CO3 : Understand occupational health hazards and general safety measures in industries

CO4 : Got to know various laws, standards and legislations.

CO5 : Able to learn about safety and proper management of industries

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	M	-	H	-	-	L	-	H	H	L
CO2	H	H	M	H	-	-	L	-	M	H	H
CO3	H	H	-	M	-	-	L	-	L	M	M
CO4	-	-	-	-	-	-	L	-	L	L	L
CO5	-	-	-	-	-	-	L	-	L	L	L

L-Low, M-Moderate(Medium), H-High

18EEOE05 - CLIMATE CHANGE AND ADAPTATION

(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

- Able get knowledge about Climate system and its changes and causes
- Able to learn about impacts, adaptation and mitigation of climate change
- Able to learn about clean technology and clean energy

UNIT I EARTH'S CLIMATE SYSTEM (09)

Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II OBSERVED CHANGES AND ITS CAUSES (09)

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT III IMPACTS OF CLIMATE CHANGE (09)

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES (09)

Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT V CLEAN TECHNOLOGY AND ENERGY (09)

Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total 45 Periods

REFERENCE BOOKS:

1. Jan C. van Dam, **"Impacts of Climate Change and Climate Variability on Hydrological Regimes"**, Cambridge University Press, 2003.
2. IPCC fourth assessment report - The AR4 synthesis report, 2007
3. IPCC fourth assessment report –Working Group I Report, " The physical Science Basis", 2007
4. IPCC fourth assessment report - Working Group II Report, **"Impacts, Adaptation and Vulnerability"**, 2007
5. IPCC fourth assessment report – Working Group III Report" Mitigation of Climate change", 2007
6. Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., **"Climate Change and Water"**. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.
7. Dash Sushil Kumar, **"Climate Change – An Indian Perspective"**, Cambridge University Press India Pvt. Ltd, 2007.

COURSE OUTCOMES:

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

CO1 : To understand the climatic system and the factors influencing the climatic changes
CO2 : To assess the uncertainty and impact of climatic changes
CO3 : To develop strategies for adaptation and mitigation of climatic changes
CO4 : To identify clean technologies for sustainable growth
CO5: To identify clean technologies for sustainable growth

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	-	-	M	-	-	H	-	L	M	M
CO2	M	-	-	M	-	-	M	-	L	L	M
CO3	M	-	-	M	-	-	H	-	L	M	M
CO4	M	M	M	H	M	M	L	M	M	L	M
CO5	M	-	-	M	-	-	M	-	L	L	L

L-Low, M-Moderate(Medium), H-High

18EEOE06 - WASTE TO ENERGY

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

- **Able to get knowledge about the utilization of waste and its purpose.**

UNIT I INTRODUCTION (09)

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS (09)

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION (09)

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION (09)

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIOGAS (09)

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total 45 Periods

REFERENCE BOOKS:

1. ***"Non Conventional Energy"****, Desai, Ashok V., Wiley Eastern Ltd., 1990.*
2. ***"Biogas Technology - A Practical Hand Book"*** *- Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.*
3. ***"Food, Feed and Fuel from Biomass"****, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.*
4. ***"Biomass Conversion and Technology"****, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.*

COURSE OUTCOMES:

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

CO1: Understand solid waste management techniques

CO2: Know what is biomass

CO3 : Study Methods and factors considered for biomass gasification

CO4 : Know equipmentmeant for biomass combustion

CO5 : Understand about biogas and its development in India

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	-	-	M	-	-	H	-	L	L	L
CO2	M	-	-	M	-	-	H	-	L	L	L
CO3	M	-	-	M	-	-	H	-	L	L	L
CO4	M	-	M	M	-	-	H	-	L	L	L
CO5	M	-	-	M	-	-	H	-	L	L	L

L-Low, M-Moderate(Medium), H-High

18GEOE07 - ENERGY IN BUILT ENVIRONMENT
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course students are able to:

- About energy use and its management
- Understand constructional requirements of buildings
- Know relationship of energy and environment

UNIT I INTRODUCTION (09)

Indoor activities and environmental control - Internal and external factors on energy use - Characteristics of energy use and its management -Macro aspect of energy use in dwellings and its implications - Thermal comfort - Ventilation and air quality - Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement

UNIT II LIGHTING REQUIREMENTS IN BUILDING (09)

The sun-earth relationship - Climate, wind, solar radiation and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings – Lighting and daylighting: Characteristics and estimation, methods of day-lighting – Architectural considerations for day-lighting

UNIT III ENERGY REQUIREMENTS IN BUILDING (09)

Steady and unsteady heat transfer through wall and glazed window - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer - Thermal gain andnet heat gain - End-use energy requirements - Status of energy use in buildings - Estimation of energy use in a building

UNIT IV ENERGY AUDIT (09)

Energy audit and energy targeting - Technological options for energy management - Natural and forced ventilation – Indoor environment and air quality - Airflow and air pressure on buildings - Flow due to stack effect

UNIT V COOLING IN BUILT ENVIRONMENT (09)

Passive building architecture – Radiative cooling - Solar cooling techniques - Solar desiccant dehumidification for ventilation - Natural and active cooling with adaptive comfort –Evaporative cooling – Zero energy building concept.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total 45 Periods

REFERENCE BOOKS:

1. *J. Krieder and A. Rabl (2000),* ***"Heating and Cooling of Buildings: Design for Efficiency"****,McGraw-Hill.*
2. *S. M. Guinnes and Reynolds (1989),* ***"Mechanical and Electrical Equipment for Buildings"****,Wiley.*
3. *A. Shaw (1991),* ***"Energy Design for Architects"****, AEE Energy Books.*
4. *ASHRAE (2001),* ***"Handbook of Fundamentals"****, ASHRAE, Atlanta, GA.*
5. *Reference Manuals of DOE-2 (1990), Orlando Lawrence-Berkeley Laboratory, University of California, and Blast, University of Illinois, USA.*

COURSE OUTCOMES:

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

CO1: Understand energy and its usage

CO2: To know lighting to be given to a building

CO3 : To study energy requirements in a building

CO4 : Understand energy audit

CO5 : To study architectural specifications of a building.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	-	-	M	-	-	M	-	L	L	L
CO2	M	-	-	M	-	-	M	-	L	L	L
CO3	M	-	-	M	-	-	M	-	L	L	L
CO4	M	-	-	M	-	M	M	-	L	L	L
CO5	M	-	-	M	-	-	M	-	L	L	L

L-Low, M-Moderate(Medium), H-High

18GEOE08 - EARTH AND ITS ENVIRONMENT
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE

To know about the planet earth, the geosystems and the resources like ground water and air and to learn about the Environmental Assessment and sustainability.

UNIT I-EVOLUTION OF EARTH (09)

Evolution of earth as habitable planet - Evolution of continents - oceans and landforms - evolution of life through geological times - Exploring the earth's interior - thermal and chemical structure - origin of gravitational and magnetic fields.

UNIT II-GEOSYSTEMS (09)

Plate tectonics - working and shaping the earth - Internal Geosystems – earthquakes – volcanoes - climatic excursions through time - Basic Geological processes - igneous, sedimentation - metamorphic processes.

UNIT III-GROUND WATER GEOLOGY (09)

Geology of groundwater occurrence - recharge process - Groundwater movement - Groundwater discharge and catchment hydrology - Groundwater as a resource - Natural groundwater quality and contamination - Modeling and managing groundwater systems.

UNIT IV- ENVIRONMENTAL ASSESMENT AND SUSTAINABILITY (09)

Engineering and sustainable development - population and urbanization - toxic chemicals and finite resources - water scarcity and conflict - Environmental risk - risk assessment and characterization - hazard assessment - exposure assessment.

UNIT V-AIR AND SOLIDWASTE (09)

Air resources engineering - introduction to atmospheric composition – behaviour - atmospheric photochemistry - Solid waste management – characterization - management concepts.

Lecture: 45 periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. John Grotzinger and Thomas H. Jordan, **"Understanding Earth"**, Sixth Edition, W. H. Freeman, 2010.
2. Younger, P. L., **"Groundwater in the Environment: An introduction"**, Blackwell Publishing, 2007.
3. Mihelcic, J. R., Zimmerman, J. B., **"Environmental Engineering: Fundamentals, Sustainability and Design"**, Wiley, NJ, 2010.

COURSE OUTCOMES

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

CO1: Know about evolution of earth and the structure of the earth.

CO2: Understand the internal Geosystems like earthquakes and volcanoes and the various geological processes.

CO3: Understand the geological process of occurrence and movement of groundwater and the modeling systems.

CO4: Assess the Environmental risks and the sustainability developments.

CO5: Learn about the photochemistry of atmosphere and the solid waste management concepts.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	-	-	M	M	-	-	H	H	-	-
CO2	H	-	H	H	-	H	-	-	-	-	-
CO3	M	-	-	-	-	-	H	-	-	M	-
CO4	-	M	-	-	L	-	H	H	H	-	H
CO5	M	M	-	L	-	-	-	H	-	-	-

L→ Low M→ Medium H→ High

18GEOE09 - NATURAL HAZARDS AND MITIGATION
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE

To get idea about the various natural hazards like Earthquakes, slope stability, floods, droughts and Tsunami and the mitigation measures.

UNIT I-EARTHQUAKES (09)

Definitions and basic concepts - different kinds of hazards – causes - Geologic Hazards – Earthquakes - causes of earthquakes – effects - plate tectonics - seismic waves - measures of size of earthquakes - earthquake resistant design concepts.

UNIT II- SLOPE STABILITY (09)

Slope stability and landslides - causes of landslides - principles of stability analysis - remedial and corrective measures for slope stabilization.

UNIT III- FLOODS (09)

Climatic Hazards – Floods - causes of flooding - regional flood frequency analysis - flood control measures - flood routing - flood forecasting - warning systems.

UNIT IV-DROUGHTS (09)

Droughts – causes - types of droughts - effects of drought - hazard assessment - decision making - Use of GIS in natural hazard assessment – mitigation - management.

UNIT V-TSUNAMI (09)

Tsunami – causes – effects – undersea earthquakes – landslides – volcanic eruptions – impact of sea meteorite – remedial measures – precautions – case studies.

Lecture: 45 periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, **"Natural Hazards and Disasters"**, Brooks/Cole Cengage Learning, 2008.
2. Edward Bryant, **"Natural Hazards"**, Cambridge University Press, 2005.
3. J Michael Duncan and Stephan G Wright, **"Soil Strength and Slope Stability"**, John Wiley & Sons, Inc, 2005.
4. Amr S Elnashai and Luigi Di Sarno, **"Fundamentals of Earthquake Engineering"**, John Wiley & Sons, Inc, 2008

COURSE OUTCOMES

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

CO1: Understand the basic concepts of earthquakes and the design concepts of earthquake resistant buildings.
CO2: Acquire knowledge about the causes and remedial measures of slope stabilization.
CO3: Gain knowledge about the causes and control measures of flood.
CO4: Understand the types, causes and mitigation of droughts.
CO5: Know the causes, effects and precautionary measures of Tsunami.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	H	-	-	H	-	M	-	H	M
CO2	H	-	-	H	H	-	L	-	M	H	M
CO3	H	-	H	-	-	-	M	-	-	H	M
CO4	H	-	M	-	L	-	-	-	-	H	M
CO5	H	-	-	-	L	-	M	-	-	H	M

L→ Low M→ Medium H→ High

18EDOE10 - BUSINESS ANALYTICS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE:

- Understand the role of business analytics within an organization.
- Analyze and solve problems from different industries such as manufacturing, service, retail,software, banking and finance, sports, pharmaceutical, aerospace etc.

BUSINESS ANALYTICS AND PROCESS **(9)**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process andorganisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

REGRESSION ANALYSIS **(9)**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

STRUCTURE OF BUSINESS ANALYTICS **(9)**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

FORECASTING TECHNIQUES **(9)**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

DECISION ANALYSIS AND RECENT TRENDS IN BUSINESS ANALYTICS **(9)**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.
Recent Trends: Embedded and collaborative business intelligence, Visual data recovery, Data Story telling and Data journalism

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

Reference:

1. *Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey* **"Business analytics Principles, Concepts, and Applications"**, Pearson FT Press.
2. *PurbaHalady Rao,2013* ***"Business Analytics: An application focus",*** PHI Learning Pvt. Ltd..
3. *R.N.Prasad, Seema Acharya, 2011****"Fundamentals of Business Analytics ",*** *Persons Education.*
4. *James Evans***"Business Analytics"**, Persons Education.

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Students will demonstrate knowledge of data analytics.

CO2: Students will demonstrate the ability of think critically in making decisions based on Data and deep analytics.

CO3: Students will demonstrate the ability to use technical skills in predicative and Prescriptive modeling to support business decision-making.

COURSE ARTICULATION MATRIX

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	L	L	L	M	L	-	L	M	-	L
CO2	-	H	L	L	L	L	-	-	L	-	-
CO3	L	L	-	-	L	-	L	M	L	-	L

L-Low, M-Moderate (Medium), H-High

18EDOE11-COST MANAGEMENT OF ENGINEERING PROJECTS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

- To be familiar with cost management and project planning.
- To acquire knowledge of decision making, price strategies and total quality management tools.

INTRODUCTION TO COST MANAGEMENT (9)

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

PROJECT PLANNING ACTIVITIES (9)

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

COST ANALYSIS (9)

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

PRICING STRATEGIES AND BUDGETORY CONTROL (9)

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

TQM AND OPERATIONS REASEARCH TOOLS (9)

Total Quality Management and Theory of constraints, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

References:

*1. "***Cost Accounting a Managerial Emphasis"**, *Prentice Hall of India, New Delhi.*

*2. Charles T. Horngren and George Foster, "**Advanced* **Management Accounting".**

*3. Robert S Kaplan Anthony A. Alkinson, "***Management & Cost Accounting".**

*4. Ashish K. Bhattacharya, "***Principles & Practices of Cost Accounting",** *A. H. Wheeler publisher.*

*5. N.D. Vohra, "***Quantitative Techniques in Management"**, *Tata McGraw Hill Book Co. Ltd.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understanding methods concepts of cost management.

CO2: Developing the skills for project planning.

CO3: Evaluating the cost behavior and profit.

COURSE ARTICULATION MATRIX

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	L	L	L	L	M	L	L	-	L
CO2	-	L	L	M	L	L	M	L	L	-	L
CO3	L	-	L	-	-	-	H	-	L	L	L

L-Low, M-Moderate (Medium), H-High

18EDOE12-INTRODUCTION TO INDUSTRIAL ENGINEERING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

- The objective of this course is to provide foundation in Industrial Engineering in order to enable the students to make significant contributions for improvements in different organisations.

INTRODUCTION (9)

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Operations Management – Production System – Input Output Model –Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

PLANT LOCATION AND LAYOUT (9)

Factors affecting Plant location – Objectives of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.

WORK SYSTEM DESIGN (9)

Need – Objectives – Method Study procedure – Principles of Motion Economy – Work Measurement procedures – Work Measurement techniques.

STATISTICAL QUALITY CONTROL (9)

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts forattributes – Sampling Inspection – Sampling Plans – Sampling Plans.

PRODUCTION PLANNING AND CONTROL (9)

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Process planning – Economic Batch Quantity – Tool control – Loading – Scheduling and control of production – Dispatching–Progress control.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

References:

*1.O.P.Khanna, 2010**, "Industrial Engineering and Management",** Dhanpat Rai Publications.*

*2.Ravi Shankar, 2009**, "Industrial Engineering and Management",** Galgotia Publications & Private Limited.*

*3. Martand Telsang,2006**, "Industrial Engineering and Production Management",** S. Chand and Company.*

*4. M.I. Khan,2004**, "Industrial Engineering and Production Management",** New Age International.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understanding thefunctioning of various kinds of Industries.

CO2: Developing the knowledge in plant location layout and work system design.

CO3: Evaluating the cost optimization in industries.

COURSE ARTICULATION MATRIX

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	L	L	L	L	L	L	M
CO2	L	L	L	L	L	L	-	-	L	H	M
CO3	L	L	-	-	-	-	H	-	-	L	-

L-Low, M-Moderate (Medium), H-High

18MFOE13 INDUSTRIAL SAFETY
(Common to All Branches)

Category: OE

PREREQUISTES :NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To be familiar with industrial safety equipments and techniques.
- To acquire practical knowledge of maintenance techniques available in industry.

UNIT –I INDUSTRIAL SAFETY **(9)**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT –II FUNDAMENTALS OF MAINTENANCE ENGINEERING **(9)**

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT –III WEAR AND CORROSION **(9)**

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT –IV FAULT TRACING **(9)**

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT –V PERIODIC AND PREVENTIVE MAINTENANCE **(9)**

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

References:

*1. Higgins & Morrow **"Maintenance Engineering Handbook",** Da Information Services, 2008*
*2. H.P.Garg **"Maintenance Engineering"**, S. Chand and Company, 2010.*
*3. Audels **"Pump-hydraulic Compressors",** Mcgrew Hill Publication, 1943.*
*4. Winterkorn, Hans **"Foundation Engineering Handbook"**, Chapman & Hall London, 1975.*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: Understand types of industrial safety equipments and techniques available.

CO2: Acquire practical knowledge of maintenance techniques available in industry.

CO3: Acquire knowledge on fault tracing techniques in industrial safety.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	L	L	-	L	L	-	M	M	L
CO 2	M	H	M	L	L	L	L	-	L	H	M
CO 3	H	H	H	L	-	L	M	-	M	L	-

L – Low, M – Moderate (Medium), H – High

18MFOE14 OPERATIONS RESEARCH
(Common to All Branches)

Category: OE

PREREQUISTES :NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVE :

- To familiarize students with the basic concepts, models and statements of the operations research theory.

UNIT- I INTRODUCTION **(9)**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT- II LINEAR PROGRAMMING PROBLEM **(9)**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

(9)

UNIT-III NON LINEAR PROGRAMMING PROBLEM

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

(9)

UNIT -IV SEQUENCING AND INVENTORY MODEL

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT -V GAME THEORY **(9)**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

References:

*1. H.A. Taha **"Operations Research, An Introduction"**, PHI, 2008*

*2. H.M. Wagner **"Principles of Operations Research"**, PHI, Delhi, 1982.*

*3. J.C. Pant **"Introduction to Optimisation: Operations Research"**, Jain Brothers, Delhi, 2008*

*4. Hitler Libermann **"Operations Research"**, McGraw Hill Pub. 2009*

*5. Pannerselvam **"Operations Research"**, Prentice Hall of India 2010*

*6. Harvey M Wagner **"Principles of Operations Research"** Prentice Hall of India 2010.*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: Apply basic theoretical principles in optimization and formulate the optimization models.
CO2: Develop mathematical skills to analyse and solve integer programming, network models arising from a wide range of industrial applications.
CO3: Implement optimization techniques in engineering problems.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	H	H	L	H	L	M	-	-	L	L
CO 2	H	H	H	L	-	L	L	-	-	L	-
CO 3	L	M	H	L	L	L	-	-	-	L	M

L – Low, M – Moderate (Medium), H – High

18MFOE15 COMPOSITE MATERIALS
(Common to All Branches)

Category: OE

PREREQUISTES :NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES :

- To be familiar with composite materials and their advantages, applications.
- To acquire knowledge of reinforcement, manufacturing and strength analysis of composites.

UNIT- I INTRODUCTION **(9)**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT- II REINFORCEMENT **(9)**

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT- III MANUFACTURING OF METAL MATRIX COMPOSITES **(9)**

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV MANUFACTURING OF POLYMER MATRIX COMPOSITE **(9)**

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT-V STRENGTH ANALYSIS OF COMPOSITES **(9)**

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

References:

1. *Lubin, George,* ***"Hand Book of Composite Materials",*** *Springer, 1982.*
2. *K.K.Chawla,* ***"Composite Materials"****, Springer, 2011*
3. *Deborah D.L. Chung* ***, "Composite Materials Science and Applications"*** *, Springer, 2010.*
4. *Danial Gay, Suong V. Hoa, and Stephen W.Tasi, "****Composite Materials Design and Applications"****, CRC Press,2002.*
5. *R.W.Cahn,* ***"Material Science and Technology – Vol 13– Composites",*** *VCH, West Germany, 1996.*
6. *WD Callister, Jr., Adapted by R. Balasubramaniam,* ***"Materials Science and Engineering, An introduction"****, John Wiley & Sons, NY, Indian edition, 2007.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the nature of composite materials and composite reinforcements.

CO2: Develop the skills for manufacturing of composites.

CO3: Evaluate the strength of composite materials.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	L	L	M	L	L	-	-	L	-	L
CO 2	L	M	H	L	L	L	-	-	L	L	L
CO 3	M	L	H	M	L	L	-	-	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE16 – GLOBAL WARMING SCIENCE
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make the students to learn about the material consequences of climate change, sea level change due to increase in the emission of greenhouse gases and to examine the science behind mitigation and adaptation proposals.

INTRODUCTION **(9)**

Terminology relating to atmospheric particles – Aerosols-types, characteristics, measurements – Particle mass spectrometry. Anthropogenic-sources, effects on humans.

CLIMATE MODELS **(9)**

General climate modeling- Atmospheric general circulation model, Oceanic general circulation model, Sea ice model, Land modelconcept, Paleo-climate, Weather prediction by Numerical process. Impacts of climate change, Climate Sensitivity, Forcings and feedbacks.

EARTH CARBON CYCLE AND FORECAST **(9)**

Carbon cycle-process, importance, advantages. Carbon on Earth, Global carbon reservoirs, Interactions between human activities and Carbon cycle. Geologic time scales, Fossil fuels and energy, Perturbed Carbon cycle.

GREEN HOUSE GASES

Blackbody Radiation, Layer model, Earth’s atmospheric composition and Green house gases effects on weather and climate. Radiative equilibrium. Earth’s energy balance.

GEO ENGINEERING **(9)**

Solar mitigation, Strategies – Carbon dioxide removal, solar radiation management, Recent observed trends in global warming for sea level rise, drought, glacier extent.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1 *Archer, David.* ***"GlobalWarming: Understanding the Forecast"****, Wiley, 2011*

2 *Budyko,* ***"Climate Changes, American Geophysical Society"****, Washington, D.C.,244 pp.*

3 *Bodansky,* ***May we engineer the climate?****Clim. Change 33, 309-321.*

4 *Dickinson,* ***"Climate Engineering-A review of aerosol approaches to changing the global energy balance"****, Clim. Change 33, 279-290.*

5 *Climate Change 2007-* ***"The Physical Science Basis: Working Group I Contribution to the Fourth Assessment Report of the IPCC"****. Cambridge University Press, 2007.*

COURSE OUTCOMES:

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

CO1: Understand the current warming in relation to climate changes throughout the Earth.

CO2: Assess the best predictions of current climate models.

CO3: Able to know about current issues, including impact from society, environment, economy as well as ecology related to greenhouse gases.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	L	L	L	M	H	M	L	M	L
CO 2	L	L	L	L	L	M	H	M	L	M	L
CO 3	L	L	L	L	L	H	M	M	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE17 – INTRODUCTION TO NANO ELECTRONICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make the students to provide strong, essential, important methods and foundations of quantum mechanics and apply quantum mechanics on engineering fields.

INTRODUCTION **(9)**

Particles and Waves, Operators in quantum mechanics, The Postulates of Quantum Mechanics, The Schrodinger Equation Values and Wave Packet Solutions, Ehrenfest's Theorem.

ELECTRONIC STRUCTURE AND MOTION **(9)**

Atoms- The Hydrogen Atom, Many-Electron Atoms, Many-Electron Atoms.Pseudopotentials, Nuclear Structure, Molecules, Crystals. Translational motion – Penetration through barriers – Particle in a box. Two Terminal Quantum Dot Devices, Two Terminal Quantum Wire Devices.

SCATTERING THEORY **(9)**

The formulation of scattering events- scattering cross section, stationary scattering state. Partial wave stationary scattering events, Multi-channel scattering, Solution for Schrodinger Equation- radial and wave equation, Greens' function.

CLASSICAL STATISTICS **(9)**

Probabilities and microscopic behaviors, Kinetic theory and transport processes in gases, Magnetic properties of materials, The partition function.

QUANTUM STATISTICS **(9)**

Statistical mechanics- Basic Concepts, Statistical models applied to metals and semiconductors. The thermal properties of solids- The electrical properties of materials. Black body radiation, Low temperatures and degenerate systems.

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1 *Peter L. Hagelstein, Stephen D. Senturia, and Terry P. Orlando,* ***"Introductory Applied Quantum Statistical Mechanics"****, Wiley (2004).*

2 *A. F. J. Levi,* ***"Applied Quantum Mechanics",*** *(2nd Edition), Cambridge (2006).*

3 *Walter A Harrison,* ***"Applied Quantum Mechanics"****, Stanfor University (2008).*

4 *Richard Liboff,* ***"Introductory Quantum Mechanics"****, 4th edition, Addison Wesley (2003).*

5 *P.W. Atkins and R.S. Friedman,* ***"Molecular Quantum Mechanics",*** *Oxford University Press, 3rd edition 1997.*

COURSE OUTCOMES:

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

CO1: The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, hetero structures.

CO2: The student should be able to set up and solve the Scfrödinger equation for different types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.

CO3: Potentially be able to join a research group in nanoscience / nanotechnology as a student researcher.

COURSE ARTICULATION MATRIX:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	M	L	M	L	M	L	L	L	L	L
CO 2	M	M	L	M	L	M	L	L	L	L	L
CO 3	M	M	L	M	L	H	L	L	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE18 – GREEN SUPPLY CHAIN MANAGEMENT
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make the students to learn and focus on the fundamental strategies, tools and techniques required to analyze and design environmentally sustainable supply chain systems.

INTRODUCTION **(9)**

Logistics – aim, activities, importance, progress, current trends. Integrating logistics with an organization.

ESSENTIALS OF SUPPLY CHAIN MANAGEMENT **(9)**

Basic concepts of supply chain management, Supply chain operations – Planning and sourcing, Making and delivering. Supply chain coordination and use of Technology. Developing supply chain systems.

PLANNING THE SUPPLY CHAIN **(9)**

Types of decisions – strategic, tactical, operational. Logistics strategies, implementing the strategy. Planning resources – types, capacity, schedule, controlling material flow, measuring and improving performance.

ACTIVITIES IN THE SUPPLY CHAIN

Procurement – cycle, types of purchase. Inventory management – EOQ, uncertain demand and safety stock, stock control. Material handling – purpose of warehouse and ownership, layout, packaging. Transport – mode, ownership, routing vehicles.

SUPPLY CHAIN MANAGEMENT STRATEGIES **(9)**

Five key configuration components, Four criteria of a good supply chain strategies, Next generation strategies- New roles for end to end supply chain management. Evolution of supply chain organization.

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1 *Rogers,Dale., and Ronald Tibben-Lembke.* ***"An Examination of Reverse Logistics Practices."*** *Journal of Business Logistics 22, no. 2 (2001) : 129-48.*

2 *Guide, V., Kumar Neeraj, et al.* ***"cellular Telephone Reuse: The ReCellular Inc. Case."*** *Managing Closed-Loop Supply Chains. Case: Part 6, (2005): 151-156.*

3 *Mark, K.* ***"Whirlpool Corrporation: Reverse Logistics."*** *Richard Ivey School of Business. Case: 9B11D001, August 8, 2011.*

4 *Porter, Michael E., and Mark R. Kramer.* ***"Strategy and Society: The Link between Competitive Advantage and Corporate Social Responsibility."*** *Harvard Business Revies 84, no. 12 (2006): 78-92.*

5 *Shoshnah Cohen, Josep Roussel,* ***"Strategic Supply Chain Management",*** *the five disciplines for top performance, McGraw-Hill, (2005.)*

COURSE OUTCOMES:

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

CO1: Evaluate complex qualitative and quantitative data to support strategic and operational decisions.

CO2: Develop self-leadership strategies to enhance personal and professional effectiveness.

CO3: The importance of the design and redesign of a supply chain as key components of an organization's strategic plan.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	L	L	L	H	L	M	L	L	L
CO 2	M	L	L	L	L	H	L	M	L	L	L
CO 3	M	L	L	L	L	H	L	M	L	L	L

L – Low, M – Moderate (Medium), H – High

18PSOE19 **DISTRIBUTION AUTOMATION SYSTEM**
(Common to all Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To study about the distributed automation and economic evaluation schemes of power network.

UNIT-I INTRODUCTION (09)

Introduction to Distribution Automation (DA) - Control system interfaces- Control and data requirements- Centralized (vs) decentralized control- DA system-DA hardware-DAS software.

UNIT-II DISTRIBUTION AUTOMATION FUNCTIONS (09)

DA capabilities - Automation system computer facilities- Management processes- Information management- System reliability management- System efficiency management- Voltage management- Load management.

UNIT-III COMMUNICATION SYSTEMS (09)

Communication requirements - reliability- Cost effectiveness- Data requirements- Two way capability- Communication during outages and faults - Ease of operation and maintenance- Conforming to the architecture of flow. Distribution line carrier- Ripple control-Zero crossing technique- Telephone, cableTV,radio, AM broadcast, FM SCA,VHF radio, microwave satellite, fiber optics-Hybrid communication systems used in field tests.

UNIT-IV ECONOMIC EVALUATION METHODS (09)

Development and evaluation of alternate plans- select study area – Select study period- Project load growth-Develop alternatives- Calculate operating and maintenance costs-Evaluate alternatives.

UNIT-V ECONOMIC COMPARISON (09)

Economic comparison of alternate plans-Classification of expenses - capital expenditures-Comparison of revenue requirements of alternative plans-Book life and continuing plant analysis- Year by year revenue requirement analysis, Short term analysis- End of study adjustment-Break even analysis, sensitivity analysis - Computational aids.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *IEEE Tutorial course* ***"Distribution Automation"***,IEEE Working Group on Distribution Automation, IEEE Power Engineering Society. Power Engineering Education Committee, IEEE Power Engineering Society. Transmission and Distribution Committee, Institute of Electrical and Electronics Engineers, 1988
2. Maurizio Di Paolo Emilio, **"Data Acquisition Systems: From Fundamentals to Applied Design"**, Springer Science & Business Media, 21-Mar-2013
3. Taub, **"Principles of Communication Systems"**, Tata McGraw-Hill Education, 07-Sep-2008
4. M.K. Khedkar, G.M. Dhole, **"A Textbook of Electric Power Distribution Automation"**, Laxmi Publications, Ltd., 2010.

COURSE OUTCOMES:

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

CO1: Analyse the requirements of distributed automation
CO2: Know the functions of distributed automation
CO3: Perform detailed analysis of communication systems for distributed automation.
CO4: Study the economic evaluation method
CO5: Understand the comparison of alternate plans

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	L	M	L	L	L	L	L
CO2	H	H	L	L	L	L	L	L	L	L	L
CO3	M	L	M	L	L	L	L	L	L	L	L
CO4	M	M	M	L	L	L	L	L	L	L	L
CO5	M	M	M	L	L	L	M	M	L	L	L

L – Low, M – Moderate (Medium), H- High

18PSOE20 POWER QUALITY ASSESSMENT AND MITIGATION **Category : OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To identify, analyze and create solutions for the power quality problems in power system networks.

UNIT-I : INTRODUCTION **(09)**

Importance of power quality - Terms and definitions as per IEEE std.1159 for transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers - Symptoms of poor power quality- Definitions and terminology of grounding- Purpose of groundings- Good grounding practices - problems due to poor grounding.

UNIT-II : FLICKERS AND TRANSIENT VOLTAGES **(09)**

RMS voltage variations in power system, complex power, voltage regulation and per unit system - Basic power flow and voltage drop - Devices for voltage regulation and impact of reactive power management - Causes and effects of voltage flicker - Short term and long term flickers -Methods to reduce flickers- Transient over voltages, impulsive transients, switching transients - Effect of surge impedance and line termination - control of transient voltages.

UNIT-III : VOLTAGE INTERRUPTIONS **(09)**

Definitions -Voltage sags versus interruptions - Economic impact, Major causes and consequences -characteristics, assessment, Influence of fault location and fault level on voltage sag - Areas of vulnerability, Assessment of equipment sensitivity, Voltage sag limits for computer equipment- CBEMA, ITIC, SEMI F 42curves, Report of voltage sag analysis, Voltage sag indices, Mitigation measures for voltage sag- DSTATCOM, UPQC, UPS, DVR, SMEs, CVT, utility solutions and end user solutions.

UNIT-IV : WAVEFORM DISTORTION **(09)**

Definition of harmonics, inter-harmonics, sub-harmonics- Causes and effects - Voltage versus current distortion, Fourier analysis, Harmonic indices, A.C. quantities under non-sinusoidal conditions, Triplet harmonics, characteristic and non characteristic harmonics- Series and Parallel resonances- Consequence - Principles for controlling and Reducing harmonic currents in loads, K-rated transformer -Computer tools for harmonic analysis- Locating sources of harmonics, Harmonic filtering- Passive and active filters - Modifying the system frequency response- IEEE Harmonic standard 519-1992.

UNIT-V : ANALYSIS AND CONVENTIONAL MITIGATION METHODS (09)

Analysis of power outages, Analysis of unbalance condition: Symmetrical components inphasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers - Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. M. H. J. Bollen, **"Understanding Power Quality Problems, Voltage Sag and Interruptions",** IEEE Press, series on Power Engineering, 2000.*

*2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., **"Electrical Power SystemQuality"**, Second Edition, McGraw Hill Publication Co., 2008.*

*3. G.T.Heydt, **"Electric Power Quality",** Stars in a Circle Publications, 1994(2nd edition).*

*4. Enrique Acha, Manuel Madrigal, **"Power System Harmonics: Computer Modeling and Analysis"**, John Wiley and Sons, 2001.*

*5. Arrillaga J. and Watson N. **"Power System Harmonics"** 2nd edition on; John Willey & sons, 2003*

6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

COURSE OUTCOMES:

CO1: Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.

CO2: Recognize the practical issues in the power system

CO3: Analyze the impact of power electronic devices and techniques in power system

CO4: Develop trouble shooting skills and innovative remedies for various power quality problems in power system

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

L – Low, M – Moderate (Medium), H- High

18PSOE21 **MODERN AUTOMOTIVE SYSTEMS** **Category : OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To expose the students with theory and applications of Automotive Electrical and Electronic Systems.

UNIT-I : INTRODUCTION TO MODERN AUTOMOTIVE ELECTRONICS **(08)**

Introduction to modern automotive systems and need for electronics in automobiles- Role of electronics and microcontrollers- Sensors and actuators- Possibilities and challenges in automotive industry- Enabling technologies and industry trends.

UNIT-II : SENSORS AND ACTUATORS **(09)**

Introduction- basic sensor arrangement- Types of sensors- Oxygen sensor, engine crankshaft angular position sensor – Engine cooling water temperature sensor- Engine oil pressure sensor- Fuel metering- vehicle speed sensor and detonation sensor- Pressure Sensor- Linear and angle sensors- Flow sensor- Temperature and humidity sensors- Gas sensor- Speed and Acceleration sensors- Knock sensor- Torque sensor- Yaw rate sensor- Tyre Pressure sensor- Actuators - Stepper motors – Relays.

UNIT-III : POWER TRAIN CONTROL SYSTEMS IN AUTOMOBILE **(09)**

Electronic Transmission Control - Digital engine control system: Open loop and close loop control systems- Engine cooling and warm up control- Acceleration- Detonation and idle speed control - Exhaust emission control engineering- Onboard diagnostics- Future automotive power train systems.

UNIT-IV : SAFETY, COMFORT AND CONVENIENCE SYSTEMS **(10)**

Cruise Control- Anti-lock Braking Control- Traction and Stability control- Airbag control system- Suspension control- Steering control- HVAC Control.

UNIT-V : ELECTRONIC CONTROL UNITS (ECU) **(09)**

Need for ECUs- Advances in ECUs for automotives - Design complexities of ECUs- V-Model for Automotive ECU‘s- Architecture of an advanced microcontroller (XC166 Family, 32-bit Tricore) used in the design of automobile ECUs- On chip peripherals, protocol interfaces, analog and digital interfaces.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. M. H. J. Bollen, ***"Understanding Power Quality Problems, Voltage Sag and Interruptions",*** *IEEE Press, series on Power Engineering, 2000.*

2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., ***"Electrical Power SystemQuality"****, Second Edition, McGraw Hill Publication Co., 2008.*

3. G.T.Heydt, ***"Electric Power Quality",*** *Stars in a Circle Publications, 1994(2nd edition).*

*4. Enrique Acha, Manuel Madrigal****, "Power System Harmonics: Computer Modeling and Analysis"****, John Wiley and Sons, 2001.*

*5. Arrillaga J. and Watson N****."Power System Harmonics",*** *2nd edition on; John Willey&sons, 2003*

6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

COURSE OUTCOMES:

CO1: Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.

CO2: Recognize the practical issues in the power system

CO3: Analyze the impact of power electronic devices and techniques in power system

CO4: Develop trouble shooting skills and innovative remedies for various power quality problems in power system

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

L – Low, M – Moderate (Medium), H- High

18PEOE22 VIRTUAL INSTRUMENTATION
(Common to All Branches)

Category:OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To comprehend the Virtual instrument action programming concepts towards measurements and control.

UNIT-I : INTRODUCTION (07)

Introduction - advantages - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - Data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT-II : GRAPHICAL PROGRAMMING AND LabVIEW (09)

Concepts of graphical programming - LabVIEW software - Concept of VIs and sub VI - Display types - Digital - Analog - Chart and Graphs. Loops - structures - Arrays – Clusters- Local and global variables – String - Timers and dialog controls.

UNIT-III : VI MANAGING FILES & DESIGN PATTERNS (11)

High-level and low-level file I/O functions available in LabVIEW – Implementing File I/O functions to read and write data to files – Binary Files – TDMS – sequential programming – State machine programming – Communication between parallel loops –Race conditions – Notifiers & Queues – Producer Consumer design patterns

UNIT-IV : PC BASED DATA ACQUISITION (09)

Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT-V : DATA ACQUISITION AND SIGNAL CONDITIONING (09)

Components of a DAQ system, Bus, Signal and accuracy consideration when choosing DAQ hardware – Measurement of analog signal with Finite and continuous buffered acquisition- analog output generation – Signal conditioning systems – Synchronizing measurements in single & multiple devices – Power quality analysis using Electrical Power Measurement tool kit.

LECTURE: 45 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 45 PERIODS

REFERENCE BOOKS:

*1. Jeffrey Travis, Jim Kring, **"LabVIEW for Everyone: Graphical Programming Made Easy and Fun", (3rd Edition),** Prentice Hall, 2006.*

*2. Sanjeev Gupta, **"Virtual Instrumentation using LabVIEW" ,** TMH, 2004*

*3. Gary W. Johnson, Richard Jennings, **"Lab-view Graphical Programming"**, McGraw Hill Professional Publishing, 2001*

*4. Robert H. Bishop, **"Learning with Lab-view"**, Prentice Hall, 2003.*

*5. Kevin James, **"PC Interfacing and Data Acquisition: Techniques for Measurement"**, Instrumentation and Control', Newness, 2000*

COURSE OUTCOMES:

CO1: *Gain Knowledge of graphical programming techniques using LabVIEW software.*

CO2: *Explore the basics of programming and interfacing using related hardware.*

CO3: *Outline the aspects and utilization of PC based data acquisition and Instrument interfaces.*

CO4: *Create programs and Select proper instrument interface for a specific application.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	-	M	H	-	-	-	-	-	-
CO2	H	H	-	M	H	-	M	-	-	-	L
CO3	-	-	H	M	H	-	-	-	-	-	L
CO4	H	H	H	M	H	-	-	-	M	-	L

L – Low, M – Moderate (Medium), H- High

18PEOE23 ENERGY AUDITING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To Comprehend energy management schemes and perform economic analysis and load management in electrical systems.

UNIT-I : BASICS OF ENERGY MANAGEMENT (09)

Energy Scenario – Energy Sector Reforms – Impact on environment – Strategy for future and conservation – Basics of Energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and Methodology - Audit Report – Energy Cost, Benchmarking and Energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, Material and energy balance diagrams.

UNIT-II : ACTION PLANNING AND MONITORING (09)

Energy Management System – Performance assessment – Goal setting by Manager – Action plan implementation – Financial Management: Investment - Financial analysis techniques, ROI, Risk and sensitivity analysis, role of Energy Service Companies. Project management: Steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.

UNIT-III : STUDY OF THERMAL UTILITIES (09)

Combustion of Oil, Coal and Gas – Performance Evaluation of Boilers – Boiler blow down – Boiler water treatment – Energy Conservation Opportunity – Cogeneration: Principal – Options - Classification – Influencing Factors and technical parameters. Waste heat recovery: Classification – application – benefits - Different heat recovery devices.

UNIT-IV : STUDY OF ELECTRICAL UTILITIES (09)

Electricity Billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – recommended luminance levels – Lighting system energy efficiency study – Energy Efficient Technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, Light controllers and Electronic ballasts.

UNIT-V : ENERGY ASSESSMENT IN UTILITY SYSTEMS (09)

Performing Financial analysis: Fixed and variable costs – Payback period – methods – factors affecting analysis – Waste Minimization Techniques: Classification – Methodology. Performance assessment of HVAC Systems: Measurements, Procedure – Evaluation. Assessment of Pumps: Measurements, Procedure – Evaluation.

LECTURE: 45 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 45 PERIODS

REFERENCE BOOKS:

1. *Murphy W.R. and G.Mckay Butter worth,* ***"Energy Management"****, Heinemann Publications.*
2. *Paul o' Callaghan,* ***"Energy Management",*** *Mc-Graw Hill Book Company – 1st edition; 1998.*
3. *John.C.Andreas,* ***"Energy Efficient Electric Motors",*** *Marcel Dekker Inc Ltd – 2nd edition; 1995.*
4. *W.C.Turner,* ***"Energy Management Handbook",*** *John Wiley and Sons, Fifth edition, 2009.*
5. ***"Energy Management and Good Lighting Practice: fuel efficiency"*** *– booklet 12 – EEO.*
6. *www.em-ea.org/gbook1.asp*

COURSE OUTCOMES:

CO1: Possess knowledge on energy management.

CO2: Analyze the feature of energy audit methodology and documentation of report.

CO3: Able to plan energy management action and develop the understanding of implementation.

CO4: Familiarize with thermal utilities.

CO5: Familiarize with electrical utilities.

CO6: Perform assessment of different systems.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	M	L	L	-	M	M	L	-	M
CO2	-	-	M	L	L	-	M	M	L	-	M
CO3	-	-	M	L	-	-	M	M	L	-	M
CO4	-	-	M	-	-	-	M	-	L	-	M
CO5	-	-	M	-	-	-	M	-	L	-	M
CO6	-	-	M	-	-	-	M	-	L	-	M

L – Low, M – Moderate (Medium), H- High

18PEOE24 ADVANCED ENERGY STORAGE TECHNOLOGY (Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To explore the fundamentals, technologies and applications of energy storage.

UNIT-I : ENERGY STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES (09)

Storage Needs- Variations in Energy Demand- Variations in Energy Supply- Interruptions in Energy Supply- Transmission Congestion - Demand for Portable Energy-Demand and scale requirements - Environmental and sustainability issues.

UNIT-II : TECHNICAL METHODS OF STORAGE (09)

Introduction: Energy and Energy Transformations, Potential energy (pumped hydro, compressed air, springs)- Kinetic energy (mechanical flywheels)- Thermal energy without phase change passive (adobe) and active (water)-Thermal energy with phase change (ice, molten salts, steam)- Chemical energy (hydrogen, methane, gasoline, coal, oil)- Electrochemical energy (batteries, fuel cells)- Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets)- Different Types of Energy Storage Systems.

UNIT-III PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS (09)

Energy capture rate and efficiency- Discharge rate and efficiency- Dispatch ability and load flowing characteristics, scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity- Ease of materials, recycling and recovery- Environmental consideration and recycling , Merits and demerits of different types of Storage.

UNIT-IV : APPLICATION CONSIDERATION (09)

Comparing Storage Technologies- Technology options- Performance factors and metrics- Efficiency of Energy Systems- Energy Recovery - Battery Storage System: Introduction with focus on Lead Acid and Lithium- Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance, Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

UNIT-V : HYDROGEN FUEL CELLS AND FLOW BATTERIES (09)

Hydrogen Economy and Generation Techniques, Storage of Hydrogen, Energy generation - Super capacitors: properties, power calculations – Operation and Design methods - Hybrid Energy Storage: Managing peak and Continuous power needs, options - Level 1: (Hybrid Power generation) Bacitor "Battery + Capacitor" Combinations: need, operation and Merits; Level 2: (Hybrid Power Generation) Bacitor + Fuel Cell or Flow Battery operation-Applications: Storage for Hybrid Electric Vehicles, Regenerative Power, capturing methods.

LECTURE: 45 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 45 PERIODS

REFERENCE BOOKS:

1. *DetlefStolten,**"Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications"**, Wiley, 2010.*
2. *Jiujun Zhang, Lei Zhang,Hansan Liu, Andy Sun, Ru-Shi Liu**, "Electrochemical Technologies for Energy Storage and Conversion",** John Wiley and Sons, 2012.*
3. *Francois Beguin and Elzbieta Frackowiak ,**"Super capacitors"**, Wiley, 2013.*
4. *Doughty Liaw, Narayan and Srinivasan, **"Batteries for Renewable Energy Storage"**, The Electrochemical Society, New Jersy,2010.*

COURSE OUTCOMES:

CO1: Recollect the historical perspective and technical methods of energy storage.

CO2: Learn the basics of different storage methods.

CO3: Determine the performance factors of energy storage systems.

CO4: Identify applications for renewable energy systems.

CO5: Understand the basics of Hydrogen cell and flow batteries.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	-	-	-	-	-	-	L	-	-
CO2	L	M	M	-	-	-	-	-	L	-	-
CO3	-	-	M	L	-	M	-	-	L	-	-
CO4	L	L	M	L	-	-	-	-	L	-	-
CO5	L	M	L	L	-	-	-	-	L	-	-

L – Low, M – Moderate (Medium), H- High

18AEOE25 DESIGN OF DIGITAL SYSTEMS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

***COURSE OBJECTIVES*: Upon completion of this course, the students will be familiar with:**

- Design synchronous and asynchronous sequential circuits.
- Develop VHDL code for digital circuits.
- Implementation in PLDs.
- Fault diagnosis.

UNIT I SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN L(9)

Analysis of Clocked Synchronous Sequential Circuits - Modeling, state table reduction, state assignment, Design of Synchronous Sequential Networks, Design of iterative circuits - ASM chart - ASM realization.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN L(9)

Analysis of Asynchronous Sequential Circuits - Races in ASC – Primitive Flow Table - Flow Table Reduction Techniques, State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers.

UNIT III SYSTEM DESIGN USING PLDS L(9)

Basic concepts – Programming Technologies - Programmable Logic Element (PLE) - Programmable Array Logic (PLA) - Programmable Array Logic (PAL) –Design of combinational and sequential circuits using PLDs – Complex PLDs (CPLDs).

UNIT IV INTRODUCTION TO VHDL L(9)

Design flow - Software tools – VHDL: Data Objects - Data types – Operators – Entities and Architectures – Components and Configurations – Signal Assignment –Concurrent and Sequential statements – Behavioral, Data flow and Structural modeling – Transport and Inertial delays – Delta delays - Attributes – Generics – Packages and Libraries.

UNIT V LOGIC CIRCUIT TESTING AND TESTABLE DESIGN L(9)

Digital logic circuit testing - Fault models - Combinational logic circuit testing - Sequential logic circuit testing-Design for Testability - Built-in Self-test, Board and System Level Boundary Scan - Case Study: Traffic Light Controller.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1 Donald G. Givone, "**Digital principles and Design**", Tata McGraw Hill, 2002.
2 Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "**Digital Logic Circuit Analysis and Design**", Prentice Hall International, Inc., New Jersey, 1995.
3 Volnei A. Pedroni, "**Circuit Design with VHDL**", PHI Learning, 2011.
4 Parag K Lala, "**Digital Circuit Testing and Testability**", Academic Press, 1997.
5 Charles H Roth, "**Digital Systems Design Using VHDL**," Cencage 2nd Edition 2012.
6 Nripendra N Biswas, "**Logic Design Theory**" Prentice Hall of India, 2001.

COURSE OUTCOMES: **Upon completion of the course the students will be able/have:**

CO1: To design synchronous and asynchronous sequential circuits based on specifications.
CO2: To develop algorithm and VHDL code for design of digital circuits.
CO3: Ability to illustrate digital design implementation on PLDs.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	-	H	-	-	-	-	-	-	-
CO2	-	-	M	M	-	-	-	-	-	-	-
CO3	L	M	-	-	H	-	-	-	-	-	-

H→ High M→ Medium L→ Low

18AEOE26 ADVANCED PROCESSORS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: *Nil*

***COURSE OBJECTIVES*: Upon completion of this course, the students will be familiar with:**

- Basics of CISC and RISC.
- Architectural features of Pentium processors.
- ARM and Special processors.

UNIT I MICROPROCESSOR ARCHITECTURE L(9)

Instruction set – Data formats – Instruction formats – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – The instruction pipeline – pipeline hazards – Instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE –PENTIUM L(9)

The software model – functional description – CPU pin descriptions – Addressing modes – Processor flags – Instruction set – Bus operations – Super scalar architecture – Pipe lining – Branch prediction – The instruction and caches – Floating point unit– Programming the Pentium processor.

UNIT III HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM INTERFACE L(9)

Protected mode operation – Segmentation – paging – Protection – multitasking – Exception and interrupts - Input /Output – Virtual 8086 model – Interrupt processing.

UNIT IV HIGH PERFORMANCE RISC ARCHITECTURE: ARM L(9)

ARM architecture – ARM assembly language program – ARM organization and implementation – ARM instruction set - Thumb instruction set.

UNIT V SPECIAL PURPOSE PROCESSORS L(9)

Altera Cyclone Processor – Audio codec – Video codec design – Platforms – General purpose processor – Digital signal processor – Embedded processor – Media Processor – Video signal Processor – Custom Hardware – Co-Processor.

Lecture : 45 Periods Tutorial : 0 Period Practical : 0 Periods Total: 45 Periods

Reference Books:

1 Daniel Tabak, "**Advanced Microprocessors**", McGraw Hill Inc., 2011.
2 James L. Antonakos, "**The Pentium Microprocessor**", Pearson Education, 1997.
3 Steve Furber, "**ARM System –On –Chip architecture**", Addison Wesley, 2009.
4 Gene. H. Miller, "**Micro Computer Engineering**", Pearson Education, 2003.
5 Barry. B. Brey, "**The Intel Microprocessors Architecture, Programming and Interfacing**", PHI, 2008.
6 Valvano, "**Embedded Microcomputer Systems**" Cencage Learing India Pvt Ltd, 2011.
7 Iain E.G. Richardson, "**Video codec design**", John Wiley & sons Ltd, U.K, 2002.

COURSE OUTCOMES: **Upon completion of the course the students will be able/have:**

CO1: To distinguish between RISC and CISC generic architectures.
CO2: To describe the architectural features of Pentium processors.
CO3: To develop simple applications using ARM processors.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	H	-	-	M	-	-	-	-	-	-
CO2	H	-	M	-	-	-	-	-	-	-	-
CO3	-	M	H	M	-	-	-	-	-	-	-

H→ High M→ Medium L→ Low

18AEOE27 PATTERN RECOGNITION
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: *Nil*

***COURSE OBJECTIVES*: Upon completion of this course, the students will be familiar with:**

- Pattern recognition in computer vision techniques
- Structural pattern methods
- Neural networks and fuzzy systems.

UNIT I PATTERN CLASSIFIER L(9)

Overview of pattern recognition -Discriminant functions-Supervised learning –Parametric estimation- Maximum likelihood estimation –Bayesian parameter estimation- Perceptron algorithm-LMSE algorithm – Problems with Bayes approach –Pattern classification by distance functions-Minimum distance pattern classifier.

UNIT II UNSUPERVISED CLASSIFICATION L(9)

Clustering for unsupervised learning and classification - Clustering concept-C-means algorithm-Hierarchical clustering procedures- Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT III STRUCTURAL PATTERN RECOGNITION L(9)

Elements of formal grammars-String generation as pattern description - recognition of syntactic description- Parsing-Stochastic grammars and applications - Graph based structural representation.

UNIT IV FEATURE EXTRACTION AND SELECTION L(9)

Entropy minimization – Karhunen - Loeve transformation-feature selection through functions approximation- Binary feature selection.

UNIT V NEURAL NETWORKS L(9)

Neural network structures for Pattern Recognition –Neural network based Pattern associators-Unsupervised learning in neural Pattern Recognition-Self organizing networks-Fuzzy logic-Fuzzy classifiers-Pattern classification using Genetic Algorithms.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1 R. O Duda, P.E Hart and Stork, "**Pattern Classification**", Wiley, 2012.

2 Robert J. Sehalkoff, "**Pattern Recognition: Statistical, Structural and Neural Approaches**", John Wiley & Sons Inc., 2007.

3 Tou & Gonzales, "**Pattern Recognition Principles**", Wesley Publication Company, 2000.

4 Morton Nadier and P. Eric Smith, "**Pattern Recognition Engineering**", John Wiley & Sons, 2000.

COURSE OUTCOMES:

Upon completion of the course the students will be able/have:

CO1: Apply parametric estimation and supervised learning techniques for pattern classification.

CO2: Describe the structural pattern recognition methods.

CO3: Apply neural networks, fuzzy systems and Genetic algorithms to pattern recognition and classification.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	-	M	-	-	-	-	-	-	-
CO2	-	-	H	-	-	-	-	-	-	-	-
CO3	M	L	-	M	M	-	-	-	-	-	-

H→ High M→ Medium L→ Low

18VLOE28 VLSI DESIGN
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES: *Upon completion of this course, the students will be able to:*

- Gain knowledge on MOS and CMOS Circuits with its characterization
- Design CMOS logic and sub-system
- Understand low power CMOS VLSI Design

INTRODUCTION TO MOS CIRCUITS (9)

MOS Transistor Theory -Introduction MOS Device Design Equations -MOS Transistor as a Switches - Pass Transistor - CMOS Transmission Gate -Complementary CMOS Inverter - Static Load MOS Inverters - Inverters with NMOS loads - Differential Inverter - Tri State Inverter - BiCMOS Inverter.

CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION (9)

Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margin and Reliability.

CMOS CIRCUIT AND LOGIC DESIGN (9)

CMOS Logic Gate Design, Physical Design of CMOS Gate, Designing with Transmission Gates, CMOS Logic Structures, Clocking Strategies, I/O Structures.

CMOS SUB SYSTEM DESIGN (9)

Data Path Operations - Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.

LOW POWER CMOS VLSI DESIGN (9)

Introduction to Low Power Design, Power Dissipation in FET Devices, Power Dissipation in CMOS, Low-Power Design through Voltage Scaling – VTCMOS Circuits, MTCMOS Circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches, Low Power Basics CMOS Gate and Adder Design.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. *Sung Ms Kang, Yusuf Lablebici, **"CMOS Digital Integrated Circuits: Analysis & Design"**, Tata Mc-Graw Hill, 2011.*
2. *N. Weste and K. Eshranghian, **"Principles of CMOS VLSI Design"**, Addison Wesley, 1998.*
3. *Neil H.E. Weste, David Harris, Ayan Banerjee, **"CMOS VLSI Design:A Circuits and Systems Perspective"**, Pearson Education 2013.*
4. *Kiat-Seng Yeo, Kaushik Roy, **"Low-Voltage, Low-Power VLSI Subsystems",** McGraw-Hill Professional, 2004.*
5. *Gary K. Yeap, **"Practical Low Power Digital VLSI Design"**, Kluwer Academic Press, 2002.*
6. *Jan M. Rabaey, **"Digital Integrated Circuits: A Design Perspective"**, Pearson Education, 2003.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1: Knowledge on MOS and CMOS Circuits with its characterization

CO2: An ability to design CMOS logic and sub-system

CO3: An understanding of low power CMOS VLSI Design

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	M	-	L	-	-	-	M	-	-
CO2	H	L	M	-	L	-	-	-	M	-	-
CO3	H	L	M	-	L	-	-	-	M	-	-

L→ Low M→ Medium H→ High

18VLOE29 ANALOG & MIXED MODE VLSI CIRCUITS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: *NIL*

COURSE OBJECTIVES**:** *Upon completion of this course, the students will be able to:*

- Acquire knowledge on MOS circuit configuration and CMOS amplifier
- Analyze and design Operational amplifier
- Understand mixed signal circuits

MOS CIRCUIT CONFIGURATION (9)

Basic CMOS Circuits - Basic Gain Stage - Gain Boosting Techniques - Super MOS Transistor - Primitive Analog Cells, Current Source, Sinks and References MOS Diode/Active resistor, Simple current sinks and mirror, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.

CMOS AMPLIFIER (9)

CMOS Amplifier Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier.

CMOS DIFFERENTIAL AMPLIFIER (9)

CMOS Differential Amplifier Differential signalling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load, Differential to single ended conversion. Linear Voltage - Current Converters - CMOS, Bipolar and Low – Voltage BiCMOS Op - Amp Design - Instrumentation Amplifier Design.

BICMOS CIRCUIT TECHNIQUES AND CURRENT-MODE SIGNAL PROCESSING (9)

Basic BiCMOS Circuit Techniques, Current - Mode Signal Processing: Continuous - Time Signal Processing – Sampled - Data Signal Processing – Switched - Current Data Converters.

ANALOG FILTERS AND A/D CONVERTERS (9)

Sampled - Data Analog Filters, Over Sampled A/D Converters and Analog Integrated Sensors: First - order and Second SC Circuits - Bilinear Transformation – Cascade Design – Switched - Capacitor Ladder Filter

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

*1. Behzad Razavi, **"Design of Analog CMOS Integrated circuits"**, Tata McGraw Hill Education, 2002.*

*2. Mohammed Ismail, Terri Fiez, **"Analog VLSI signal and Information Processing"**, McGraw - Hill International Editons, 1994.*

*3. R. Jacob Baker, Harry W. Li, and David E. Boyce, **"CMOS: Circuit Design , Layout and Simulation"**,Prentice Hall of India, 1997.*

*4. David A. Johns and Ken Martin, **"Analog Integrated circuit Design"**, John Wiley & Son, 2013*

*5. Greogorian and Tames, **"Analog MOS Integrated Circuits for Signal Processing",** John Wiley & Sons Inc., 4th Edition, 1986.*

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1: Knowledge on MOS circuit configuration and CMOS amplifier

CO2: To analyze and design Operational amplifier

CO3: An understanding on mixed signal circuits

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	L	-	-	-	-	-	M	L	-
CO2	H	-	L	-	-	-	-	-	M	L	-
CO3	H	-	L	-	-	-	-	-	M	L	-

L→ Low M→ Medium H→ High

18VLOE30 HARDWARE DESCRIPTION LANGUAGES
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES:*NIL*

COURSE OBJECTIVES: *Upon completion of this course, the students will be able to:*

- Gain knowledge on HDLs and Modeling styles
- Understand the VHDL and Verilog HDL.
- Design sub-systems using VHDL/VERILOG

BASIC CONCEPTS OF HARDWARE DESCRIPTION LANGUAGES (9)

VLSI Design flow, Features of VHDL, Capabilities, Hierarchy, Syntax and Semantics of VHDL; Basic Language Elements - Data objects - Variable signal, and constant, Data types, Operators and signal assignments, Design Suits - Entities, architecture declaration, configurations, Packages.

MODELING STYLES (VHDL) (9)

Behavioral Modeling - Process statement, Sequential assignment statements, Loops, wait statement, assertion statement, Delay Model – Inertial delay Model, Transport delay model;

Gate Level Modeling – Component instantiation statements; Data flow Modeling - Concurrent assignment statement, Conditional assignment statements, Procedures, functions, Generics, attributes, Model simulation - Writing a test bench, Logic Synthesis.

INTRODUCTION TO VERILOG HARDWARE DESCRIPTION LANGUAGE (9)

Key features, Capabilities, Language Constructs and Conventions in Verilog, Syntax and Semantics of Verilog; Basic Language Elements: Operators, nets, registers, vectors, arrays, parameters, system tasks, complier directives, Module, port connection rules.

MODELING STYLES (VERILOG) (9)

Gate Level Modeling - Gate types, Gate delays; Dataflow Modeling – continuous assignment, Behavioral Modeling - Initial & Always Construct, Assignments with Delays, wait

construct, Multiple always blocks, If and if - else, assign, Loop Construct, Sequential and Parallel blocks, Switch level modeling - MOS switches, CMOS switches.

DESIGN SUB-SYSTEMS USING VHDL/VERILOG (9)

Combinational logics – Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter; Flip flop, state machines – Mealy type FSM, Moore type FSM, Counters and Shift register. Synthesis of digital logic circuits.

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total: 45 Periods

Reference Books:

1. J. Bhaskar, "**A VHDL Primer"**, 3rd Edition, Pearson Education, 2015.
2. Douglas Perry, "**VHDL"**, McGraw Hill International, New York, 1998.
3. S. Brown & Z. Vransesic, "**Fundamental of digital Logic with Verilog design"**, Tata McGraw Hill, 2002.
4. S. Palnitkar, "**Verilog HDL: A Guide to Digital Design and Synthesis"**, Prentice Hall (NJ, USA), 2003.
5. Frank Vahid, **"Digital Design"**, Wiley, 2006.
6. Peter J Ashenden, **"The Designer's Guide to VHDL"**, Morgan Kaufmann Publishers, 2008.
7. Navabi, **"VHDL Analysis & Modeling of digital systems"**, McGraw Hill, 1998.

COURSE OUTCOMES**:** *Upon completion of this course, the students will have:*

CO1: Knowledge on HDLs and Modeling styles

CO2: To write the VHDL and Verilog HDL codes

CO3: To design sub-systems USING VHDL/VERILOG

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	H	L	M	-	-	-	M	-	-
CO2	H	L	H	-	M	-	-	-	M	-	-
CO3	H	L	H	-	M	-	-	-	M	-	-

L→ Low M→ Medium H→ High

18CSOE31 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- Artificial Intelligence and intelligent agents, history of Artificial Intelligence
- Building intelligent agents (search, games, constraint satisfaction problems)
- Machine Learning algorithms
- Applications of AI (Natural Language Processing, Robotics/Vision)
- Solving real AI problems through programming with Python, Tensor Flow and Keras library.

UNIT I FOUNDATIONS OF AI **L(9)**

Introduction - History of Artificial Intelligence - Intelligent Agents - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Adversarial Search - Constraint Satisfaction Problems.

UNIT II SUPERVISED AND UNSUPERVISED LEARNING **L(9)**

Maximum likelihood estimation -Regression -Linear, Multiple, Logistic - bias-variance, Bayes rule, maximum a posteriori inference- Classification techniques - k-NN, naïve Bayes - Decision Trees - Clustering - k-means, hierarchical, high-dimensional- Expectation Maximization.

UNIT III ENSEMBLE TECHNIQUES AND REINFORCEMENT LEARNING **L(9)**

Graphical Models - Directed and Undirected Models - Inference - Learning- maximum margin, support vector machines - Boosting and Bagging - Random Forests - PCA and variations - Markov models, hidden Markov models -Reinforcement Learning- introduction - Markov Decision Processes - Value-based methods - Q-learning- Policy-based methods

UNIT IV DEEP LEARNING **L(9)**

Neural Network Basics - Deep Neural Networks - Recurrent Neural Networks (RNN) - Deep Learning applied to Images using CNN - Tensor Flow for Neural Networks & Deep Learning

UNIT V AI APPLICATIONS **L(9)**

Applications in Computer Vision : Object Detection- Face Recognition - Action and Activity Recognition -Human Pose Estimation.

Natural Language Processing - Statistical NLP and text similarity - Syntax and Parsing techniques - Text Summarization Techniques - Semantics and Generation - Application in NLP - Text Classification -speech Recognition - Machine Translation - Document Summarization - Question Answering

Applications in Robotics : Imitation Learning - Self-Supervised Learning -Assistive and Medical Technologies - Multi-Agent Learning

Lecture: 45 Periods **Tutorial : 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Reference Books

1. Peter Norvig and Stuart J. Russell, "**Artificial Intelligence: A Modern Approach**", Third edition
2. Tom Mitchell, **"Machine Learning"**, McGraw-Hill, 1997
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courvillem, "**Deep Learning**", MIT press, 2016.
4. Michael Nielson , **"Neural Networks and Deep Learning"**
5. Christopher Bishop, **"Pattern Recognition and Machine Learning",** Springer, 2006
6. Richard Sutton and Andrew Barto, **Reinforcement Learning: An introduction",** MIT Press,1998
7. Kevin P. Murphy, **"Machine Learning: A Probabilistic Perspective"**, MIT Press, 2012.
8. Trevor Hastie, Robert Tibshirani, Jerome Friedman, **"The Elements of Statistical Learning"**, Second Edition ,Springer, 2011

***COURSE OUTCOMES**: Upon completion of this course, the students will be able to:*

CO1: Develop expertise in popular AI & ML technologies and problem-solving methodologies. ***[Familiarity]***

CO2: Use fundamental machine learning techniques, such as regression, clustering, knearest neighbor methods, etc. ***[Usage]***

CO3: Distinguish between supervised and unsupervised machine learning methods. ***[Usage]***

CO4: Gain knowledge of the different modalities of Deep learning currently used. ***[Familiarity]***

CO5: Use popular AI & ML technologies like Python, Tensorflow and Keras todevelop Applications. ***[Usage]***

COURSE ARTICULATION MATRIX:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	H	H	H	M	H	H	-	-	L	-	M
CO2	H	M	M	M	M	M	-	-	L	-	M
CO3	H	H	H	M	H	M	-	-	L	-	L
CO4	H	H	M	H	M	H	-	-	L	-	L
CO5	H	H	H	M	H	M	-	-	L	-	L

L→ Low M→ Medium H→ High

18CSOE32 COMPUTER NETWORK ENGINEERING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- The hardware and software architecture of Computer Networks
- The concepts of internetworking
- Issues in resource allocation
- End-to-end protocols and data transmission
- Network management models

UNIT I FOUNDATION **L(9)**

Applications – Requirements – Network Architecture – Implementing Network software – Performance – Perspectives on connecting – Encoding – Framing – Error detection – Reliable transmission – Ethernet and Multiple Access Networks – Wireless.

UNIT II INTERNETWORKING **L(9)**

Switching and bridging – IP – Routing – Implementation and Performance – Advanced Internetworking – The Global Internet – Multicast – Multiprotocol and Label Switching – Routing among Mobile devices.

UNIT III CONGESTION CONTROL AND RESOURCE ALLOCATION **L(9)**

Issues in Resource allocation – Queuing disciplines – Congestion Control – Congestion avoidance mechanism – Quality of Service.

UNIT IV END-TO-END PROTCOLS AND DATA **L(9)**

Simple Demultiplexer – Reliable Byte Stream –Remote Procedure Call – RTP – Presentation formatting - Multimedia data.

UNIT V NETWORK MANAGEMENT **L(9)**

SNMPv1 and v2 Organization and information model - Communication model – Functional model - SNMP proxy server- Remote monitoring- RMON1 andRMON2.

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

Reference Books

1. Larry L. Peterson, Bruce S. Davie, **"Computer Networks a Systems approach"**, Fifth edition, Elsevier, 2011.
2. Priscilla Oppenheimer, **"Top-down Network Design: A Systems Analysis Approach to Enterprise Network Design"**, 3rd Edition, Cisco Press, 2010.
3. James D. McCabe, Morgan Kaufmann, **"Network Analysis, Architecture, and Design"**, Third Edition, Elsevier, 2007.
4. William Stallings, **"SNMP, SNMPv2, SNMPv3, and RMON 1 and 2,"** Third Edition, Pearson Education, 2012
5. Mani Subramanian, **"Network Management Principles and practice"**, Pearson Education, 2010.

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

CO1: Explain the architecture and applications of Computer Networks. ***[Familiarity]***
CO2: Analyze the performance of MAC protocols. ***[Assessment]***
CO3: Configure switches and Routers. ***[Assessment]***
CO4: Design algorithms to ensure congestion control and QOS. ***[Usage]***
CO5: Appreciate the performance of End-to-End protocols and data transmission techniques. ***[Assessment]***
CO6: Use SNMP and RMON. ***[Usage]***

COURSE ARTICULATION MATRIX :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	M	-	-	M	-	M
CO2	H	H	M	H	M	H	-	-	M	-	M
CO3	H	H	M	H	M	H	-	-	M	-	M
CO4	H	H	H	M	H	M	-	-	M	-	M
CO5	H	H	M	H	M	H	L	-	M	-	M
CO6	H	H	H	M	H	M	L	-	M	-	M

L→ Low M→ Medium H→ High

18CSOE33 BIG DATA ANALYTICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- Statistical methods
- Bayesian, Support Vector and Kernel Methods
- Time Series Analysis and Rule Induction
- Neural networks and Fuzzy Logic
- Visualization Techniques

UNIT I STATISTICAL CONCEPTS AND METHODS L(9)

Statistical Concepts: Probability, Sampling and Sampling Distributions, Statistical Inference, Prediction and Prediction Errors–Resampling- Statistical Method: Linear Models, Regression Modeling, Multivariate Analysis.

UNIT II BAYESIAN METHODS AND SUPPORT VECTOR AND KERNEL METHODS L(9)

Bayesian Methods: Bayesian Paradigm, modeling, inference and networks – Support Vector and Kernel Methods: Kernel Perceptron, Overfitting and Generalization Bounds, Support Vector Machines, Kernel PCA and CCA.

UNIT III TIME SERIES ANALYSIS AND RULE INDUCTION L(9)

Analysis of time series: linear systems analysis, nonlinear dynamics, Delay Coordinate Embedding - Rule induction: Propositional Rule Learning, Rule Learning as search, Evaluating quality of rules, Propositional rule induction, First order rules-ILP systems.

UNIT IV NEURAL NETWORKS AND FUZZY LOGIC L(9)

Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees.

UNIT V STOCHASTIC SEARCH METHODS AND VISUALIZATION L(9)

Stochastic Search Methods: Stochastic Search by Simulated Annealing, Adaptive Search by Evolution- Evolution Strategies- Genetic Algorithms & Programming- Visualization : Classification of Visual Data Analysis Techniques, Data Type to be Visualized, Visualization Techniques, Interaction Techniques and Specific Visual Data Analysis Techniques.

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

Reference Books

1. Michael Berthold, David J. Hand, **"Intelligent Data Analysis-An Introduction"**, Second Edition, Springer, 2007.
2. Bill Franks, **"Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics"**, John Wiley & sons, 2012.
3. Jimmy Lin and Chris Dyer, **"Data Intensive Text Processing using Map Reduce"**, Morgan and Claypool Publishers, 2010.
4. Tom White, **"Hadoop: The Definitive Guide"**, O`Reilly Publishers, 2012
5. David Loshin, "**Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph**", Morgan Kaufmann, 2013.
6. Paul Zikopoulos, Chris Eaton, "**Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data**", McGraw-Hill Education, 2011.

***COURSE OUTCOMES**: Upon completion of this course, the students will be able to:*

CO1: Explain the statistical concepts and methods. ***[Familiarity]***
CO2: Use Bayesian, support vector and kernel Methods. ***[Usage]***
CO3: Perform Time series analysis. ***[Usage]***
CO4: Use Rule induction. ***[Usage]***
CO5: Apply Neural network and Fuzzy logic. ***[Usage]***
CO6: Use Stochastic search methods. ***[Usage]***
CO7: Explain Visualization Techniques. ***[Familiarity]***

COURSE ARTICULATION MATRIX :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	M	-	-	M	-	M
CO2	H	H	H	M	H	M	-	-	M	-	M
CO3	H	H	H	M	H	M	L	-	M	L	M
CO4	H	H	H	M	H	M	-	-	M	-	M
CO5	H	H	H	M	H	M	-	-	M	-	M
CO6	H	H	H	M	H	M	L	-	M	-	M
CO7	H	M	M	M	M	M	-	-	M	L	M

L→ Low M→ Medium H→ High

18AEACZ1 - ENGLISH FOR RESEARCH PAPER WRITING
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Writing quality research papers in English*

UNIT I **L(6)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II **L(6)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism

UNIT III **L(6)**

Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV **L(6)**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V **L(6)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 **Goldbort R (2006) Writing for Science, Yale University Press** (available on GoogleBooks).

2 **Day R (2006) How to Write and Publish a Scientific Paper**, Cambridge University Press.

3 **Highman N (1998), Handbook of Writing for the Mathematical Sciences**, SIAM. Highman's book .

4 **Adrian Wallwork , English for Writing Research Papers**, Springer New York Dordrecht Heidelberg London, 2011.

COURSE OUTCOMES:

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

CO1: Utilize writing skills to write best quality research paper and provide better readability.

CO2: Describe each section of a paper with clarity.

CO3: Review the papers efficiently.

CO4: Utilize the key skills to write title, abstract, introduction and literature review of the paper.

CO5: Write the methods, results, Discussion and Conclusion using the required skills and useful phrases.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	L	L	M	-	-	H	-	-	-
CO2	H	H	L	L	M	-	-	H	-	-	-
CO3	H	H	L	L	M	-	-	H	-	-	-
CO4	H	H	L	L	M	-	-	H	-	-	-
CO5	H	H	L	L	M	-	-	H	-	-	-

L→ Low M→ Medium H→ High

18AEACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Key concepts in disaster risk reduction.
- Types of disasters and hazards.
- Disaster prone areas in India.
- Strengths and weaknesses of disaster management approaches.
- Risk assessment methods.

UNIT I INTRODUCTION L(6)

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT IIREPERCUSSIONS OF DISASTERS AND HAZARDS L(6)

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA L(6)

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT IVDISASTER PREPAREDNESS AND MANAGEMENT L(6)

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V RISK ASSESSMENT L(6)

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 R. Nishith, Singh AK, "**Disaster Management in India: Perspectives, issues and strategies**" New Royal book Company.

2 Sahni, Pardeep Et.Al. (Eds.), **"Disaster Mitigation Experiences And Reflections"**, Prentice Hall Of India, New Delhi.

3 Goel S. L. , "**Disaster Administration And Management Text And Case Studies**" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

4 Jagbir Singh, **"Disaster Management: Future Challenges and Opportunities",** I.K. International Publishing House Pvt. Ltd. , New Delhi, 2007

COURSE OUTCOMES:

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

CO1: Differentiate hazard and disaster and types of disasters.

CO2: Identify the causes and types of manmade and natural disaster.

CO3: Describe the disaster prone areas in India.

CO4: To predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences

CO5: Provide survival strategies based on risk assessment.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	-	M	M	L	-	H	-	M	-	M
CO2	M	-	M	M	L	-	H	-	M	-	M
CO3	M	-	M	H	L	-	H	-	M	-	M
CO4	M	-	M	M	L	-	H	-	M	-	M
CO5	M	-	M	H	L	-	H	-	M	-	M

L→ Low M→ Medium H→ High

18AEACZ3 - VALUE EDUCATION
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Value of education and self- development
- Requirements of good values in students
- Importance of character

UNIT I - ETHICS AND SELF-DEVELOPMENT **L(6)**

Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements.

UNIT II - PERSONALITY AND BEHAVIOR DEVELOPMENT **L(6)**

Soul and Scientific attitude .Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness.Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.

UNIT III - VALUES IN HUMAN LIFE **L(6)**

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature ,Discipline

UNIT IV - VALUES IN SOCIETY **L(6)**

True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT V - POSITIVE VALUES **L(6)**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 Chakroborty, S.K. **"Values and Ethics for organizations Theory and practice"**, Oxford University Press, New Delhi
2 Dr. Yogesh Kumar Singh, **"Value Education"**, A.P.H Publishing Corporation, New Delhi
3 R.P Shukla, **"Value Education and Human Rights"**, Sarup and Sons, NewDelhi.
4 https://nptel.ac.in/courses/109104068/36

COURSE OUTCOMES

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

CO1: Understand the values and work ethics

CO2: Enhance personality and behaviour development

CO3: Apply the values in human life.

CO4: Gain Knowledge of values in society.

CO5. Learn the importance of positive values in human life.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	H	-	H	-	-	-	H	-
CO2	H	M	M	H	-	H	-	-	-	M	-
CO3	H	M	M	H	-	H	-	-	-	M	-
CO4	H	M	M	H	-	H	-	-	-	M	-
CO5	H	M	M	H	-	H	-	-	-	M	-

L→ Low M→ Medium H→ High

18AEACZ4 - CONSTITUTION OF INDIA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Indian constitution
- Constitutional rights & duties
- Organs of governance
- Local administration
- Roles and functions of Election commission

UNIT I - INDIAN CONSTITUTION **L(6)**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features

UNIT II - CONSTITUTIONAL RIGHTS & DUTIES **L(6)**

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III - ORGANS OF GOVERNANCE **L(6)**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT IV - LOCAL ADMINISTRATION **L(6)**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V - ELECTION COMMISSION **L(6)**

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 **"The Constitution of India"**, 1950 (Bare Act), Government Publication.

2 Dr. S. N. Busi, Dr. B. R. Ambedkar, **"Framing of Indian Constitution"**, 1st Edition, 2015.

3 M. P. Jain, **"Indian Constitution Law"**, 7th Edn., Lexis Nexis, 2014.

4 D.D. Basu, **"Introduction to the Constitution of India"**, Lexis Nexis, 2015.

COURSE OUTCOMES

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

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Understand the various organs of Indian governance.

CO4: Familiarize with the various levels of local administration.

CO5: Gain knowledge on election commission of India.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	H	-	L	H	-	-	H	M
CO2	-	-	-	H	-	L	H	-	-	H	M
CO3	-	-	-	H	-	L	H	-	-	H	M
CO4	-	-	-	H	-	L	H	-	-	H	M
CO5	-	-	-	H	-	L	H	-	-	H	M

L→ Low M→ Medium H→ High

18AEACZ5 - PEDAGOGY STUDIES
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Understanding of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies.
- Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology.

UNIT I - INTRODUCTION **L(6)**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT II - PEDAGOGICAL PRACTICES **L(6)**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the

UNIT III - PEDAGOGICAL APPROACHES **L(6)**

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teacher's attitudes and beliefs and Pedagogic strategies.

UNIT IV - PROFESSIONAL DEVELOPMENT **L(6)**

Professional development: alignment with classroom practices and follow-up support. Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes.

UNIT V - CURRICULUM AND ASSESSMENT **L(6)**

Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

2 Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3 Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4 Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5 Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6 Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

7 www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES:

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

CO1: Explain the concept of curriculum, formal and informal education systems and teacher education.

CO2: Explain the present pedagogical practices and the changes occurring in pedagogical approaches.

CO3: Understand the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class.

CO4: Perform research in design a problem in pedagogy and curriculum development.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	H	-	H	M	-	-	H	L
CO2	-	-	-	H	-	H	M	-	-	H	M
CO3	-	-	-	H	-	H	M	-	-	H	M
CO4	-	-	-	H	-	H	H	-	-	H	M

L-Low M-Medium H-High

18AEACZ6 - STRESS MANAGEMENT BY YOGA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Eight parts of yoga
- Techniques to achieve overall health of body and mind
- Breathing techniques and its effects

UNIT I **L(6)**

Definitions of Eight parts of yog. (Ashtanga).

UNIT II **L(6)**

Yam and Niyam.-Do's and Don't's in life.

UNIT III **L(6)**

Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT IV **L(6)**

Asan and Pranayam : Various yog poses and their benefits for mind & body.

UNIT V **L(6)**

Regularization of breathing techniques and its effects-Types of pranayam.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 **'Yogic Asanas for Group Tarining-Part-I"**: Janardan Swami Yogabhyasi Mandal, Nagpur

2 **"Rajayoga or conquering the Internal Nature"** by Swami Vivekananda, Advaita Ashrama(Publication Department), Kolkata

3 Pandit Shambu Nath, **"Speaking of Stress Management Through Yoga and Meditation"**, New Dawn Press, New Delhi.

4 K.N Udupa, **"Stress and its management by Yoga"**, Motilal Banarsidass Publ, New Delhi.

***COURSE OUTCOMES**:*

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

CO1: Understand the basics of Yoga.
CO2: Identify Do's and Dont's in life.
CO3: Follow ethical and moral guidelines given by Yamas and Niyamas in life.
CO4: Develop healthy mind in a healthy body thus improving social health by Asan and Pranayam
CO5: Use breathing techniques to live a stress free life

COURSE ARTICULATION MATRIX:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	-	-	H	-	M	H	-	-	H	-
CO2	-	-	-	H	-	M	H	-	-	H	L
CO3	-	-	-	H	-	M	H	-	-	H	-
CO4	-	-	-	H	-	M	H	-	-	H	-
CO5	-	-	-	H	-	M	H	-	-	H	-

L→ Low M→ Medium H→ High

18AEACZ7 - PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Techniques to achieve the highest goal happily
- How to become a person with stable mind, pleasing personality and determination
- Awakening wisdom in students

UNIT I **L(6)**

Neetisatakam-Holistic development of personality-Verses- 19,20,21,22 (wisdom)-Verses- 29,31,32 (pride & heroism)-Verses- 26,28,63,65 (virtue)

UNIT II **L(6)**

Verses- 52,53, 59 (dont's)-Verses- 71,73,75,78 (do's). - Approach to day to day work and duties.- Shrimad Bhagwad Geeta - Chapter 2-Verses 41, 47,48,

UNIT III **L(6)**

Shrimad Bhagwad Geeta -Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35,-Chapter 18-Verses 45, 46, 48.

UNIT IV **L(6)**

Statements of basic knowledge.-Shrimad Bhagwad Geeta: -Chapter2-Verses 56, 62, 68 -Chapter 12 -Verses 13, 14, 15, 16,17, 18-Personality of Role model.

UNIT V **L(6)**

Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38, 39-Chapter18 – Verses 37,38,63

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. **"Srimad Bhagavad Gita"** by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.
3. **"Bhagavad Gita: The Song of God"**, Swami Mukundananda, Jagadguru Kripaluji Yog, USA
4. **"Bhagavad-Gita As It Is"**, A.C. Bhaktivedanta Swami Prabhupada, Bhaktivedanta Book Trust Publications

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: Understand the Holistic development
CO2: Understand the day to day to day work and duties
CO3: Understand mankind to peace and prosperity
CO4: Become versatile personality.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	H	M	L	-	H
CO2	-	-	-	-	-	-	H	-	M	-	H
CO3	-	-	-	-	-	-	H	-	M	-	H
CO4	-	-	-	-	-	-	H	M	M	-	H

L→ Low M→ Medium H→ High

18AEACZ8 - SANSKRIT FOR TECHNICAL KNOWLEDGE
(Common to all Branches)

Category : AC

	L	T	P	C
PREREQUISITES: Nil	**2**	**0**	**0**	**0**

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Alphabets and tense of the language.
- Sentence formation
- The Technical information in Sanskrit Literature

UNIT I **L(6)**

Alphabets in Sanskrit, Past/Present/Future Tense

UNIT II **L(6)**

Simple Sentences - Order, Introduction of roots

UNIT III **L(6)**

Technical information about Sanskrit Literature

UNIT IV **L(6)**

Technical concepts of Engineering-Electrical, Mechanical

UNIT V **L(6)**

Technical concepts of Engineering-Architecture, Mathematics

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. **"Abhyaspustakam"** – *Dr.Vishwas, Samskrita-Bharti Publication, New Delhi*
2. **"Teach Yourself Sanskrit"** *Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication*
3. **"India's Glorious Scientific Tradition"** *Suresh Soni, Ocean books (P) Ltd., New Delhi.*

COURSE OUTCOMES:

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

CO1: Read and write sentences

CO2: Explore the huge knowledge from ancient literature

CO3: Use technical concepts to develop logic in mathematics and engineering.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	M	L	-	H
CO2	L	-	-	-	-	-	-	-	M	-	H
CO3	-	L	H	H	-	-	-	-	H	M	H

L→ Low M→ Medium H→ High