Curriculum and Syllabi

M.E. APPLIED ELECTRONICS

SEMESTERS I to IV

Regulations 2022

Programme: M.E. APPLIED ELECTRONICS
2022 Regulations
(2022 Batch onwards)
Curriculum for Semesters I to IV
SEMESTER I

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Courses									
1.	22FC101	Applied Mathematics for Electronics Engineers	3	1	0	4	4	60 / 40	FC
2.	22RM101	Research Methodology and IPR	2	0	0	2	2	60 / 40	RMC
3.	22AE101	Advanced Digital System Design	3	1	0	4	4	60 / 40	PCC
4.	22AE102	Digital CMOS VLSI Design	3	0	0	3	3	60 / 40	PCC
5.	22AE103	Sensors, Actuators and Interface Electronics	3	0	0	3	3	60 / 40	PCC
6.	22AE104	Advanced Digital Image Processing	3	0	0	3	3	60 / 40	PCC
Practical Courses									
7.	22AE105	Electronic System Design Laboratory	0	0	4	4	2	40 / 60	PCC
8.	22AE106	Image Processing Laboratory	0	0	4	4	2	40 / 60	PCC

SEMESTER II

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Cum Practical Course									
1.	22AE201	Embedded Systems	3	0	2	5	4	60 / 40	PCC
Theory Courses									
2.	22AE202	Analog and Mixed Signal IC Design	3	0	0	3	3	60 / 40	PCC
3.	22AE203	Industrial Internet of Things	3	0	0	3	3	60 / 40	PCC
4.	22AE204	Power Conversion Circuits for Electronics	3	0	0	3	3	60 / 40	PCC
5.		Professional Elective – I	3	0	0	3	3	60 / 40	PEC
6.		Professional Elective – II	3	0	0	3	3	60 / 40	PEC
7.		Audit Course –I *	2	0	0	2	0	0 / 100	AC
Practical Course									
8.	22AE205	VLSI Design Laboratory	0	0	4	4	2	40 / 60	PCC
9.	22EEC201	Mini Project with seminar	0	0	2	2	1	0/100	EEC

SEMESTER III

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Theory Courses									
1.		Professional Elective – III	3	0	0	3	3	60 / 40	PEC
2.		Professional Elective – IV	3	0	0	3	3	60 / 40	PEC
3.		Professional	3	0	0	3	3	60 / 40	PEC

		Elective – V							
4.		Open Elective	3	0	0	3	3	60 / 40	OEC
5.		Audit Course – II *	2	0	0	2	0	0 / 100	AC
Practical Course									
6.	22EEC301	Project Work I	0	0	12	12	6	60 / 40	EEC

***** Audit Course is optional

SEMESTER IV

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
Practical Course									
1.	22EEC401	Project Work II	0	0	24	24	12	60 / 40	EEC

Total Credits: 75

SUMMARY

S.No	SUBJECT AREA	CREDITS AS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1	**FC**	4				**4**
2	**PCC**	17	15			**32**
3	**PEC**		6	9		**15**
4	**RMC**	2				**2**
5	**EEC**		1	6	12	**19**
6	**OEC**			3		**3**
	Total	**23**	**22**	**18**	**12**	**75**
9	**AC**		**~**	**~**		

FOUNDATION COURSES (FC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22FC101	Applied Mathematics for Electronics Engineers	3	1	0	4	4	60 / 40	FC

PROFESSIONAL CORE COURSES (PCC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22AE101	Advanced Digital System Design	3	1	0	4	4	60 / 40	PCC
2.	22AE102	Digital CMOS VLSI Design	3	0	0	3	3	60 / 40	PCC
3.	22AE103	Sensors, Actuators and Interface Electronics	3	0	0	3	3	60 / 40	PCC
4.	22AE104	Advanced Digital Image Processing	3	0	0	3	3	60 / 40	PCC
5.	22AE105	Electronic System Design Laboratory	0	0	4	4	2	40 / 60	PCC
6.	22AE106	Image Processing Laboratory	0	0	4	4	2	40 / 60	PCC
7.	22AE201	Embedded Systems	3	0	2	5	4	60 / 40	PCC
8.	22AE202	Analog and Mixed Signal IC Design	3	0	0	3	3	60 / 40	PCC
9.	22AE203	Industrial Internet of Things	3	0	0	3	3	60 / 40	PCC

10.	22AE204	Power Conversion Circuits for Electronics	3	0	0	3	3	60 / 40	PCC
11.	22AE205	VLSI Design Laboratory	0	0	4	4	2	40 / 60	PCC

RESEARCH METHODOLOGY AND IPR COURSE (RMC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22RM101	Research Methodology and IPR	2	0	0	2	2	60 / 40	RMC

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22EEC201	Mini Project with seminar	0	0	2	2	1	0/100	EEC
2.	22EEC301	Project Work I	0	0	12	12	6	60 / 40	EEC
3.	22EEC401	Project Work II	0	0	24	24	12	60 / 40	EEC

AUDIT COURSES (AC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22AC001	English for Research Paper Writing	2	0	0	2	0	0 / 100	AC
2.	22AC002	Disaster Management	2	0	0	2	0	0 / 100	AC
3.	22AC003	Constitution of India	2	0	0	2	0	0 / 100	AC
4.	22AC004	நற்றமிழ் இலக்கியம்	2	0	0	2	0	0 / 100	AC

PROFESSIONAL ELECTIVE COURSES (PEC)

PROFESSIONAL ELECTIVE - I

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAE01	Applications Specific Integrated Circuits	3	0	0	3	3	60 / 40	PEC
2.	22PAE02	Computer Architecture and Parallel Processing	3	0	0	3	3	60 / 40	PEC
3.	22PAE03	Automotive Electronics	3	0	0	3	3	60 / 40	PEC
4.	22PAE04	Robotics	3	0	0	3	3	60 / 40	PEC
5.	22PAE05	Soft Computing and Optimization Techniques	3	0	0	3	3	60 / 40	PEC

PROFESSIONAL ELECTIVE - II

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAE06	RF System Design	3	0	0	3	3	60 / 40	PEC
2.	22PAE07	Electromagnetic Interference and Compatibility	3	0	0	3	3	60 / 40	PEC
3.	22PAE08	VLSI Design Techniques	3	0	0	3	3	60 / 40	PEC
4.	22PAE09	Nano Technologies	3	0	0	3	3	60 / 40	PEC
5.	22PAE10	VLSI Testing	3	0	0	3	3	60 / 40	PEC
6.	22PAE11	Edge Analytics and Internet of Things	3	0	0	3	3	60 / 40	PEC

PROFESSIONAL ELECTIVE - III

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAE12	Quantum Computing	3	0	0	3	3	60 / 40	PEC
2.	22PAE13	VLSI for Wireless Communication	3	0	0	3	3	60 / 40	PEC
3.	22PAE14	Micro Electro Mechanical Systems	3	0	0	3	3	60 / 40	PEC
4.	22PAE15	Hardware Secure Computing	3	0	0	3	3	60 / 40	PEC
5.	22PAE16	CAD for VLSI Design	3	0	0	3	3	60 / 40	PEC

PROFESSIONAL ELECTIVE - IV

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAE17	Sensors and Actuators	3	0	0	3	3	60 / 40	PEC
2.	22PAE18	Signal Integrity for High Speed Design	3	0	0	3	3	60 / 40	PEC
3.	22PAE19	Consumer Electronics	3	0	0	3	3	60 / 40	PEC
4.	22PAE20	Advanced Microprocessors and Microcontrollers Architectures	3	0	0	3	3	60 / 40	PEC
5.	22PAE21	Biomedical Signal Processing	3	0	0	3	3	60 / 40	PEC

PROFESSIONAL ELECTIVE - V

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22PAE22	Modeling and Synthesis with HDL	3	0	2	5	4	60 / 40	PEC
2.	22PAE23	Deep Learning	3	0	2	5	4	60 / 40	PEC
3.	22PAE24	Advanced Digital Image Processing	3	0	2	5	4	60 / 40	PEC
4.	22PAE25	PCB Design	3	0	2	5	4	60 / 40	PEC

OPEN ELECTIVE COURSES (OEC)

S. No	Course Code	Course	L	T	P	Total Contact Periods/Week	Credits	External / Internal	Category
1.	22OBM01	Security Practices	3	0	0	3	3	60 / 40	OEC
2.	22OBM02	Cloud Computing Technologies	3	0	0	3	3	60 / 40	OEC
3.	22OBM03	Blockchain Technologies	3	0	0	3	3	60 / 40	OEC
4.	22OBM04	Design Thinking	3	0	0	3	3	60 / 40	OEC
5.	22OBM05	Principles of Multimedia	3	0	0	3	3	60 / 40	OEC

M.E. – Applied Electronics

Regulation – 2022

SEMESTER - I

S.No	COURSE CODE	COURSE NAME	L	T	P	C	External / internal	Category
THEORY								
1	22FC101	Applied Mathematics for Electronics Engineers	3	1	0	4	60 / 40	FC
2	22RM101	Research Methodology and IPR	3	0	0	3	60 / 40	RMC
3	22AE101	Advanced Digital System Design	3	1	0	4	60 / 40	PC
4	22AE102	Digital CMOS VLSI Design	3	0	0	3	60 / 40	PC
5	22AE103	Sensors, Actuators and Interface Electronics	3	0	0	3	60 / 40	PC
6	22AE104	Digital Image Processing	3	0	0	3	60 / 40	PC
7		Audit Course - I	2	0	0	0	-	AC
PRACTICALS								
8	22AE105	Electronic System Design Laboratory	0	0	4	2	40 / 60	PC
9	22AE106	Image Processing Laboratory	0	0	4	2	40 / 60	PC

22FC101- APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To introduce the fundamentals of fuzzy logic.
- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables.
- To make students understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete – time Markov chains.
- To provide the required fundamental concepts in queuing models and apply these techniques in networks, image processing.

UNIT I - FUZZY LOGIC **12**

Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy qualifiers.

UNIT II - PROBABILITY AND RANDOM VARIABLES **12**

Probability – Axioms of probability – Conditional probability – Bayes theorem – 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.

UNIT III - TWO DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT IV - RANDOM PROCESSES **12**

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

UNIT V - QUEUEING MODELS **12**

Poisson process – Markovian queues – Single and multi server models – Little's formula – Machine Interference model – Steady state analysis – Self service queue.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Apply the concepts of fuzzy sets, fuzzy logic, fuzzy prepositions and fuzzy quantifiers and in relate.

- Analyze the performance in terms of probabilities and distributions achieved by the determined solutions.
- Use some of the commonly encountered two dimensional random variables and extend to multivariate analysis.
- Classify various random processes and solve problems involving stochastic processes.
- Use queueing models to solve practical problems.

REFERENCES:

1. Ganesh M., "Introduction to Fuzzy Sets and Systems, Theory and Applications", Academic Press, New York, 1997.
2. George J. Klir and Yuan B," Fuzzy sets and Fuzzy logic" Prentice Hall, New Delhi, 2006.
3. Devore J.L, "Probability and Statistics for Engineering and Sciences", Cengage learning, 9th Edition, Boston, 2017.
4. Johnson R.A. and Gupta, C.B., "Miller and Freunds Probability and Statistics for Engineers", Pearson India Education, Asia, 9th Edition, New Delhi, 2017.
5. Oliver C. Ibe," Fundamentals of applied probability and Random process", Academic press, Boston, 2014.
6. Gross D. and Harris C.M., "Fundamentals of Queuing theory", Willey student, 3rd Edition, New Jersey, 2004.

22RM101 - RESEARCH METHODOLOGY AND IPR **L T P C**

3 0 0 3

UNIT I - RESEARCH DESIGN **9**

Overview of research process and design, Use of Secondary and exploratory data to answer the Research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II - DATA COLLECTION AND SOURCES **9**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III - DATA ANALYSIS AND REPORTING **9**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV - INTELLECTUAL PROPERTY RIGHTS **9**

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V - PATENTS 9

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL:45 PERIODS

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.

3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.

4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

22AE101 - ADVANCED DIGITAL SYSTEM DESIGN

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To design asynchronous sequential circuits.
- To learn about hazards in asynchronous sequential circuits.
- To study the fault testing procedure for digital circuits.
- To understand the architecture of programmable devices.
- To design and implement digital circuits using programming tools.

UNIT I - SEQUENTIAL CIRCUIT DESIGN 12

Analysis of Clocked Synchronous Sequential Circuits and Modelling- State Diagram, State Table, State Table Assignment and Reduction-Design of Synchronous Sequential Circuits Design of Iterative Circuits-ASM Chart and Realization using ASM.

UNIT II - ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 12

Analysis of Asynchronous Sequential Circuit – Flow Table Reduction-Races-State AssignmentTransition Table and Problems in Transition Table- Design of Asynchronous Sequential Circuit - Static, Dynamic and Essential hazards – Mixed Operating Mode Asynchronous Circuits – Designing Vending Machine Controller.

UNIT III - FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 12

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.

UNIT IV - SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES 12

Programming Logic Device Families – Designing a Synchronous Sequential Circuit using PLA/PAL – Designing ROM with PLA – Realization of Finite State Machine using PLD – FPGA – Xilinx FPGA - Xilinx 4000.

UNIT V - SYSTEM DESIGN USING VERILOG 12

Hardware Modelling with Verilog HDL – Logic System, Data Types And Operators For Modelling 11 In Verilog HDL - Behavioural Descriptions In Verilog HDL – HDL Based Synthesis – Synthesis Of Finite State Machines– Structural Modelling – Compilation And Simulation Of Verilog Code – Test Bench - Realization Of Combinational And Sequential Circuits Using Verilog – Registers – Counters – Sequential Machine – Serial Adder – Multiplier-Divider – Design Of Simple Microprocessor, Introduction To System Verilog.

TOTAL:60 PERIODS

COURSE OUTCOMES:

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

CO1: Analyse and design synchronous sequential circuits.

CO2: Analyse hazards and design asynchronous sequential circuits.

CO3: Knowledge on the testing procedure for combinational circuit and PLA.

CO4: Able to design PLD and ROM.

CO5: Design and use programming tools for implementing digital circuits of industry standards.

REFERENCES :

1. Charles H.Roth jr., “Fundamentals of Logic Design” Thomson Learning,2013.

2. M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999

3. M.G.Arnold, Verilog Digital – Computer Design, Prentice Hall (PTR), 1999.

4. Nripendra N Biswas "Logic Design Theory" Prentice Hall of India,2001.

5. Paragk.Lala "Fault Tolerant and Fault Testable Hardware Design" BS Publications,2002

6. Paragk.Lala "Digital System Design Using PLD" B S Publications,2003.

7. Palnitkar , Verilog HDL – A Guide to Digital Design and Synthesis, Pearson , 2003.

22AE102 - DIGITAL CMOS VLSI DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the transistor level design of all digital building blocks common to all CMOS microprocessors, network processors, digital backend of all wireless systems etc.
- To introduce the principles and design methodology in terms of the dominant circuit choices, constraints and performance measures
- To learn all important issues related to size, speed and power consumption.

UNIT I - MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER 12

MOSFET characteristic under static and dynamic conditions, MOSFET secondary effects, Elmore constant, CMOS inverter-static characteristic, dynamic characteristic, power, energy, and energy delay parameters, stick diagram and layout diagrams.

UNIT II - COMBINATIONAL LOGIC CIRCUITS 9

Static CMOS design, different styles of logic circuits, logical effort of complex gates, static and dynamic properties of complex gates, interconnect delay, dynamic logic gates.

UNIT III - SEQUENTIAL LOGIC CIRCUITS 9

Static latches and registers, dynamic latches and registers, timing issues, pipelines, clocking Strategies, nonbistable sequential circuits.

UNIT IV - ARITHMETIC BUILDING BLOCKS 9

Data path circuits, architectures for adders, accumulators, multipliers, barrel shifters, speed, power and area tradeoffs.

UNIT V - MEMORY ARCHITECTURES 6

Memory architectures and Memory control circuits: Read-Only Memories, ROM cells, Read Write Memories (RAM), dynamic memory design, 6 Transistor SRAM cell, sense amplifiers.

COURSE OUTCOMES:

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

CO1: Use mathematical methods and circuit analysis models in analysis of CMOS digital circuits

CO2: Create models of moderately sized static CMOS combinational circuits that realize specified digital functions and to optimize combinational circuit delay using RC delay models and logical effort

CO3: Design sequential logic at the transistor level and compare the tradeoffs of sequencing elements including flip-flops, transparent latches

CO4: Understand design methodology of arithmetic building blocks

CO5: Design functional units including ROM and SRAM

TOTAL:45 PERIODS

REFERENCES:

1. N.Weste, K. Eshraghian, “ Principles Of Cmos VLSI Design”, Addision Wesley, 2nd Edition, 1993

2. M J Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997

3. Sung-Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits Analysis And Design”, Mcgraw-Hill, 1998

4. Jan Rabaey, Anantha Chandrakasan, B Nikolic, “ Digital Integrated Circuits: A Design Perspective”, Prentice Hall Of India, 2nd Edition, Feb 2003.

22AE103 - SENSORS, ACTUATORS AND INTERFACE ELECTRONICS L T P C

3 0 0 3

COURSE OBJECTIVES:

- Understand static and dynamic characteristics of measurement systems.
- Study various types of sensors.
- Study different types of actuators and their usage.
- Study State-of-the-art digital and semiconductor sensors.

UNIT I - INTRODUCTION TO MEASUREMENT SYSTEMS 9

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static characteristics of measurement systems, accuracy, precision, sensitivity, other characteristics: linearity, resolution, systematic errors, random errors, dynamic characteristics of measurement systems: zero-order, first-order, and second-order measurement systems and response.

UNIT II - RESISTIVE AND REACTIVE SENSORS 9

Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to the LVDT.

UNIT III - SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

UNIT IV - ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS 9

Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

UNIT V - DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS 9

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, CCD imaging sensors , ultrasonic sensors, fiber-optic sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course the student will be able to

- Compare Actuators
- Evaluate digital sensors and semiconductor device sensors
- Discuss Self-generating sensors

REFERENCES:

1. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006.

2. D. Johnson, "Process Control Instrumentation Technology", John Wiley and Sons.

3. D.Patranabis, "Sensors and Transducers", TMH 2003.

4. E.O. Doeblin, "Measurement System : Applications and Design", McGraw Hill publications

5. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.

6. Herman K.P. Neubrat, "Instrument Transducers – An Introduction to Their Performance and Design", Oxford University Press. 22.

7. Ian Sinclair, Sensors and Transducers, Elsevier, 3rd Edition, 2011.

8. Jon Wilson , "Sensor Technology Handbook", Newne 2004.

9. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011.

10. Ramon PallásAreny, John G. Webster, "Sensors and Signal Conditioning", 2nd edition, John Wiley and Sons, 2000. 11. Sensors and Actuators: Control System Instrumentation, Clarence W. de Silva CRC Press , 2007.

22AE104 - DIGITAL IMAGE PROCESSING

L T P C
3 0 0 3

COURSE OBJECTIVES:

The students should be made to:

- Understand fundamentals of digital images
- Learn different image transforms
- Study concept of segmentation

UNIT I- DIGITAL IMAGE FUNDAMENTALS 9

A simple image model, Sampling and Quantization, Imaging Geometry, Digital Geometry, Image Acquisition Systems, Different types of digital images. Basic concepts of digital distances, distance transform, medial axis transform, component labeling, thinning, morphological processing, extension to gray scale morphology.

UNIT II - IMAGE TRANSFORMS 9

1D DFT, 2D transforms - DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet transform.

UNIT III - SEGMENTATION OF GRAY LEVEL IMAGES **9**

Histogram of gray level images, multilevel thresholding, optimal thresholding using Bayesian classification, Watershed and Dam Construction algorithms for segmenting gray level image. Detection of edges and lines: First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking.

UNIT IV - IMAGE ENHANCEMENT AND COLOR IMAGE PROCESSING **9**

Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration. Color Representation, Laws of color matching, chromaticity diagram, color enhancement, color image segmentation, color edge detection, color demosaicing.

UNIT V - IMAGE COMPRESSION **9**

Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should be able to:

- Discuss image enhancement techniques
- Explain color image processing
- Compare image compression schemes

REFERENCES:

1. A.K. Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, Addison-Wesley, 1989.

2. B. Jähne, “Practical Handbook on Image Processing for Scientific Applications“, CRC Press,1997.

3. Bernd Jähne, Digital Image Processing, Springer-Verlag Berlin Heidelberg 2005.

4. Bovik (ed.), “Handbook of Image and Video Processing”, Academic Press, 2000.

5. Gonzalez and Woods, Digital Image Processing, Prentice-Hall.

6. J. C. Russ. The Image Processing Handbook. CRC, Boca Raton, FL, 4th edn., 2002.

7. J. S. Lim, “Two-dimensional Signal and Image Processing” Prentice-Hall, 1990.

8. M. Petrou, P. Bosdogianni, “Image Processing, The Fundamentals“, Wiley, 1999.

9. Rudra Pratap, Getting Started With MATLAB 7. Oxford University Press, 2006

10. Stephane Marchand-Maillet, Yazid M. Sharaiha, Binary Digital Image Processing, A Discrete Approach, Academic Press, 2000.

11. W. K. Pratt. Digital image processing, PIKS Inside. Wiley, New York, 3rd, edn., 2001.

22AE105 - ELECTRONIC SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- Design of instrumentation amplifier and voltage regulator
- Design of PCB layout
- Write a Verilog HDL coding of various combinational circuits
- Verify the design functionality for various memory modules.

LIST OF EXPERIMENTS:

1. Design of a 4-20 mA transmitter for a bridge type transducer using LVDT
2. Design of AC/DC voltage regulator using SCR
3. PCB layout design using Tanner
4. Drawing the schematic of simple electronic circuit and design of PCB layout using Tanner.
5. HDL based design entry and simulation of Parameterizable cores of Counters, Shift registers, adder, Subtractor, Multiplier, 4-bit adder, 4-bit Multiplier, Comparator.
6. ALU design using HDL.
7. Design MOS based SRAM cell using HDL.
8. Modeling of sequential digital design using verilog.
9. Realization of Fast Fourier Transform algorithm in HDL.
10. Design a shift register using D Flipflop.

TOTAL :60 PERIODS

COURSE OUTCOMES:

CO1: Design a transducer and voltage regulator.
CO2: Design a PCB layout using Tanner tool
CO3: Write a Verilog code for various combinational and sequential circuits.
CO4: Develop a memory module with FPGA
CO5: Design a FFT using HDL.

22AE106 - IMAGE PROCESSING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To practice the basic image processing techniques.
- To compute magnitude and phasor representation of images.
- To understand the concepts of image restoration and segmentation.
- To explore the applications of image processing techniques.

LIST OF EXPERIMENTS

Simulation using MATLAB

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection.
10. Basic Morphological operations.
11. Segmentation using watershed transformation
12. Analysis of images with different color models.
13. Image compression techniques
14. Image restoration.

TOTAL :60 PERIODS

COURSE OUTCOMES:

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

- Perform enhancing operations on the image using spatial filters and frequency domain filters.
- Use transforms and analyse the characteristics of the image.
- Perform segmentation operations in the images.
- Estimate theefficiency of the compression technique on the images.
- Apply image processing technique to solve real health care problems.

22AE201	EMBEDDED SYSTEMS	L	T	P	C
		3	0	2	4

Syllabus Version V 0.1

Course Objectives:

1. Learn Embedded design challenges and design methodologies
2. Study general and single purpose processor 21 Understand bus structures
3. Design a state machine and concurrent process models
4. Know about Embedded software development tools and RTOS

Course Content:

UNIT I EMBEDDED SYSTEM OVERVIEW 9

Embedded System Overview, Design Challenges – Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Single Purpose Processors.

UNIT II GENERAL AND SINGLE PURPOSE PROCESSOR 9

Basic Architecture, Pipelining, Superscalar and VLIW architectures, Programmer's view, Development Environment, Application-Specific Instruction-Set Processors (ASIPs) Microcontrollers, Timers, Counters and watchdog Timer, UART, LCD Controllers and Analog-to Digital Converters, Memory Concepts.

UNIT III BUS STRUCTURES 9

Basic Protocol Concepts, Microprocessor Interfacing – I/O Addressing, Port and Bus-Based I/O, Arbitration, Serial Protocols, I2C, CAN and USB, Parallel Protocols – PCI and ARM Bus, Wireless Protocols – IrDA, Bluetooth, IEEE 802.11.

UNIT IV STATE MACHINE AND CONCURRENT PROCESS MODELS 9

Basic State Machine Model, Finite-State Machine with Datapath Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, Dataflow Model, Real-time Systems, Automation: Synthesis, Verification : Hardware/Software Co-Simulation, Reuse: Intellectual Property Cores, Design Process Models

UNIT V EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND RTOS 9

Compilation Process – Libraries – Porting kernels – C extensions for embedded systems – emulation and debugging techniques – RTOS – System design using RTOS.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to
CO1: Able to design an Embedded system
CO2: Understand a general and single purpose processor
CO3: Explain different protocols
CO4: Discuss state machine and design process models
CO5: Outline embedded software development tools and RTOS

Reference Books:

1. Bruce Powel Douglas, "Real time UML, second edition: Developing efficient objects for embedded systems", 3rd Edition 1999, Pearson Education.
2. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education, 2002.
3. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
4. Steve Heath, "Embedded System Design", Elsevier, Second Edition, 2004

List of Experiments:

EQUIVALENT SOFTWARE PACKAGE/ PROCESSOR BASED IMPLEMENTATION

1. Comparative study of software development tools and design steps with respect to FPGA based and Non – FPGA based (defined logic) embedded system development. (For Example: consider any Spartan FPGA board for FPGA based Embedded System Consider any cortex- M based board for Non – FPGA based Embedded system)
2. Implement adder and decoder logic blocks in any one of the FPGA chip based development board.
3. Design and development of UART protocol logic block in any one of FPGA chip based development board.
4. Consider on board LEDS (any four) and timer logic block of cortex- M board. Write a program which enables LEDS to glow in different timing.
5. Consider on board switches and (2x16) LCD display develop a program which displays the status of switch activation.
6. Demonstrate GPIO based I/O interfacing by considering LM 35 temperature sensor and cortex- M board.
7. Development of one interfacing scheme which transmits data from one cortex- M board to another cortex- M board using on chip CAN logic blocks.
8. Consider on board EPROM IC of Cortex- M board by utilizing on chip I2c logic block transmit data to EPROM IC and receive stored data from EPROM IC.
9. Consider on board LEDs (4 Nos) of Cortex - M board. Demonstrate time management service concept of RTOS for glowing all four LEDS in different timings.
10. Consider two ultrasonic sensors which are interfaced with cortex- M board. Both are located some distance (2 meters) apart vertically so that the system can identify the movement of object in term of distance. Consider data reception and display of each sensor as two different tasks by RTOS. Establish a RTOS based system to recognize the height of moving object.

TOTAL PRACTICAL PERIODS 30 Periods
TOTAL LECTURE CUM PRACTICAL PERIODS 75 Periods

22AE202	ANALOG AND MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1.To study the concepts of MOS large signal model and small signal model

2.To provide in-depth understanding of the analog integrated circuit and building blocks

3.To learn the Analog and Digital layout design for mixed signal circuits

4. To Understand the methodologies for analysis and design of fundamental CMOS Analog and Mixed signal Circuits like Data Converters and filters.

5.To study the integrated circuits like oscillators and PLLs

Course Content:

UNIT I INTRODUCTION AND BASIC MOS DEVICES 9

Challenges in analog design-Mixed signal layout issues- MOS FET structures and characteristics- large signal model – small signal model- single stage Amplifier-Source follower Common gate stage – Cascode Stage

UNIT II SUBMICRON CIRCUIT DESIGN 9

Submicron CMOS process flow, Capacitors and resistors, Current mirrors, The MOSFET Switch, Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise - OP Amp parameters

UNIT III DATA CONVERTERS 9

Characteristics of Sample and Hold- Digital to Analog Converters- architecture-Differential Non linearity-Integral Non linearity- Voltage Scaling-Cyclic DAC-Pipeline DAC-Analog to Digital Converters- architecture – Flash ADC-Pipeline ADC-Differential Non linearity-Integral Non linearity. Overview of SNR of Data Converters- Clock Jitters- Improving Using Averaging – Decimating Filters for ADC- Band pass and High Pass Sinc Filters- Interpolating Filters for DAC

UNIT IV ANALOG AND DIGITAL LAYOUT DESIGN FOR MIXED SIGNAL 9

Layout introduction: Introduction, MOS transistor layers, stick diagram, symbolic diagram. Digital layout design: Introduction, guide line of transistor layout, PMOS and NMOS transistor layout, CMOS transistor layout. Introduction to analog layout techniques and Passive component layout - capacitor, resistor and inductor, Floor planning of analog and digital components, power supply and ground pin issues, matching, shielding, interconnection issues.

UNIT V OSCILLATORS AND PLL 9

LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops. Applications of PLL frequency multiplication and synthesis. Introduction to RF IC Design, building blocks, applications.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to
CO1: Carry out research and development in the area of analog and mixed signal IC design.
CO2: Well versed with the MOS fundamentals, small signal models and analysis of MOSFET based circuits.
CO3: Analyse and model data converters architecture
CO4: Understand and Design different mixed signal circuits for various applications as per the user specifications.
CO5: Analyze and design mixed signal circuits such as Comparator, ADCs, DACs, PLL.

Reference Books:

1.P. Allen and D. Holberg, "CMOS Analog Circuit Design", Oxford University Press, Second Edition, 2012.
2.B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2003.
3.R.Jacob Baker,H.W.Li, and D.E. Boyce CMOS Circuit Design ,Layout and Simulation, Prentice-Hall of India,1998.
4.Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley Publishers, Fifth Edition, 2009.

22AE203	**INDUSTRIAL INTERNET OF THINGS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Syllabus Version V 0.1

Course Objectives:
1.To understand the fundamentals of Internet of Things
2.To learn about the basics of IOT protocols
3.To build a small low cost embedded system using IoT
4.To apply the concept of I0T in the real world scenario

Course Content:

UNIT I INTRODUCTION AND ARCHITECTURE OF IoT 9

Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT- Components of IoT - A Simplified IoT Architecture – Core IoT Functional Stack.

UNIT II INDUSTRIAL IoT 9

IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking

UNIT III IIOT ANALYTICS 9

Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop

UNIT IV IOT SECURITY 9

Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT

UNIT V CASE STUDY 9

Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Understand the basic concepts and Architectures of Internet of Things.

CO2: Understand various IoT Layers and their relative importance.

CO3: Realize the importance of Data Analytics in IoT.

CO4: Study various IoT platforms and Security

CO5: Understand the concepts of Design Thinking.

Reference Books:

1.Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017

2."Industrial Internet of Things: Cybermanufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017

3.Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.

22AE204	POWER CONVERSION CIRCUITS FOR ELECTRONICS	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1.To provide the students a deep insight in to the working of different switching devices with respect to their characteristics

2. To analyze different converters with their applications.

3.To study advanced converters and switching techniques implemented in recent technology

Course Content:

UNIT I POWER ELECTRONIC DEVICES AND 9

SEMICONDUCTOR SWITCHES

Introduction, Applications of power electronics, Power electronics devices: Characteristics of power devices – characteristics of SCR, diac, triac, GTO, PUJT, power transistors – power FETs – LASCR – two transistor model of SCR Protection of thyristors against over voltage – over current, dv/dt and di/dt. Power Semiconductor Switches: Rectifier diodes, fast recovery diodes.

UNIT II SCR PERFORMANCE AND APPLICATIONS 9

Turn on circuits for SCR – triggering with single pulse and train of pulses synchronizing with supply – Thyristor turn off methods, natural and forced commutation, self-commutation series and parallel operations of SCRs. Rectifiers: Single phase and three phase controlled Rectifiers with inductive loads, RL load. Construction & Working of Opto- Isolators, Opto-TRIAC, Opto-SCR.

UNIT III INVERTERS AND VOLTAGE CONTROLLERS 9

Voltage and current source inverters, resonant, Series inverter, PWM inverter. AC and DC choppers – DC to DC converters – Buck, boost and buck – boost. Single phase and three phase Cyclo-conveters, Power factor control and Matrix Converters. Industrial applications DC and AC Drives DC Motor Speed control Induction Motor Speed Control.

UNIT IV TIMERS & DELAY ELEMENTS, HIGH FREQUENCY POWER HEATING, SENSOR AND ACTUATORS 9

RC Base Constant Timers, Timer Circuits using SCR, IC-555, Programmable Timer and their Industrial Applications, Induction Heating and Dielectric Heating System and Their Applications, Sensors, Transducers, and Transmitters for Measurement, Control & Monitoring : Thermoresistive Transducer, Photoconductive Transducers, Pressure Transducers, Flow Transducers, Level Sensors, Speed Sensing, Vibration Transducers, Variable-Frequency Drives, Stepper Motors and Servomotor Drives.

UNIT V AUTOMATION AND CONTROL 9

Data Communications for Industrial Electronics, Telemetry, SCADA & Automation, AC & DC Drives, Voltage & Power Factor Control through Solid State Devices, Soft Switching, Industrial Robots.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Describe the characteristics, operation of power switching devices and identify their ratings and applications.

CO2: Understand the requirements SCR Protection, Describe the Functioning of SCR their Construction and Performance.

CO3: Analyze and Design the Converter Based on SCR for various Industrial Applications.

CO4: Demonstrate ability to understand High Frequency, Heating Systems, Timers, Relevant

Sensors & Actuator and their Application in Industrial Setting.
CO5: Demonstrate the ability to understand and apply Data Communication, Telemetry & SCADA System in Industrial Applications.

Reference Books:

1. Thomas E. Kissell, Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls, 3rd edition, 2003, Prentice Hall.
2. B. Paul, Industrial Electronic and Control, Prentice Hall of India Private Limited (2004).
3. M.H. Rashid, "Power Electronics: Circuits, Devices & Applications", Prentice Hall of India Ltd. 3rd Edition, 2004.
4. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.
5. . M.S. Jamil Asghar, "Power Electronics" Prentice Hall of India Ltd., 2004
6. V.R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications" Oxford University Press, 2007.
7. G.K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall inc. (1989).
8. J.M.D. Murphy, F.G. Turnbull, Power Electronic Control of Ac Motors, Pergamon (1990).

22AE205	**VLSI DESIGN LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Syllabus Version V 0.1

Course Objectives:

1.Familiarize with different FPGA boards
2. Analyze digital design using Front end Tools
3.Analyze the CMOS circuits using CAD tools
4. Analyze the interfacing of I/O devices with Arduino Boards using Embedded C

PRACTICAL EXPERIMENTS:

1.Synthesize and implement Combinational and Sequential Circuits in VERILOG / VHDL
2.Synthesize and implement MAC unit and GCD unit in Verilog /VHDL
3.Implementation of sampling of input signal and display in FPGA Synthesize and implement FIR filter and IIR filter Verilog /VHDL
4.Synthesize and implement 8 bit general purpose processor in Verilog/VHDL
5.Synthesize and implement UART and USART
6.Simulation and Analysis of CMOS combinational and sequential logic circuits using CAD tools

TOTAL PERIODS **60 Periods**

Expected Course Outcome: On completion of the course, the student is expected to
CO1:Program in Verilog/VHDL for combinational and sequential circuits and implement the program in FPGA
CO2:Implement FIR and IIR filters in FPGA
CO3:Implement data path design and interfaces
CO4: Handle CAD tools to draw/edit, and analyze the CMOS circuits.
CO5:Program and interface the Arduino Boards using Embedded C

22PAE01	APPLICATIONS SPECIFIC INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To prepare the student to be an entry-level industrial standard ASIC or FPGA designer.
2. To analyze the issues and tools related to ASIC/FPGA design and implementation.
3. To understand basics of System on Chip and Platform based design.

Course Content:

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN **9**

Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell -Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS **9**

Anti-fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

UNIT III PROGRAMMABLE ASIC ARCHITECTURE **9**

Architecture and configuration of Spartan / Cyclone and Virtex / Stratix FPGAs – Micro-Blaze / Nios based embedded systems – Signal probing techniques.

UNIT IV LOGIC SYNTHESIS, PLACEMENT AND ROUTING **9**

Logic synthesis - ASIC floor planning- placement and routing – power and clocking strategies.

UNIT V HIGH PERFORMANCE ALGORITHMS FOR ASICs/ SOCs. SOC CASE STUDIES **9**

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

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: To architect ASIC library design
CO2: To develop programmable ASIC logic cells
CO3: To design I/O cells and interconnects
CO4: To understand logic synthesis, placement and routing
CO5: To identify new developments in SOC and low power design

Reference Books:

1. Douglas J. Smith, HDL Chip Design, Madison, AL, USA: Doone Publications, 1996.
2. Jose E. France, YannisTsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication

and Signal Processing", Prentice Hall, 1994.
3. M.J.S.Smith, " Application - Specific Integrated Circuits", Pearson,2003.
4. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw Hill, 1994.
5. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, "FPGA-based Implementation of Signal Processing Systems", Wiley, 2008.
6. Steve Kilts, "Advanced FPGA Design," Wiley Inter-Science,2007

		L	T	P	C
22PAE02	**COMPUTER ARCHITECTURE AND PARALLEL PROCESSING**	**3**	**0**	**0**	**3**

Syllabus Version V 0.1

Course Objectives:

1. Discuss the basic concepts and structure of computers.
2. Explain the concepts of number representation and arithmetic operations.
3. Explain different types of Memory architectures.
4. Describe various parallel processing schemes and vector architecture.
5. Summarize the Instruction execution stages and Memory hierarchy.

Course Content:

UNIT I INTRODUCTION TO COMPUTER ORGANIZATION 9

Architecture and function of general computer system - Basic Operational Concepts, Bus Structures, Software Performance – Memory locations & addresses – Memory operations – Instruction and instruction sequencing – addressing modes – assembly language - System buses, Multi-bus organization

UNIT II DATA REPRESENTATION 9

Signed number representation, fixed and floating point representations, character representation. Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder - multiplication - shift-and-add, Booth multiplier, carry save multiplier - Division - non-restoring and restoring techniques, floating point arithmetic.

UNIT III PROCESSOR ARCHITECTURE AND CONTROL UNIT 9

A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Hardwired control – micro programmed control - Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions. Processor Architecture: Very Long Instruction Word (VLIW) Architecture, Digital Signal Processor Architecture, System on Chip (SoC) architecture, MIPS Processor and programming

UNIT IV PARALLEL PROCESSING 9

Parallel processing challenges – Flyn's classification – Single Instruction Single Data (SISD), Multiple Instruction Multiple Data (MIMD), Single Instruction Multiple Data (SIMD), Single

Program Multiple Data (SPMD), and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors

UNIT V MEMORY & I/O SYSTEMS 9

Memory Hierarchy – memory technologies – cache memory – measuring and improving cache performance – virtual memory, Translation Lookaside Buffers – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – Universal Serial Bus.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Understand the basic organization of computer and different instruction formats and addressing modes.

CO2: Interpret the representation and manipulation of data on the computer.

CO3: Illustrate about implementation schemes of control unit and pipeline performance.

CO4: Summarize the various types of parallelism architectures.

CO5: Compare the various memory hierarchy and I/O systems.

Reference Books:

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann / Elsevier, 5th Edition, 2014.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, "Computer Organization and Embedded Systems", Tata McGraw Hill, 6th Edition, 2012.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, 8th Edition, 2010.
4. John P. Hayes, "Computer Architecture and Organization", Tata McGraw Hill, 3rd Edition, 2012.
5. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann Elsevier Publishers, 5th Edition, 2012

22PAE03	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To explain the principle of electronic management system and different sensors used in the systems.
2. To know the concepts and develop basic skills necessary to diagnose automotive electronic problems.
3. To know Starting, and charging, lighting systems, advanced automotive electrical systems.
4. To include electronic accessories and basic computer control.
5. To explore practically about the components present in an Automotive electrical and electronics system.

Course Content:

UNIT I FUNDAMENTALS 9

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references, Comparator, Multiplier. Amplifier, filters, A/D and D/A converters.

UNIT II MODERN SENSORS 9

Film sensors, micro-scale sensors, Particle measuring systems, Vibration Sensors, SMART sensors, Machine Vision, Multi-sensor systems Applications of Sensors: Applications and case studies of Sensors in Automobile Engineering, Aeronautics, Machine tools and Manufacturing processes.

UNIT III CHARGING SYSTEM 9

Generation of Direct Current- Shunt Generator Characteristics- Armature Reaction- Third Brush Regulation- Cutout. Voltage and Current Regulators- Compensated Voltage Regulator Alternators Principle and Constructional Aspects and Bridge Rectifiers- New Developments.

UNIT IV AUTOMOTIVE TRANSMISSION CONTROL SYSTEMS 9

Transmission control - Cruise control – Braking control – Traction control –Suspension control – Steering control – Stability control – Integrated engine control.

UNIT V ELECTRONICS SYSTEMS 9

Current Trends in Automotive Electronic Engine Management System- Types of EMS Electromagnetic interference Suppression- Electromagnetic Compatibility- Electronic Dashboard Instruments- Onboard Diagnostic System- Security - Warning System infotainment and Telematics.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Explain the fundamentals, operation, function of various sensors and actuators in engine management systems.

CO2: Explain the Automotive Transmission Control Systems.

CO3: Enumerate the principles, application, construction and specification of different sensors and actuators usable in typical automobile by suitable testing.

CO4: List out the principles and characteristics of charging system components and demonstrate their working with suitable tools.

CO5: Describe the principles and architecture of electronics systems and its components present in an automobile related to instrumentation, control, security and warning systems.

Reference Books:

1. Allan Bonnick, “Automotive Computer Controlled Systems”, Butterworth- Heinemann, Elsevier, Indian Edition, 2011.
2. Eric Chowanietz, “Automobile Electronics” by SAE Publications, 1995
3. Tom Weather Jr and Cland C. Hunter, “Automotive Computers and Control System” Prentice HallInc.,1984 New Jersey.
4. R.K. Jurgen, “Automotive Electronics Handbook”, McGraw Hill 2 nd Edition,1995.
5. William B Ribbens, “understanding automotive electronics”, 5th edition - Butter worth Heinemann Woburn, 1998.

22PAE04	ROBOTICS	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To Introduce the concepts of Robotic systems
2. To understand the concepts of Instrumentation and control related to Robotics
3. To understand the kinematics and dynamics of robotics
4. To explore robotics in Industrial applications

Course Content:

UNIT I INTRODUCTION TO ROBOTICS 9

Robotics -History - Classification and Structure of Robotic Systems - Basic components -Degrees of freedom - Robot joints coordinates- Reference frames - workspace- Robot languages- Robotic sensors- proximity and range sensors, ultrasonic sensor, touch and slip sensor.

UNIT II ROBOT KINEMATICS AND DYNAMICS 9

Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

UNIT III ROBOTICS CONTROL 9

Control of robot manipulator - state equations - constant solutions -linear feedback systems, singleaxis PID control - PD gravity control -computed torque control, variable structure control and impedance control.

UNIT IV ROBOT INTELLIGENCE AND TASK PLANNING 9

Artificial Intelligence - techniques - search problem reduction - predicate logic means and end analysis -problem solving -robot learning - task planning - basic problems in task planning - AI in robotics and Knowledge Based Expert System in robotics

UNIT V INDUSTRIAL ROBOTICS 9

Robot cell design and control - cell layouts - multiple robots and machine interference - work cell design - work cell control - interlocks – error detection deduction and recovery - work cell controller - robot cycle time analysis. Safety in robotics, Applications of robot and future scope.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Describe the fundamentals of robotics

CO2: Understand the concept of kinematics and dynamics in robotics.

CO3: Discuss the robot control techniques

CO4: Explain the basis of intelligence in robotics and task planning

CO5: Discuss the industrial applications of robotics

Reference Books:

1. John J. Craig, 'Introduction to Robotics (Mechanics and Control)', Addison-Wesley, 2nd Edition, 2004.
2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, 'Robotics Engineering: An Integrated Approach', PHI Learning, New Delhi, 2009.
3. K.S.Fu, R.C.Gonzalez and C.S.G.Lee, 'Robotics Control, Sensing, Vision and Intelligence', Tata McGraw Hill, 2nd Reprint,2008.
4. Reza N.Jazar, 'Theory of Applied Robotics Kinematics, Dynamics and Control', Springer, 1st Indian Reprint, 2010.
5. Mikell. P. Groover, Michell Weis, Roger. N. Nagel, Nicolous G.Odrey, 'Industrial Robotics Technology, Programming and Applications ', McGraw Hill, Int 2012.

22PAE05	SOFT COMPUTING AND OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To classify various soft computing frame works.
2. To be familiar with the design of neural networks, fuzzy logic, and fuzzy systems.
3. To learn mathematical background for optimized genetic programming.
4. Be exposed to neuro-fuzzy hybrid systems and its applications.
5. To understand the various evolutionary optimization techniques.

Course Content:

UNIT I FUZZY LOGIC: 9

Introduction to Fuzzy logic - Fuzzy sets and membership functions- Operations on Fuzzy sets Fuzzy relations, rules, propositions, implications, and inferences- Defuzzification techniques- Fuzzy logic controller design- Some applications of Fuzzy logic.

UNIT II ARTIFICIAL NEURAL NETWORKS: 9

Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, The perceptron, Back propagation networks: architecture, multilayer perceptron, back propagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network.

Unsupervised Learning: Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network

UNIT III GENETIC ALGORITHM: 9

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators – Encoding scheme – Fitness evaluation – crossover - mutation - Travelling Salesman Problem, Particle swam optimization, Ant colony optimization.

UNIT IV NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems (ANFIS) – architecture - Coactive Neuro-Fuzzy Modeling, framework, neuron functions for adaptive networks – Data Clustering Algorithms – Rule base Structure Identification –Neuro Fuzzy Control – the inverted pendulum system.

UNIT V CONVENTIONAL OPTIMIZATION TECHNIQUES 9

Introduction to optimization techniques, Statement of an optimization problem, classification, Unconstrained optimization-gradient search method-Gradient of a function, steepest gradientconjugate gradient, Newton's Method, Marquardt Method, Constrained optimization –sequential linear programming, Interior penalty function method, external penalty function method.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Develop application on different soft computing techniques like Fuzzy, GA and Neural network

CO2: Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system.

CO3: Implement machine learning through Neural networks.

CO4: Model Neuro Fuzzy system for clustering and classification**.**

CO5: Able to use the optimization techniques to solve the real world problems

Reference Books:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, PHI / Pearson Education 2004.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications,Prentice Hall, 1995.
4. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.
5. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2003.
6. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
7. Simon Haykins, Neural Networks: A Comprehensive Foundation, Prentice Hall International Inc, 1999.
8. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997

22PAE06	RF SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. Be familiar with RF transceiver system design for wireless communications
2. Be exposed to design methods of receivers and transmitters used in communication systems
3. Design RF circuits and systems using an advanced design tool.
4. Exemplify different synchronization methods circuits and describe their block schematic and design criteria
5. Measure RF circuits and systems with a spectrum analyzer.

Course Content:

UNIT I BASICS OF RADIO FREQUENCY SYSTEM DESIGN 9

Definitions and models of Linear systems and Non-linear system. Specification parameters: Gain, noise figure, SNR, Characteristic impedance, S-parameters, Impedance matching and Decibels. Elements of digital base band signalling: complex envelope of band pass signals, Average value, RMS value, Crest factor, Sampling, jitter, modulation techniques, filters, pulse shaping, EVM, BER, sensitivity, selectivity, dynamic range and, adjacent and alternate channel power leakages

UNIT II RADIO ARCHITECTURES AND DESIGN CONSIDERATIONS 9

Super heterodyne architecture, direct conversion architecture, Low IF architecture, band-pass sampling radio architecture, System Design Considerations for an Analog Frontend Receiver in Cognitive Radio Applications, Interference, Near, In-band & wide-band considerations.

UNIT III AMPLIFIER MODELING AND ANALYSIS 9

Noise: Noise equivalent model for Radio frequency device, amplifier noise model, cascade performance, minimum detectable signal, performance of noisy systems in cascade. Non-Linearity: Amplifier power transfer curve, gain compression, AM-AM, AM-PM, polynomial approximations, Saleh model, Wiener model and Hammerstein model, inter modulation, Single and two tone analyses, second and third order distortions and measurements, SOI and TOI points, cascade performance of nonlinear systems.

UNIT IV MIXER AND OSCILLATOR MODELING AND ANALYSIS 9

Mixers: Frequency translation mechanisms, frequency inversion, image frequencies, spurious calculations, principles of mixer realizations. Oscillators: phase noise and its effects, effects of oscillator spurious components, frequency accuracy, oscillator realizations: Frequency synthesizers, NCO.

UNIT V APPLICATIONS OF SYSTEMS DESIGN 9

Multimode and multiband Superheterodyne transceiver: selection of frequency plan, receiver system and transmitter system design – Direct conversion transceiver: receiver system and transmitter system design.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: understand the specifications of transceiver modules

CO2: understand pros and cons of transceiver architectures and their associated design considerations

CO3: understand the impact of noise and amplifier non-linearity of amplification modules and also will learn the resultant effect during cascade connections

CO4: get exposure about spurs and generation principles during signal generation and frequency translations

CO5: understand the case study of transceiver systems and aid to select specification parameters

Reference Books:

1. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2004.
2. Qizheng Gu, “RF System Design of Transceivers for Wireless Communications”, Springer ,2005.
3. Kevin McClaning, “Wireless Receiver Design for Digital Communications,” Yes Dee Publications, 2012.
4. M C Jeruchim, P Balapan and K S Shanmugam, “Simulation of Communication systems:Modeling, Methodology and Techniques”, Kluwer Academic/Plenum Publishers, 2nd Edition, 2000.

22PAE07	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To gain broad conceptual understanding of the various aspects of electromagnetic (EM) interference and compatibility
2. To develop a theoretical understanding of electromagnetic shielding effectiveness
3. To understand ways of mitigating EMI by using shielding, grounding and filtering
4. To understand the need for standards and to appreciate measurement methods
5. To understand how EMI impacts wireless and broadband technologies

Course Content:

UNIT I INTRODUCTION & SOURCES OF EM INTERFERENCE 9

Introduction - Classification of sources - Natural sources - Man-made sources - Survey of the electromagnetic environment.

UNIT II EM SHIELDING 9

Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures

UNIT III INTERFERENCE CONTROL TECHNIQUES 9

Equipment screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.

UNIT IV EMC STANDARDS, MEASUREMENTS AND TESTING 9

Need for standards - The international framework - Human exposure limits to EM fields - EMC measurement techniques - Measurement tools - Test environments.

UNIT V EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES 9

Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks – EMC and digital subscriber lines - EMC and power line telecommunications.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Demonstrate knowledge of the various sources of electromagnetic interference

CO2: Display an understanding of the effect of how electromagnetic fields couple through apertures, and solve simple problems based on that understanding

CO3: Explain the EMI mitigation techniques of shielding and grounding

CO4: Explain the need for standards and EMC measurement methods

CO5: Discuss the impact of EMC on wireless and broadband technologies

Reference Books:

1. Christopoulos C, Principles and Techniques of Electromagnetic Compatibility, CRC Press, Second Edition, Indian Edition, 2013.
2. Paul C R, Introduction to Electromagnetic Compatibility, Wiley India, Second Edition,2008.
3. Kodali V P, Engineering Electromagnetic Compatibility, Wiley India, Second Edition,2010.
4. Henry W Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons Inc, Newyork,2009.

5. Scott Bennett W, Control and Measurement of Unintentional Electromagnetic Radiation, John Wiley& Sons Inc., Wiley Interscience Series, 1997.

22PAE08	VLSI DESIGN TECHNIQUES	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To understand the basics I-V characteristics of MOS transistor
2. To introduce the VLSI design flow
3. To Design combinational and sequential circuits
4. To introduce testing of VLSI circuits
5. To explore system design using Verilog HDL

Course Content:

UNIT I CMOS TECHNOLOGY 9

MOS transistor, Ideal I–V characteristics, C–V characteristics, non-ideal I–V effects – CMOS Inverter and Pass transistor DC transfer characteristics – CMOS technologies, Layout design Rules – Stick Diagram – CMOS process enhancements– VLSI design Flow

UNIT II CIRCUIT DELAY,POWER, INTERCONNECT AND VERILOG HDL 9

Delay estimation – Logical effort and Transistor sizing – Power dissipation – Interconnect – Design margin –Reliability – Scaling – SPICE – Device models. Verilog: Procedural assignments –conditional statements – Design of combinational and sequential circuits using different types of modeling –Test benches.

UNIT III COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN 9

Circuit families –Circuit Pitfalls – Sequencing static circuits, Max-min delay constraints, Time borrowing, Clock Skew – circuit design of latches and flip flops – synchronizers, Metastability, communication between asynchronous clock domains.

UNIT IV CMOS TESTING 9

Need for testing – Testers, Text fixtures and test programs – Logic verification – Silicon debug principles –Manufacturing test – Design for testability – Boundary scan test.

UNIT V SYSTEM DESIGN USING VERILOG HDL 9

Basic concepts- identifiers- gate primitives- gate delays- operators timing controls- procedural assignments-conditional statements- Design of combinational and sequential circuits using Data flow- structural gate level- switch level modeling and Behavioral modeling-Test benches.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to
CO1: Analyze the characteristics of CMOS transistor
CO2: Identify the methods to distribute clock and reduce power dissipation in CMOS circuits.
CO3: Design combinational and sequential circuits
CO4: Analyze the methods to test the CMOS circuits
CO5: Synthesize the combinational and sequential circuits using Verilog HDL

Reference Books:

1. Weste and Harris: "CMOS VLSI DESIGN" 4th Edition, Pearson Education, 2013
2. Uyemura J.P: "Introduction to VLSI circuits and systems", Wiley 2002.
3. D.APucknell&K.Eshraghian, "Basic VLSI Design", 3rd Edition, PHI, 2003
4. Wayne Wolf, "Modern VLSI design", 4th edition Pearson Education, 2009
5. M.J.S.Smith, "Application specific integrated circuits", 1st edition, Addison-Wesley Professional,1997
6. Ciletti, "Advanced Digital Design with the Verilog HDL", 2nd edition, Pearson Education 2010
7. Samir Palnitkar "Verilog HDL a guide to digital design and Synthesis", Prentice Hall, 2nd edition, 2003

22PAE09	**NANO TECHNOLOGIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Syllabus Version V 0.1

Course Objectives:
1.To introduce the basics of nano electronics
2.To understand the basics of semiconductor materials
3.To understand the basics of MOSFETS and its application in nano electronics
4.To learn the advanced nanoscale devices
5.To explore about Biosensors

Course Content:

UNIT I INTRODUCTION TO NANOELECTRONICS 9

Introduction to nanoelectronics, Limitations of conventional microelectronics. Classical Particles, Classical Waves and Quantum Particles-Quantum Mechanics of Electronics - Schrödinger wave equation.

UNIT II MATERIALS FOR NANOELECTRONICS 9

Introduction- Semiconductors, Crystal lattices: Bonding in crystals- Electron energy bandsSemiconductor heterostructures-Lattice-matched and pseudomorphic heterostructures-

Carbon nanomaterials: nanotubes and fullerenes.

UNIT III SHRINK-DOWN APPROACHES 9

Moore's Law- Technology Scaling and Reliability Challenges. Basic MOS Transistor-Types, Modes of operation, n-MOS operation, Drain Current, Threshold Voltage, Energy band diagram of MOSFET, nanoscale MOSFET, SCEs-limits to scaling, system integration limits.

UNIT IV ADVANCED NANOSCALE DEVICES 9

Double Gate MOSFETs, Tri-Gate MOSFETs, Tunnel FETs-Multi-Gate TFETs and Heterojunction TFETs- Graphene and Carbon Nanotube Transistors.

UNIT V FET BASED BIOSENSORS 9

Principles- Components of biosensor-Classification of Biosensors based on transducers, FET based Biosensor- ion-sensitive field effect transistor-operation and fabrication-Characteristics and Performance.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Understand the basic concepts of nano electronics and various aspects of nano electronics.

CO2: Summarize the basic knowledge of Semiconductor materials and carbon nano tubes.

CO3: Understand the basic concepts of MOS scaling.

CO4: understand the advanced nanoscale devices.

CO5: Understand the Bio sensor devices.

Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

2. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications", Cambridge University Press 2011.

3.Pierre R. Coulet, Loïc J. Blum, Biosensor Principles and Applications, CRC press-2019

4.Donald A. Neamen, "Semiconductor Physics and Devices Basic Principles", Third Edition, McGraw-Hill Higher- Education, 2003.

22PAE10	VLSI TESTING	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To introduce the VLSI testing.
2. To introduce logic and fault simulation and testability measures.
3. To study the test generation for combinational and sequential circuits.

4. To study the design for testability.
5. To study the fault diagnosis.

Course Content:

UNIT I INTRODUCTION TO TESTING 9

Introduction – VLSI Testing Process and Test Equipment – Challenges in VLSI Testing - Test Economics and Product Quality – Fault Modeling – Relationship Among Fault Models.

UNIT II LOGIC & FAULT SIMULATION & TESTABILITY MEASURES 9

Simulation for Design Verification and Test Evaluation – Modeling Circuits for Simulation – Algorithms for True Value and Fault Simulation – Scoap Controllability and Observability

UNIT III TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Algorithms and Representations – Redundancy Identification – Combinational ATPG Algorithms – Sequential ATPG Algorithms – Simulation Based ATPG – Genetic Algorithm Based ATPG

UNIT IV DESIGN FOR TESTABILITY 9

Design for Testability Basics – Testability Analysis - Scan Cell Designs – Scan Architecture – Built-in Self-Test – Random Logic Bist – DFT for Other Test Objectives.

UNIT V FAULT DIAGNOSIS 9

Introduction and Basic Definitions – Fault Models for Diagnosis – Generation of Vectors for Diagnosis – Combinational Logic Diagnosis - Scan Chain Diagnosis – Logic BIST Diagnosis.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1:Understand VLSI Testing Process
CO2:Develop Logic Simulation and Fault Simulation
CO3:Develop Test for Combinational and Sequential Circuits
CO4:Understand the Design for Testability
CO5:Perform Fault Diagnosis

Reference Books:

1.Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, “VLSI Test Principles and Architectures”, Elsevier, 2017
2.Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits” , Kluwer Academic Publishers, 2017.
3.Niraj K. Jha and Sandeep Gupta, “Testing of Digital Systems”, Cambridge University Press, 2017.

22PAE11	EDGE ANALYTICS AND INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1.To introduce the IoT protocols and system for edge analytics.

2.To study the Neural network ,artificial intelligence and machine learning.

3.To study the quantization model for edge devices.

Course Content:

UNIT I INTRODUCTION TO IOT 9

Importance and Need for IoT - Application and Use cases of IoT - Overview of Industrial IoT - Intersection of IoT and Edge Analytics.

UNIT II IOT PROTOCOLS AND SYSTEMS 9

IoT protocols and standards - Cloud IoT Infrastructure - Setup and program IoT device- Data Collection from IoT device.

UNIT III MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE 9

Introduction to Machine Learning and Artificial Intelligence - Overview of Deep Learning and Neural Networks- Introduction to Convolution Neural Networks.

UNIT IV AUTO ENCODERS AND ITS PROGRAMMING 9

Introduction to Recurrent Neural Networks- Introduction to Auto Encoders-Programming Practice: Build Image Classifier, Build Anomaly Detector

UNIT V EDGE ANALYTICS 9

Challenges with Edge Devices and Deployment - Need for Model Quantization-Quantization Aware Training- Post Model Quantization- Programming Practice: Model quantization, Deploying model on Edge Devices

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO 1: Use the foundational concepts in Edge Analytics for application design and development

CO 2: Use IOT protocols in cloud environments.

CO 3: Implement and use Machine Learning and Artificial Intelligence algorithms and tools

CO 4: implement and use Deep Learning techniques for applications

CO 5: Analyze Edge devices analytics models and and its challenges

Reference Books:

1.Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC

Press, 2012.
2.P. Flach, “Machine learning: The art and science of algorithms that make sense of data‖, Cambridge University Press, 2012.
3.Anirudh Koul, Siddha Ganju, Meher Kasam, “Practical Deep Learning for Cloud, Mobile, and Edge” O'Reilly Media, 2019.
4.Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011.

22PAE12 **QUANTUM COMPUTING**

L	T	P	C
3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To introduce the building blocks of Quantum computers and highlight the paradigm change between conventional computing and quantum computing
2. To understand the Quantum state transformations and the algorithms
3. To understand entangled quantum subsystems and properties of entangled states
4. To explore the applications of quantum computing

Course Content:

UNIT I QUANTUM BUILDING BLOCKS 9

. The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere

UNIT II QUANTUM STATE TRANSFORMATIONS 9

Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations.

UNIT III QUANTUM ALGORITHMS 9

Computing with Superposition, Quantum Subroutines, Quantum Fourier Transformations, Shor's Algorithm and Generalizations, Grover's Algorithm and Generalizations

UNIT IV ENTANGLED SUBSYSTEMS AND ROBUSTQUANTUM COMPUTATION 9

Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graphstates and codes, CSS Codes, Stabilizer Codes, Fault Tolerance and Robust Quantum Computing

UNIT V QUANTUM INFORMATION PROCESSING 9

Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Understand the basic principles of quantum computing.

CO2: Gain knowledge of the fundamental differences between conventional computing and quantum computing.

CO3: Understand several basic quantum computing algorithms.

CO4: Understand the classes of problems that can be expected to be solved well by quantum computers.

CO5: Simulate and analyze the characteristics of Quantum Computing Systems.

Text Book(s):

1. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
2. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021
3. Parag Lala, Quantum Computing, 2019

Reference Books:

1. Eleanor Rieffel and Wolfgang Polak, QUANTUM COMPUTING A Gentle Introduction, 2011
2. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.2002
3. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004 Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000

22PAE13	VLSI FOR WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

- To understand the concepts of basic wireless communication concepts.
- To study the parameters in receiver and low noise amplifier design.
- To study the various types of mixers designed for wireless communication.
- To study and design PLL and VCO.
- To understand the concepts of transmitters and power amplifiers in wireless communication.

Course Content:

UNIT I COMMUNICATION CONCEPTS 9

. Introduction – Overview of Wireless systems – Standards – Access Methods – Modulation schemes – Classical channel – Wireless channel description – Path loss – Multipath fading – Standard Translation.

UNIT II RECEIVER ARCHITECTURE & LOW NOISE AMPLIFIERS 9

Receiver front end – Filter design – Non-idealities – Design parameters – Noise figure & Input intercept point. LNA Introduction – Wideband LNA design – Narrow band LNA design: Impedance matching & Core amplifier.

UNIT III MIXERS 9

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion – Noise - A Complete Active Mixer. Switching Mixer – Distortion, Conversion Gain & Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain, Distortion, Intrinsic & Extrinsic Noise in Single Ended Sampling Mixer.

UNIT IV FREQUENCY SYNTHESIZERS 9

PLL – Phase detector – Dividers – Voltage Controlled Oscillators – LC oscillators – Ring Oscillators – Phase noise – Loop filters & design approaches – A complete synthesizer design example (DECT) – Frequency synthesizer with fractional divider.

UNIT V TRANSMITTER ARCHITECTURES & POWER AMPLIFIERS **9**

Transmitter back end design – Quadrature LO generator – Power amplifier design.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Able to recollect basic wireless communication concepts.

CO2: To understand the parameters in receiver and design a low noise amplifier

CO3: In a position to apply his knowledge on various types of mixers designed for wireless communication.

CO4: Design PLL and VCO

CO5: Understand the concepts of transmitters and utilize the power amplifiers in wireless communication.

Text Book(s):

1. Thomas H.Lee, "The Design of CMOS Radio – Frequency Integrated Circuits", Cambridge University Press ,2003
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.

Reference Books:

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999.
3. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI wireless design – Circuits & Systems", Kluwer Academic Publishers, 2000.
4. J. Crols and M. Steyaert, "CMOS Wireless Transceiver Design," Boston, Kluwer Academic Pub., 1997.

22PAE14	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

- To understand the operation of sensors and actuators
- To understand the operation of major classes of MEMS devices/systems
- To give the fundamentals of standard micro fabrication techniques and processes
- To understand the unique demands, environments and applications of MEMS devices
- To understand RF MEMS, Bio MEMS and MOEMS

Course Content:

UNIT I INTRODUCTION TO MEMS 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection

UNIT II SENSORS AND ACTUATORS 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitorPiezoresistive sensors – Piezoresistive sensor materials - piezoelectric effects – piezoelectric materials-Stress analysis of mechanical elements – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components.

UNIT III MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies – Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT IV POLYMER AND OPTICAL MEMS 9

Polymers in MEMS – SU-8, PMMA, PDMS, Langmuir – Blodgett Films, Micro System fabrication – Photolithography – Ion implantation- Diffusion – Oxidation – Chemical vapour deposition – Etching- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

UNIT V OVERVIEW OF MEMS AREAS 9

Bonding techniques for MEMS : Surface bonding , Anodic bonding , Silicon - on - Insulator , wire bonding , Sealing – Assembly of micro systems- RF MEMS - switches, active and passive components, Bio MEMS - Microfluidics, Digital Micro fluidics, Ink jet printer,- MOEMS - optical switch, optical cross-connect, tunable VCSEL, micro bolometers.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Understand the working principles of micro sensors and actuators

CO2: Understand the application of scaling laws in the design of micro systems

CO3: Understand the typical materials used for fabrication of micro machines

CO4: Understand the principles of standard micro fabrication techniques

CO5: Appreciate the challenges in the design and fabrication of RF,Bio, and MOEMS systems

Text Book(s):

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012

Reference Books:

1. Stephen D Senturia, ‘Microsystem Design’, Springer Publication, 2000
2. Marc J. Madou, ‘Fundamentals of Microfabrication: The Science of Miniaturization’, Second Edition , 2002.
3. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2001.
4. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.

22PAE15	HARDWARE SECURE COMPUTING	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. Describe the fundamental principles in Data security
2. Discuss the watermarking algorithms and its usage
3. Explain the physical attacks and Modular arithmetic security methods
4. Describe the memory based attacks and vulnerabilities using deceptive mechanisms
5. Discuss the methods of FPGA implementation of cryptographic algorithms

Course Content:

UNIT I INTRODUCTION TO CRYPTO ALGORITHMS 9

Cryptography basics, Cryptographic algorithms - Symmetric Key algorithms, Public Key algorithms and Hash Algorithms, Data Encryption Standards, Advanced Encryption Standards, RSA, BowFish

UNIT II DESIGN INTELLECTUAL PROPERTY PROTECTION 9

Introduction to IP Protection, Watermarking Basics, Watermarking Examples, Good Watermarks, Fingerprinting, Hardware Metering.

UNIT III PHYSICAL ATTACKS AND MODULAR EXPONENTIATION 9

Physical Attacks (PA) Basics, Physical Attacks and Countermeasures, Building Secure Systems, Modular Exponentiation (ME) Basics, ME in Cryptography, ME Implementation and Vulnerability, Montgomery Reduction.

UNIT IV ATTACKS AND COUNTER MEASURES 9

Introduction to Side Channel Attacks, Memory Vulnerabilities and Cache Attacks, Power Analysis, More Attacks and Countermeasures, Modified Modular Exponentiation, Hardware Trojan (HT) and Trusted IC, Hardware Trojan Taxonomy, Hardware Trojan Detection Overview, Hardware Trojan Detection Methods, Trusted IC Design with HT Prevention.

UNIT V EMERGING TECHNOLOGIES 9

FPGA Implementation of Crypto algorithms, Vulnerabilities and Countermeasures in FPGA Systems, Role of Hardware in Security and Trust, Physical Unclonable Functions (PUF) Basics, Reliability, Trust Platform Modules

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1:Understand the basics of Cryptography(K2)
CO2: Identify the mechanism of Data Integrity protection mechanisms(K2)
CO3: Analyze the counter measures for physical attacks and the use of Modular exponentiation(K2)
CO4: Study side channel attacks and Trojan-based attacks(K2)
CO5: Challenges in Realization using VLSI implementations(K2)

Text Book(s):

1. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, Hardware Security: Design, Threats, and Safeguards, CRC Press,2014
2. Doug Stinson, Cryptography Theory and Practice, CRC Press,2018

Reference Books:

1. Tehranipoor, Mohammad, Wang, Introduction to Hardware Security and Trust, Springer,2011.
2. Ted Huffmire, Handbook of FPGA Design Security, Springer,2010.
3. Stefan Mangard, Elisabeth Oswald, Thomas Popp, Power Analysis Attacks - Revealing the Secrets of Smart Cards, Springer,2007

22PAE16	CAD FOR VLSI DESIGN	L	T	P	C
		3	0	0	3
	Syllabus Version	V 0.1			

Course Objectives:

1. To introduce the VLSI design methodologies and design methods.
2. To introduce data structures and algorithms required for VLSI design.
3. To study algorithms for partitioning and placement.
4. To study algorithms for floor planning and routing.
5. To study algorithms for modeling, simulation and synthesis

Course Content:

UNIT I INTRODUCTION 9

Introduction to VLSI Design Methodologies – VLSI Design Cycle – New Trends in VLSI Design Cycle – Physical Design Cycle – New Trends in Physical Design Cycle – Design Styles – Review of VLSI Design Automation Tools

UNIT II DATA STRUCTURES AND BASIC ALGORITHMS 9

Introduction to Data Structures and Algorithms – Algorithmic Graph Theory and Computational Complexity – Tractable and Intractable Problems – General Purpose Methods for Combinatorial Optimization.

UNIT III ALGORITHMS FOR PARTITIONING AND PLACEMENT 9

Layout Compaction – Problem Formulation – Algorithms for Constraint Graph Compaction – Partitioning – Placement – Placement Algorithms.

UNIT IV ALGORITHMS FOR FLOORPLANNING AND ROUTING 9

Simulation – Gate Level Modeling and Simulation – Logic Synthesis and Verification – Binary Decision Diagrams – High Level Synthesis.

UNIT V MODELLING, SIMULATION AND SYNTHESIS 9

Simulation – Gate Level Modeling and Simulation – Logic Synthesis and Verification – Binary Decision Diagrams – High Level Synthesis.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: use various VLSI design methodologies

CO2: understand different data structures and algorithms required for VLSI design.

CO3: develop algorithms for partitioning and placement.

CO4: develop algorithms for floor planning and routing.

CO5: design algorithms for modeling, simulation and synthesis

Text Book(s):

1. Sabih H. Gerez, "Algorithms for VLSI Design Automation", Second Edition, Wiley-India, 2017.
2. Naveed a. Sherwani, "Algorithms for VLSI Physical Design Automation", 3rd Edition, Springer,2017

Reference Books:

1. Charles J. Alpert, Dinesh P. Mehta and Sachin S Sapatnekar, "Handbook of Algorithms forPhysical Design Automation, CRC Press, 1st Edition, 2.
2. N.a. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

22PAE17	SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. Understand static and dynamic characteristics of measurement systems.
2. Study various types of sensors.
3. Study different types of actuators and their usage
4. Study State-of-the-art digital and semiconductor sensors.

Course Content:

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS 9

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static and dynamic characteristics of measurement systems, zero-order, firstorder, and second-order measurement systems and response.

UNIT II SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

UNIT III SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

UNIT IV ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS 9

Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

UNIT V DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS **9**

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer Vibrating wire strain gages, vibrating cylinder sensors, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, MOSFET transistors, CCD imaging sensors, ultrasonic sensors, fiber-optic sensors.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Compare Actuators with various drive characteri
2. Evaluate digital sensors and semiconductor device sensors performance metrics.
3. Characterize the performance of Self-generating sensors.
4. Analyze the performance of self-generating Sensors.
5. Analyze the performance of resistive and reactive sensors.

Text Book(s):

1. Ian Sinclair, Sensors and Transducers, Elsevier, 3rd Edition, 2011
2. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011.

Reference Books:

1. Sensors and Actuators: Control System Instrumentation, Clarence W. de Silva CRC Press, 2007
2. Ramon PallásAreny, John G. Webster, “Sensors and Signal conditioning”, 2nd edition, John Wiley and Sons, 2000.
3. Jon Wilson , “Sensor Technology Handbook”, Newne 2004
4. Herman K.P. Neubrat, “Instrument Transducers – An Introduction to Their Performance and Design”, Oxford University Press. 22,1999
5. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.
6. D. Johnson, “Process Control Instrumentation Technology”, 8th Ed, 2014, John Wiley and Sons.
7. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006

22PAE18 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN

		L	T	P	C
22PAE18	**SIGNAL INTEGRITY FOR HIGH SPEED DESIGN**	**3**	**0**	**0**	**3**

Syllabus Version V 0.1

Course Objectives:

1. To identify sources affecting the speed of digital circuits
2. To introduce methods to improve the signal transmission characteristics

Course Content:

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave vs. circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion.

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9

Multi-conductor transmission-lines, coupling physics, per unit length parameters ,Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossless models.

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions , Parasitic inductance and capacitance , Transmission line losses – Rs, tanδ , routing parasitic, Common-mode current, differential-mode current , Connectors.

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO , DC power bus design , layer stack up, SMT decoupling ,, Logic families, power consumption, and system power delivery , Logic families and speed Package types and parasitic SPICE, IBIS models ,Bit streams, PRBS and filtering functions of link-path components , Eye diagrams , jitter , inter-symbol interference Bit-error rate ,Timing analysis.

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Identify sources affecting the speed of digital circuits.
2. Identify methods to improve the signal transmission characteristics
3. Characterize and model multiconductor transmission line
4. Analyze clock distribution system and understand its design parameters
5. Analyze nonideal effects of transmission line

Text Book(s):

1. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003.
2. Eric Bogatin , Signal Integrity – Simplified , Prentice Hall PTR, 2003.

Reference Books:

1. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handboo of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.
2. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.

22PAE19 **CONSUMER ELECTRONICS**

L	T	P	C
3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field Effect Transistors, Power control devices etc.,
2. To know about the working principle of LED, LCD and other Opto-electronic devices.
3. To introduce the concept of Sensors and voice controls.
4. To provide the knowledge on Smart home devices.
5. To gain knowledge on current communication technology.

Course Content:

UNIT I CONSUMER ELECTRONICS FUNDAMENTALS 9

History of Electronic Devices- Vacuum Tubes, Transistors, Integrated Circuits- Moorse Law, Semiconductor Devices, Diodes, Rectifiers, Transistors, Logic Gates, Combinational Circuits, ADC, DAC and Microprocessors, Microprocessor Vs Microcontrollers, Microcontrollers in consumer electronics, Energy management, Intelligent Building Perspective.

UNIT II ENTERTAINMENT ELECTRONICS 9

Audio systems: Construction and working principle of: Microphone, Loud speaker, AM and FM receiver, stereo, Home theatre. Display systems: CRT, LCD, LED and Graphics displays Video Players: DVD and Blue RAY. Recording Systems: Digital Cameras and Camcorders.

UNIT III SMART HOME - SENSORS 9

Technology involved in Smart home, Home Virtual Assistants- Alexa and Google Home. Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT IV HOME APPLIANCES 9

Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks.

UNIT V INTRODUCTION TO SMART OS AND COMMUNICATION 9

Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems. Cordless Telephones, Fax Machines, PDAs- Tablets, Smart Phones and Smart Watches.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Explain the V-I characteristic of diode, UJT and SCR. Describe the equivalence circuits of transistors.
2. Operate the basic electronic devices such as PN junction diode, Bipolar and Field Effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.
3. Gain knowledge on sensors and controls.
4. Emphasize the need for communication systems.
5. Explore the current technology and apply on home applications.

Text Book(s):

1. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2018.
2. Nick vandome, Smart homes in easy steps, - Master smart technology for your home 2018.

Reference Books:

1. Jordan Frith, " Smartphones as Locative Media ", Wiley. 2014.
2. Dennis C Brewer, " Home Automation", Que Publishing 2013
3. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2012.

22PAE20	ADVANCED MICROPROCESSORS AND MICROCONTROLLERS ARCHITECTURES	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To expose the students to the fundamentals of microprocessor architecture.
2. To explore the high performance features in CISC architecture
3. To familiarize the high performance features in RISC architecture
4. To introduce the basic features in Motorola microcontrollers.
5. To enable the students to understand PIC Microcontroller

Course Content:

UNIT I MICROPROCESSOR ARCHITECTURE 9

Instruction Set – Data 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.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM 9

CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

UNIT III HIGH PERFORMANCE RISC ARCHITECTURE – ARM 9

Organization of CPU – Bus architecture –Memory management unit - ARM instruction set- Thumb Instruction set- addressing modes – Programming the ARM processor

UNIT IV MSP430 16 - BIT MICROCONTROLLER 9

The MSP430 Architecture- CPU Registers - Instruction Set, On-Chip Peripherals - MSP430 - Development Tools, ADC - PWM - UART - Timer Interrupts - System design using MSP430Microcontroller.

UNIT V PIC MICROCONTROLLER 9

CPU Architecture – Instruction set – interrupts- Timers- I2C Interfacing –UART- A/D Converter – PWM and introduction to C-Compilers.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

- To understand the fundamentals of microprocessor architecture.
- To know and appreciate the high performance features in CISC architecture.
- To know and appreciate the high performance features in RISC architecture.
- To perceive the basic features in Motorola microcontrollers.
- To interpret and understand PIC Microcontroller.

Text Book(s):

1. Gene .H.Miller .” Micro Computer Engineering ”, Pearson Education , 2003.
2. John H.Davis , “MSP 430 Micro controller basics”, Eelsevier, 2008.

Reference Books:

1. Daniel Tabak , „‟ Advanced Microprocessors” McGraw Hill.Inc., 1995
2. James L. Antonakos , “ The Pentium Microprocessor”, Pearson Education , 1997.
3. Steve Furber , ‟ ARM System –On –Chip architecture”, Addision Wesley , 2000.
4. John .B.Peatman , “ Design with PIC Microcontroller” , Prentice hall, 1997.
5. James L.Antonakos, “An Introduction to the Intel family of Microprocessors”, Pearson Education 1999.
6. Barry.B.Breg, “The Intel Microprocessors Architecture , Programming and Interfacing “, PHI,2002. Valvano "Embedded Microcomputer Systems" Thomson Asia PVT LTD first reprint 2001.
7. Readings: Web links -- www.ocw.mit.edu, www.arm.com

22PAE21	BIOMEDICAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. Describe the properties and suitable models of biomedical signals Introduce the basic signal processing techniques in analyzing biomedical signals
2. Develop computational skills in filtering of biomedical signals
3. Develop an understanding on ECG signal compression algorithms
4. Develop an understanding on feature extraction of biomedical signals

Course Content:

UNIT I INTRODUCTION TO BIOMEDICAL SIGNALS 9

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. Electrocardiography: Basic electro cardiography, ECG lead systems, ECG signal characteristics. Signal Conversion :Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits

UNIT II SIGNAL AVERAGING 9

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. Adaptive Noise Cancelling: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering

UNIT III DATA COMPRESSION TECHNIQUES 9

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG

UNIT IV CARDIOLOGICAL SIGNAL PROCESSING 9

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Realtime ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor

UNIT V NEUROLOGICAL SIGNAL PROCESSING 9

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG, spike and wave detection

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

1. Possess skills necessary to analyze ECG and EEG Signals
2. Apply classical and modern filtering techniques for ECG and EEG Signals
3. Apply classical and modern compression techniques for ECG and EEG Signals
4. Develop an understanding on ECG feature extraction CO5: Develop an understanding on EEG feature extraction

Text Book(s):

1. John G Proakis, Dimitris and G. Manolakis, "Digital Signal Processing Principles algorithms, applications" PHI Third Edition. 2006
2. D C Reddy "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005

Reference Books:

1. Rangaraj M Rangayyan "Biomedical Signal Analysis – A case study approach" IEEE press series in biomedical engineering, First Edition, 2002
2. Willis J. Tompkins " Biomedical Digital Signal Processing", EEE, PHI, 2004
3. J G Webster "Medical Instrumentation: Application & Design", John Wiley & Sons Inc., 2001.

22PAE22	MODELING AND SYNTHESIS WITH HDL	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

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

Course Content:

UNIT I INTRODUCTION TO LOGIC DESIGN WITH VERILOG 7

Overview of Digital Design with Verilog HDL - Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block - Basic Concept- Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. Tasks and Functions

UNIT II LEVELS OF MODELING 12

Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types. Behavioral Modeling: Structured procedures, initial and always, blocking and non blocking statements, delay control, generate statement, event control, conditional statements, multiway branching, loops, sequential and parallel blocks.

UNIT III DESIGN OF DIGITAL LOGIC USING HDL 12

Design of combinational logic: adders, multiplexers, de-multiplexers, encoders and decoders, comparators, multipliers - Design of Sequential logic: Flip-flops, synchronous and Asynchronous counters, shift registers, Universal shift register, FSM and LFSR. (Using various Levels of Modeling)

UNIT IV LOGIC SYNTHESIS AND DESIGN FLOW 7

Logic Synthesis with verilog HDL-Synthesis Design flow, RTL and Test Bench Modeling Techniques and Timing and Path Delay Modeling, Timing Checks, Switch Level Modeling

UNIT V PROGRAMMABLE LOGIC DEVICES 7

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

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: demonstrate knowledge on HDL design flow and digital circuits design.
CO2:design and develop the combinational and sequential circuits using various modeling
CO3: solving algorithmic state machines using hardware description language
CO4: analyze the process of synthesizing the combinational and sequential descriptions
CO5:know the advantages of programmable logic devices and their description in Verilog

Reference Books:

1. Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003.
2. Michael D Ciletti - Advanced Digital Design with the VERILOG HDL, 2ND Edition, PHI, 2009.
3. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.
4. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.

22PAE23	DEEP LEARNING	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. Develop and Train Deep Neural Networks.
2. Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
3. Build and train RNNs, work with NLP and Word Embeddings
4. The internal structure of LSTM and GRU and the differences between them
5. The Auto Encoders for Image Processing

Course Content:

UNIT I DEEP LEARNING CONCEPTS 6

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS 9

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Preprocessing for neural networks, Feature Engineering. Overfitting and Under fitting. Hyper parameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK 10

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, and Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN 10

About NLP & its Toolkits. Language Modeling. Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 9

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Auto encoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Auto encoders for Feature Extraction. Auto Encoders for Classification. Denoising Auto encoders. Sparse Auto encoders

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to

CO1: Feature Extraction from Image and Video Data

CO2: Implement Image Segmentation and Instance Segmentation in Images

CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)

CO4: Traffic Information analysis using Twitter Data

CO5: Auto encoder for Classification & Feature Extraction

Reference Books:

1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

22PAE24	ADVANCED DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Syllabus Version V 0.1

Course Objectives:

1. To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
2. To understand the image segmentation and representation techniques.
3. To understand how image are analyzed to extract features of interest.
4. To introduce the concepts of image registration and image fusion.
5. To analyze the constraints in image processing when dealing with 3D data sets.

Course Content:

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Morphological image processing.

UNIT II SEGMENTATION 9

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature-based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

UNIT III FEATURE EXTRACTION 9

First and second order edge detection operators, Phase congruency, Localized feature extraction detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Run length features, Fractal model-based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSIO 9

Registration- Pre-processing, Feature selection-points, lines, regions and templates Feature Correspondence-Point pattern matching, Line matching, region matching Template matching. Transformation functions-Similarity transformation and Affine Transformation. Resampling-Nearest Neighbour and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transforms, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION 9

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, multiply connected surfaces, Image processing in 3D, Measurements on 3D images

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to
CO1: To understand image formation and the role of human visual system plays in perception of gray and color image data.
CO2: To apply image processing techniques in both the spatial and frequency (Fourier) domains.
CO3: To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
CO4: To conduct independent study and analysis of feature extraction techniques.
CO5: To understand the concepts of image registration and image fusion.
CO6:To analyze the constraints in image processing when dealing with 3D data sets and to apply image processing algorithms in practical applications.

Reference Books:

1. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.
2. Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press, 2008.
3. Ardeshir Goshtasby, “2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications”, John Wiley and Sons, 2005.
4. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing', Pearson, Education, Inc., Second Edition, 2004.
5. Anil K. Jain, , Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.
6. Rick S.Blum, Zheng Liu,“ Multisensor image fusion and its Applications“, Taylor & Francis, 2006.

22PAE25	**PCB DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Syllabus Version V 0.1

Course Objectives:

1. Understand the need for PCB Design and steps involved in PCB Design and Fabrication process.
2. Familiarize Schematic and layout design flow using Electronic Design Automation (EDA) Tools.
3. Understand basic concepts of transmission line, crosstalk and thermal issues
4. Design (schematic and layout) PCB for analog circuits, digital circuits and mixed circuits.
5. Schematic creation & interpretation

Course Content:

UNIT I INTRODUCTION TO PRINTED CIRCUIT BOARD 9

Introduction to Printed circuit board: fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.

UNIT II DESIGN RULES FOR PCB 9

Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications, PCB Technology Trends: Multilayer PCBs. Multiwire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.

UNIT III INTRODUCTION TO ELECTRONIC DESIGN AUTOMATION(EDA) TOOLS FOR PCB DESIGNING 9

Introduction to Electronic design automation(EDA) tools for PCB designing: Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design.

UNIT IV INTRODUCTION PRINTED CIRCUIT BOARD PRODUCTION TECHNIQUES 9

Introduction printed circuit board production techniques: Photo printing, film-master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations

UNIT V PCB DESIGN FOR EMI/EMC 9

PCB design for EMI/EMC: Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards.

TOTAL LECTURE PERIODS 45 Periods

Expected Course Outcome: On completion of the course, the student is expected to
CO1: Appreciate the necessity and evolution of PCB, types and classes of PCB.
CO2: Understand the steps involved in schematic, layout, fabrication and assembly process of PCB design.
CO3: Apply advanced techniques, skills and modern tools for designing and fabrication of PCBs.
CO4: Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
CO5: Design (schematic and layout) and fabricate PCB for simple circuits.

Reference Books:

1. Printed circuit board design, fabrication assembly and testing by R. S. Khandpur, Tata

McGraw Hill 2006
2. Printed Circuits Handbook, Sixth Edition,by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016
3. Complete PCB Design Using OrCAD Capture and PCB Editor,Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition 2009.
4. Introduction to System-on-Package, Rao R, Tummala, & Madhavan Swaminathan, McGraw Hill, 2008
5. EMC and Printed circuit board, Design theory and layout, Mark I Montrose IEEE compatibility society
6. Electronic Product Design Volume-I by S D Mehta, S Chand Publications

22OBM01 **SECURITY PRACTICES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY 9

Model of network security – Security attacks, services and mechanisms – OSI security architecture – A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.

UNIT II NETWORK SECURITY 9

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.

UNIT III SECURITY MANAGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY 9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

COURSE OUTCOMES:

CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

TOTAL: 45 PERIODS

REFERENCES

1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022
3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
4. Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
5. John Sammons, "The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics", Syngress, 2012
6. Cory Altheide and Harlan Carvey, "Digital Forensics with Open Source Tools",2011 Syngress, ISBN: 9781597495875.
7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.

22OBM02	CLOUD COMPUTING TECHNOLOGIES	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

Basics of Virtual Machines - Process Virtual Machines - System Virtual Machines -Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization — Hardware Maximization - Architectures - Virtualization Management - Storage Virtualization - Network Virtualization- Implementation levels of virtualization - virtualization structure - virtualization of CPU, Memory and I/O devices - virtual clusters and Resource Management – Virtualization for data center automation

UNIT II CLOUD PLATFORM ARCHITECTURE 12

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges

UNIT III AWS CLOUD PLATFORM - IAAS 9

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV PAAS CLOUD PLATFORM 9

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops

UNIT V PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

COURSE OUTCOMES:

CO1: Employ the concepts of virtualization in the cloud computing

CO2: Identify the architecture, infrastructure and delivery models of cloud computing

CO3: Develop the Cloud Application in AWS platform

CO4: Apply the concepts of Windows Azure to design Cloud Application

CO5: Develop services using various Cloud computing programming models.

TOTAL: 45 PERIODS

REFERENCES

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.
4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.
5. Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
6. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

22OBM03 **BLOCKCHAIN TECHNOLOGIES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN 9

Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II BITCOIN AND CRYPTOCURRENCY 9

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

UNIT III INTRODUCTION TO ETHEREUM 9

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, , Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 10

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

UNIT V BLOCKCHAIN APPLICATIONS 8

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand and explore the working of Blockchain technology

CO2: Analyze the working of Smart Contracts

CO3: Understand and analyze the working of Hyperledger

CO4: Apply the learning of solidity to build de-centralized apps on Ethereum

CO5: Develop applications on Blockchain

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency

Technologies: A Comprehensive Introduction” Princeton University Press, 2016
3. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014. .
4. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017.

22OBM04 DESIGN THINKING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I UX LIFECYCLE TEMPLATE 8

Introduction. A UX process lifecycle template. Choosing a process instance for your project. The system complexity space. Meet the user interface team. Scope of UX presence within the team. More about UX lifecycles. Business Strategy. Value Innovation. Validated User Research. Killer UX Design. The Blockbuster Value Proposition. What Is a Value Proposition?.

UNIT II CONTEXTUAL INQUIRY 10

The system concept statement. User work activity data gathering. Look for emotional aspects of work practice. Abridged contextual inquiry process. Data-driven vs. model-driven inquiry. Organizing concepts: work roles and flow model. Creating and managing work activity notes. Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III DESIGN THINKING, IDEATION, AND SKETCHING 9

Design-informing models: second span of the bridge . Some general “how to” suggestions. A New example domain: slideshow presentations. User models. Usage models. Work environment models. Barrier summaries. Model consolidation. Protecting your sources. Abridged methods for design-informing models extraction. Design paradigms. Design thinking. Design perspectives. User personas. Ideation. Sketching

UNIT IV UX GOALS, METRICS, AND TARGETS 8

Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures. Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed results. Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

UNIT V ANALYSING USER EXPERIENCE 10

Sharpening Your Thinking Tools. UX Research and Strength of Evidence. Agile Personas. How to Prioritize Usability Problems. Creating Insights, Hypotheses and Testable Design Ideas. How to Manage Design Projects with User Experience Metrics. Two Measures that Will Justify Any Design Change. Evangelizing UX Research. How to Create a User Journey Map. Generating Solutions to Usability Problems. Building UX Research Into the Design Studio Methodology. Dealing with Common objections to UX Research. The User Experience Debrief Meeting.

Creating a User Experience Dashboard.

SUGGESTED ACTIVITIES:

1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

COURSE OUTCOMES:

CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

TOTAL : 45 PERIODS

REFERENCES

1. UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work, Westley Knight. Apress, 2018
2. The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson, Pardha Pyla. Morgan Kaufmann, 2012
3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers, Edward Stull. Apress, 2018
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

22OBM05	PRINCIPLES OF MULTIMEDIA	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION 9

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents, Multimedia Tasks and Concerns, Production, sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

Suggested Activities:

1. Flipped classroom on media Components.
2. External learning - Interactive presentation.

Suggested Evaluation Methods:

1. Tutorial - Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA 9

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations - data types, file formats, color models; video - color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:

1. Flipped classroom on different file formats of various media elements.
2. External learning - Adobe after effects, Adobe Media Encoder, Adobe Audition.

Suggested Evaluation Methods:

1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS 9

Authoring Tools - Features and Types - Card and Page Based Tools - Icon and Object Based Tools - Time Based Tools - Cross Platform Authoring Tools - Editing Tools - Painting and Drawing Tools - 3D Modeling and Animation Tools - Image Editing Tools - Sound Editing Tools – Digital Movie Tools.

Suggested Activities:

1. Flipped classroom on multimedia tools.
2. External learning - Comparison of various authoring tools.

Suggested Evaluation Methods:

1. Tutorial - Audio editing tool.
2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS 9

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard - JPEG 2000, basic audio compression - ADPCM, MPEG Psychoacoustics, basic Video compression techniques - MPEG, H.26X - Multimedia Database System - User Interfaces - OS Multimedia Support - Hardware Support - Real Time Protocols - Play Back Architectures - Synchronization - Document Architecture - Hypermedia Concepts: Hypermedia Design - Digital Copyrights, Content analysis.

Suggested Activities:

1. Flipped classroom on concepts of multimedia hardware architectures.

2. External learning - Digital repositories and hypermedia design.

Suggested Evaluation Methods:

1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial - Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS 9

ADDIE Model - Conceptualization - Content Collection - Storyboard-Script Authoring Metaphors – Testing - Report Writing - Documentation. Multimedia for the web and mobile platforms. Virtual Reality, Internet multimedia content distribution, Multimedia Information sharing - social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

Suggested Activities:

1. External learning - Game consoles.
2. External learning - VRML scripting languages.

Suggested Evaluation Methods:

1. Demonstration of simple interactive games.
2. Tutorial - Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:

1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, “Fundamentals of Multimedia”, Springer, Third Edition, 2021.
2. Prabhat K.Andleigh, Kiran Thakrar, “MULTIMEDIA SYSTEMS DESIGN”, Pearson Education, 2015.
3. Gerald Friedland, Ramesh Jain, “Multimedia Computing”, Cambridge University Press, 2018. (digital book)
4. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw-Hill Education, 2017