KIT - Kalaignarkarunanidhi Institute of Technology

An Autonomous Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE, MECH & MBA)

An ISO 9001 : 2015 Certified Institution, Coimbatore - 641 402.

Regulations, Curriculum & Syllabus - 2023

(For Students admitted from the Academic Year 2023-24 and onwards)

MASTER OF ENGINEERING DEGREE

IN

APPLIED ELECTRONICS

Department of Electronics and Communication Engineering

PG-Applied Electronics

	Conceptual Framework (For Students admitted from theAcademicYear2023-24onwards)	

Semester	**Level of Course**	**Hours / Week**	**No of Courses**	**Range of Credits / Courses**	**Total Credits**
PART I					
A – Foundation Courses					
I	Foundation Courses **(FC)**	4	1	4	4
B – Professional Core Courses					
I to III	Professional Core**(PC)**	3	11	2-3	31
C – Elective Courses					
I to III	Professional Elective**(PE)**	3	5	3	15
D – Project Work					
III & IV	Project Work**(PW)**	12-24	2	6-12	18
PART II- Career Enhancement Courses (CEC)					
II	Article Writing and Seminar	2	1	1	1
Total Credit					**69**

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Curriculum and Scheme of Assessment

(For Students admitted from the Academic Year 2023-24 and onwards)

Semester I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23MAT101	Applied Mathematics for Electronics Engineers	FC	4	3	0	0	4	40	60	100
M23AET101	Advanced Digital Signal Processing	PC	3	3	0	0	3	40	60	100
M23AET102	Sensors, Actuators and Interface Electronics	PC	3	3	0	0	3	40	60	100
M23AET103	Advanced Digital System Design	PC	3	3	0	0	3	40	60	100
M23CST101	Research methodology and IPR	PC	3	3	0	0	3	40	60	100
	Professional Elective - I	PE	3	3	0	0	3	40	60	100
Practical										
M23AEP101	Electronics System Design Laboratory - I	PC	4	0	0	4	2	60	40	100
Total credits to be earned							**21**			

Semester II										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23AET201	Soft Computing and Optimization Techniques	PC	3	3	0	0	3	40	60	100
M23AET202	Embedded System Design	PC	3	3	0	0	3	40	60	100
M23AET203	Hardware-Software Co-Design	PC	3	3	0	0	3	40	60	100
M23AET204	Power Electronics and Applications	PC	3	3	0	0	3	40	60	100
	Professional Elective - II	PE	3	3	0	0	3	40	60	100
	Professional Elective - III	PE	3	3	0	0	3	40	60	100
Practical										
M23AEP201	Electronics System Design Laboratory - II	PC	4	0	0	4	2	60	40	100
M23CEP203	Article Writing and Seminar	CEC	2	0	0	2	1	100	-	100
Total credits to be earned							**21**			

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Semester III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23AET301	Advanced Microprocessors and Microcontrollers Architecture	PC	3	3	0	0	3	40	60	100
	Professional Elective - IV	PE	3	3	0	0	3	40	60	100
	Professional Elective - V	PE	3	3	0	0	3	40	60	100
Practical										
M23AEP301	Project Work (Phase I)	PW	12	0	0	12	6	40	60	100
Total credits to be earned							**15**			

Semester IV										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Practical										
M23AEP401	Project Work (Phase II)	PW	24	0	0	24	12	40	60	100
Total credits to be earned							**12**			

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FOUNDATION COURSES(FC)											
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical											
M23MAT101	Applied Mathematics for Electronics Engineers	FC	4	3	1	0	4	40	60	100
Total credits to be earned							**4**			

PROFESSIONAL CORE(PC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23AET101	Advanced Digital Signal Processing	PC	3	3	0	0	3	40	60	100
M23AET102	Sensors, Actuators and Interface Electronics	PC	3	3	0	0	3	40	60	100
M23AET103	Advanced Digital System Design	PC	3	3	0	0	3	40	60	100
M23CST101	Research methodology and IPR	PC	3	3	0	0	3	40	60	100
M23AEP101	Electronics System Design Laboratory-I	PC	4	0	0	0	2	60	40	100
M23AET201	Soft Computing and Optimization Techniques	PC	3	3	0	0	3	40	60	100
M23AET202	Embedded System Design	PC	3	3	0	0	3	40	60	100
M23AET203	Hardware-Software Co-Design	PC	3	3	0	0	3	40	60	100
M23AET204	Power Electronics and Applications	PC	3	3	0	0	3	40	60	100
M23AEP201	Electronics System Design Laboratory-II	PC	4	0	0	0	2	60	40	100
M23AET301	Advanced Microprocessors and Microcontrollers Architecture	PC	3	3	0	0	3	40	60	100
Total credits to be earned							**31**			

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PROFESSIONAL ELECTIVES(PE)											
Semester– I											
Elective – I											
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory / Theory with Practical										
M23VDT101	CMOS Digital VLSI Design	PE	3	3	0	0	3	40	60	100
M23AEE101	Computer Architecture and Parallel Processing	PE	3	3	0	0	3	40	60	100
M23AEE102	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3	40	60	100
M23AEE103	Neural Networks and Applications	PE	3	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES(PE)											
Semester – II											
Elective – II											
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory / Theory with Practical										
M23VDT103	CAD for VLSI Circuits	PE	3	3	0	0	3	40	60	100
M23VDE203	Nano Electronics	PE	3	3	0	0	3	40	60	100
M23AEE201	High Performance Networks	PE	3	3	0	0	3	40	60	100
M23AEE202	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES(PE)											
Semester – II											
Elective – III											
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory / Theory with Practical										
M23AEE203	RF System Design	PE	3	3	0	0	3	40	60	100
M23AEE204	Speech and Audio Signal Processing	PE	3	3	0	0	3	40	60	100
M23VDT201	Device Modeling	PE	3	3	0	0	3	40	60	100
M23AEE205	Robotics	PE	3	3	0	0	3	40	60	100

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PROFESSIONAL ELECTIVES(PE)											
Semester– III											
Elective – IV											
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical											
M23AEE301	DSP Processor Architecture and Programming	PE	3	3	0	0	3	40	60	100
M23AEE302	Wavelets and Multi resolution Processing	PE	3	3	0	0	3	40	60	100
M23VDE204	System on Chip Design	PE	3	3	0	0	3	40	60	100
M23VDE305	MEMS and NEMS	PE	3	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES(PE)											
Semester–III											
Elective –V											
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical											
M23VDE306	Machine Learning and Algorithm design	PE	3	3	0	0	3	40	60	100
M23AEE303	Advanced Digital Image Processing	PE	3	3	0	0	3	40	60	100
M23AEE304	Pattern Recognition	PE	3	3	0	0	3	40	60	100
M23AEE305	Secure Computing Systems	PE	3	3	0	0	3	40	60	100

PROJECT WORK(PW)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23AEP301	Project Work (Phase I)	PW	12	0	0	12	6	40	60	100
M23AEP401	Project Work (Phase II)	PW	24	0	0	24	12	40	60	100

CAREER ENHANCEMENT COURSE(CEC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23CEP203	Article Writing and Seminar	CEC	2	0	0	2	1	40	60	100

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M.E. AE	M23MAT101 APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in electronics engineering.
2.	To extend matrix theory in the field of communication engineering.
3.	To understand the basic concepts of probability and random variables to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
4.	To understand the concept of dynamic programming and apply in communication networks**.**
5.	To understand the basic concepts of Queueing Models and to apply in real life engineering problems.

UNIT – I FUZZY LOGIC	12
Classical logic – Multi valued logics - Fuzzy propositions – Fuzzy quantifiers.	

UNIT – II MATRIX THEORY	12
Cholesky decomposition - Generalized Eigenvectors - Canonical basis – QR factorization – Least squares method - Singular value decomposition.	

UNIT – III 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 and Normal distributions (MGF Derivation for each distribution).	

UNIT – IV DYNAMIC PROGRAMMING	12
Dynamic programming - Principle of optimality - Forward and backward recursion -Applications of dynamic programming: Shortest distance Problem in communication networks - Problems of dimensionality.	

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UNIT – V QUEUEING MODELS	12
Poisson Process - Markovian queues - Single and multi server models: M/M/1, M/M/C models with infinite and finite capacity - Little's formula - M/G/1 queue - Pollaczek Khinchine formula – Simple problems.	
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Develop Fuzzy rules, fuzzy logic, fuzzy propositions and fuzzy quantifiers relationships and its application in fuzzy sets.
CO2	Make use of various methods in matrix theory to solve system of linear equations.
CO3	Identify moments, standard distributions of discrete and continuous random variables.
CO4	Apply the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.
CO5	Demonstrate the queueing models and expose the basic characteristic features of a queueing system.

Reference Books	
1.	Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw Hill, 2nd Edition, 2011.
2.	George, J. Klir. and Yuan, B., "Fuzzy sets and Fuzzy logic, Theory and Applications", Pearson Education, India, 1st Edition, 2015.
3.	Gross, D., Shortle J. F., Thompson, J.M., and Harris, C. M., "Fundamentals of Queueing Theory", John Wiley, 4th Edition 2014.
4.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5.	Taha, H.A., "Operations Research: An Introduction", Pearson education, Asia, New Delhi, 9th Edition, 2016.

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M.E.	M23AET101- ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To comprehend mathematical description and modeling of discrete time random signals.
2.	To conversant with important theorems and algorithms.
3.	To learn relevant figures of merit such as power, energy, bias and consistency
4.	To learn about Adaptive filters
5.	To familiar with estimation, equalization and filtering concepts.

UNIT-I	DISCRETE RANDOM SIGNAL PROCESSING	9

Wide sense stationary process – Ergodic process – Mean – Variance - Auto-correlation and Auto-correlation matrix - Properties - Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem–Finite Data records, Simulation of uniformly distributed/Gaussian distributed white noise – Simulation of Sine wave mixed with Additive White Gaussian Noise

UNIT-II	SPECTRUM ESTIMATION	9

Bias and Consistency of estimators - Non-Parametric methods - Correlation method - Co- variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation

UNIT-III	LINEAR ESTIMATION AND PREDICTION	9

Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method - Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion – Wiener filter - Discrete Wiener Hoff equations – Mean square error.

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UNIT-IV	ADAPTIVE FILTERS	9
Recursive estimators - Kalman filter - Linear prediction – Forward prediction and Backward prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equation		
UNIT-V	**MULTIRATE DIGITAL SIGNAL PROCESSING**	**9**
FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS – Sliding window RLS - Simplified IIR LMS Adaptive filter		
		Total Instructional hours:45

Course Outcomes :Students will be able to	
CO1	Outline various properties of random process
CO2	Explain various spectrum estimation methods
CO3	Explain various linear estimation and prediction methods
CO4	Design various prediction systems for adaptive filters
CO5	Design models for adaptive equalization and filtering.

Reference Books	
1.	John G.Proakis, Dimitris G.Manolakis,“Digital Signal Processing”,Prentice Hall of India,NewDelhi,2005.
2.	Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley andSonsInc.,NewYork,2006.
3.	P.P.Vaidyanathan, “Multirate Systems and Filter Banks”,Prentice Hall,1992.
4.	S.Kay, ”Modern spectrum Estimation theory and application”,Prentice Hall, Englehood Cliffs,NJ1988.
5.	SimonHaykin, “Adaptive Filter Theory”, Prentice Hall, Englehood Cliffs,NJ1986.
6.	Sophoncles J. Orfanidis, “Optimum Signal Processing“,McGraw-Hill,2000.

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M.E.	M23AET102- SENSORS, ACTUATORS AND INTERFACE ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand static and dynamic characteristics of measurement systems.
2.	To study various types of sensors.
3.	To study various types of Amplifiers.
4.	To study different types of actuators
5.	To 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-GENERATINGSENSORS	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: synchro's, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.		
UNIT-V	**DIGITAL SENSOR 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 Instructional hours: 45	

Course Outcomes: Students will be able to	
CO1	Outline the concepts of measurement systems
CO2	Explain the resistive and reactive sensors
CO3	Explain the self-generating sensors
CO4	Analyze the characteristics of actuators
CO5	Examine about digital and semiconductor sensors

Reference Books	
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.

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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.	HermanK.P.Neubrat, "Instrument Transducers–An Introduction toTheir Performance and Design", Oxford University Press.
7.	IanSinclair, "Sensors and Transducers", Elsevier, 3rd Edition,2011.
8.	JonWilson,"Sensor Technology Handbook", Newone 2004.
9.	KevinJames, "PC Interfacing and Data acquisition", Elsevier, 2011.
10	Ramon Pallás Areny, John G. Webster, "Sensors and Signal conditioning",2nd Edition, John Wiley and Sons,2000
11.	Clarence W.deSilva, "Sensors and Actuators: Control System Instrumentation", CRC Press, 2007

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M.E.	M23AET103- ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce methods to analyze and design synchronous sequential circuits.
2.	To introduce methods to analyze and design asynchronous sequential circuits.
3.	To introduce fault diagnosis and testing algorithms.
4.	To introduce the architectures of programmable devices
5.	To introduce design and implementation of digital circuits using programming tools

UNIT - I	SEQUENTIAL CIRCUIT DESIGN	9

Analysis of clocked synchronous sequential circuits and modeling- 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	9

Analysis of asynchronous sequential circuit – flow table reduction-races-state assignment-transition table and problems in transition table- design of asynchronous sequential circuit-Static, dynamic and essential hazards – data synchronizers – mixed operating mode asynchronous circuits – designing vending machine controller.

UNIT - III	FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS	9

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

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UNIT - IV	SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES	9
Programming logic device families – Designing a synchronous sequential circuit using PLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA-Xilinx 4000.		

UNIT - V	SYSTEM DESIGN USING VERILOG	9
Hardware Modelling with Verilog HDL – Logic System, Data Types and Operators For Modelling in Verilog HDL - Behavioural Descriptions in Verilog HDL – HDL Based Synthesis– Synthesis of Finite State Machines– structural modeling – compilation and simulation ofVerilog code –Test bench - Realization of combinational and sequential circuits using Verilog – Registers – counters – sequential machine – serial adder – Multiplier- Divider – Design of simple microprocessor.		
		Total Instructional hours:45

Course Outcomes : Students will be able to	
CO1	Analyze and design synchronous sequential digital circuits
CO2	Analyze and design asynchronous sequential digital circuits
CO3	Design fault diagnosis system for testing various faults
CO4	Identify the programmable devices for system design
CO5	Design and implement digital circuits of industry standards by using programming tools

Reference Books	
1.	Charles H. Roth Jr, " Fundamentals of Logic Design", Thomson Learning,2004
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.	NripendraNBiswas, "Logic Design Theory", Prentice Hall of India, 2001.
5.	Parag K. Lala, "Fault Tolerant and Fault Testable Hardware Design", BS Publications, 2002.
6.	ParagK.Lala, " Digital system Design using PLD", BS Publications, 2003.
7.	S.Palnitkar, " Verilog HDL – A Guide to Digital Design and Synthesis", Pearson, 2003.

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M.E.	M23CST101 - RESEARCH METHODOLOGY AND IPR (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection.

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.

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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 Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO2	Understand research problem formulation & Analyze research related information and Follow research ethics.
CO3	Correlate the results of any research article with other published results. Write a review article in the field of engineering.
CO4	Appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Text Books	
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.

Reference Books	
1.	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
2.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

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PROFESSIONAL ELECTIVE- I

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M.E.	M23VDT101-CMOS DIGITAL VLSI DESIGN (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the principle of operation of CMOS inverter.
2.	To study the concept of combinational logic circuits.
3.	To study the concept of sequential logic circuits.
4.	To introduce the architectures of VLSI system.
5.	To learn about the interconnect and clocking process.

UNIT-I	MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER	9

MOS(FET)Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, Process Variations, Technology Scaling, Internet Parameter and electrical wise models CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy and Energy Delay parameters.

UNIT-II	COMBINATIONAL LOGIC CIRCUITS	9

Propagation Delays, Stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT-III	FIELD EFFECT TRANSISTORS	9

Drain and Transfer characteristics, Current equations, Pinch off voltage and significance of JFET, Drain and Transfer Characteristics, Threshold voltage, Channel length modulation of MOSFET, Comparison of MOSFET with JFET.

UNIT-IV	SPECIAL SEMICONDUCTOR DEVICES	9

MESFET, FINFET, PINFET, CNTFET, Schottky barrier diode, Zener diode, Varactor diode, Tunnel diode, LASER diode and LDR.

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UNIT-V	POWER DEVICES AND DISPLAY DEVICES	9
UJT, SCR, Diac, Triac, Power BJT, LED, LCD, Phototransistor, Opto Coupler, Solar cell.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Explain the V-I characteristic of PN diode
CO2	Describe the models and equivalence circuits of Bipolar Junction Transistors
CO3	Explain the characteristic of Field Effect Transistors
CO4	Operate the Special Semiconductor Devices such as MESFET, FINFET, LASER diode and LDR
CO5	Operate the basic electronic devices such as power Bipolar Transistors, Power control devices, LED, LCD and other Optoelectronic devices

Text Books	
1.	Jan Rabaey, Anantha Chandrakasan, B Nikolic, “Digital Integrated Circuits: A Design Perspective”. Second Edition, Feb 2003, Prentice Hall of India.
2.	Jacob Baker “CMOS: Circuit Design, Layout, and Simulation, Third Edition”, Wiley IEEE Press 2010 3rd Edition.

Reference Books	
1.	M J Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997.
2.	N.Weste, K. Eshraghian, “Principles of CMOS VLSI Design”. Second Edition, 1993 Addision Wesley.

Approved by BoS Chairman

M.E.	M23AEE101-COMPUTERARCHITECTURE AND PARALLEL PROCESSING (Common to AE&VLSI)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study various types of processor architectures and the importance of scalable architectures.
2.	To introduce parallel processing and pipelining.
3.	To learn about the memory hierarchy
4.	To study the multiprocessor architecture
5.	To study the multicore architecture

UNIT-I	COMPUTER DESIGN AND PERFORMANCE MEASURES	9

Fundamentals of Computer Design – Parallel and Scalable Architectures – Multiprocessors– Multi-vector and SIMD architectures – Multithreaded architectures – Stanford Dash multiprocessor – KSR1 - Data-flow architectures - Performance Measures.

UNIT-II	PARALLEL PROCESSING, PIPELINING AND ILP	9

Instruction Level Parallelism and Its Exploitation - Concepts and Challenges - Pipelining processors -Overcoming Data Hazards with Dynamic Scheduling – Dynamic Branch Prediction - Speculation - Multiple Issue Processors - Performance and Efficiency in Advanced Multiple Issue Processors.

UNIT-III	MEMORY HIERARCHY DESIGN	9

Memory Hierarchy - Memory Technology and Optimizations – Cache memory – Optimizations of Cach Performance – Memory Protection and Virtual Memory - Design of Memory Hierarchies.

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UNIT-IV	MULTIPROCESSORS	9
Symmetric and distributed shared memory architectures – Cache coherence issues – Performance Issues – Synchronization issues – Models of Memory Consistency - Interconnection networks – Buses, crossbar and multi-stage switches.		

UNIT-V	MULTI-CORE ARCHITECTURES	9
Software and hardware multithreading – SMT and CMP architectures – Design issues – Case-studies – Intel Multi-core architecture – SUN CMP architecture – IBM cell architecture–hp architecture.		
Total Instructional hours:45		

Course Outcomes: Students will be able to	
CO1	Explain the multiprocessors and its performance measure
CO2	Explain the concept of parallel processing and pipelining
CO3	Analyze about the memory hierarchy design
CO4	Outline the issues related to multiprocessors
CO5	Compare multicore architectures
Text Books	
1.	A David E.Culler,JaswinderPalSingh,“Parallel Computing Architecture: A hardware /software approach”, MorganKaufmann / Elsevier,1997
2.	Dimitrios Soudris, Axel Jantsch, "Scalable Multi-core Architectures: Design Methodologies and Tools", Springer, 2012.

Reference Books	
1.	Hwang Briggs,“ Computer Architecture and parallel processing”,McGrawHill,1984.
2.	JohnL.Hennessey and David A.Patterson,“ Computer Architecture– A quantitative approach”,MorganKaufmann/Elsevier,4th.Edition,2007.

Approved by BoS Chairman

M.E.	M23AEE102- ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the basics of EMI.
2.	To learn the coupling mechanism.
3.	To introduce the problems in EMI.
4.	To study the different standards.
5.	To learn the measurement techniques for immunity.

UNIT-I	BASIC THEORY	9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC Engineering Application.

UNIT-II	COUPLING MECHANISM	9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT-III	EMI MITIGATION TECHNIQUES	9

Working principle of Shielding and Murphy"s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient Protection.

UNIT-IV	STANDARD AND REGULATION	9
Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.		

UNIT-V	EMI TEST METHODS AND INSTRUMENTATION	9
Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.		
Total Instructional hours:45		

Course Outcomes: Students will be able to	
CO1	Explain the multiprocessors and its performance measure
CO2	Explain the concept of parallel processing and pipelining
CO3	Analyze about the memory hierarchy design
CO4	Outline the issues related to multiprocessors
CO5	Compare multicore architectures

Text Books	
1.	A David E.Culler,JaswinderPalSingh,“Parallel Computing Architecture: A hardware /software approach”, MorganKaufmann / Elsevier,1997
2.	Dimitrios Soudris, Axel Jantsch, "Scalable Multi-core Architectures: Design Methodologies and Tools", Springer, 2012.

Reference Books	
1.	Hwang Briggs,“ Computer Architecture and parallel processing”,McGrawHill,1984.
2.	JohnL.Hennessey and David A.Patterson,“ Computer Architecture– A quantitative approach”,MorganKaufmann/Elsevier,4th.Edition,2007.

Approved by BoS Chairman

M.E.	M23AEE103 - NEURAL NETWORKS AND APPLICATIONS (Common to AE & VLSI)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the artificial neural network concepts.
2.	To study various types of artificial neural network architectures.
3.	To study advanced artificial neural network concepts.

UNIT-I	INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS	9
Neuro-physiology - General Processing Element - ADALINE - LMS learning rule - MADALINE – MR2 training algorithm.		

UNIT-II	BPN AND BAM	9
Back Propagation Network - updating of output and hidden layer weights -application of BPN — associative memory - Bi-directional Associative Memory - Hopfield memory -traveling sales man problem		

UNIT-III	SIMULATED ANNEALING AND CPN	9
Annealing, Boltzmann machine - learning - application - Counter Propagation network - architecture -training - Applications.		

UNIT-IV	SOM AND ART	9
Self organizing map - learning algorithm - feature map classifier - applications - architecture of Adaptive Resonance Theory - pattern matching in ART network.		

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UNIT-V	NEOCOGNITRON	9
Architecture of Neocognitron - Data processing and performance of architecture of spacio – temporal networks for speech recognition.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Explain the concepts of neural networks and different training / learning algorithms
CO2	Design BPNN to solve real time problems
CO3	Apply the concept of counter propagation network for various applications
CO4	Illustrate problem-solving based on pattern matching with specified Self Organizing Map algorithm
CO5	Apply spatial-temporal networks for speech recognition

Text Books	
1.	J.A.Freeman and B.M.Skapura, "Neural Networks, Algorithms Applications and Programming Techniques", Addison-Wesely, 2003.
2.	Laurene Fausett, "Fundamentals of Neural Networks: Architecture, Algorithms and Applications", Prentice Hall, 2004

Reference Books	
1.	Simon Haykin, “Neural Networks & Learning Machines”, third edition Pearson Education 2011.
2.	MartinT.Hagan,Howard B.Demuth,MarkBeale,“Neural Network Design”, Thomson 2008.

Approved by BoS Chairman

M.E.	M23AEP101- ELECTRONICS SYSTEM DESIGN LABORATORY–I	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To study of different interfaces.
2	To learn asynchronous and clocked synchronous sequential circuits.
3	To understand the concept of builtin self-test and fault diagnosis.

List of Experiments	
Expt.No.	**Description of the Experiments**
1.	System design using PIC,MSP430,51Microcontroller and16-bit Microprocessor–8086
2.	Study of different interfaces (using embedded microcontroller)
3.	Implementation of Adaptive Filters and multistage multirate system in DSP Processor
4.	Simulation of QMF using Simulation Packages
5.	Analysis of Asynchronous and clocked synchronous sequential circuits
6.	Builtin self-test and fault diagnosis
7.	Sensor design using simulation tools
8.	Design and analysis of real time signal processing system — Data acquisition and signal processing
	Total Instructional hours:60

Course Outcomes: Students will be able to	
CO1	ApplyPIC,MSP430,51Microcontroller and 8086 for system design
CO2	Examine the simulation of QMF
CO3	Design sensor using simulation tools
CO4	Design and analyse the realtime signal processing system
CO5	Design and analyse the data acquisition system

Approved by BoS Chairman

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
Sl. No.	**Description of the Equipment**	**Quantity Required (Nos.)**
1.	Desktop computer	25
2.	PIC16XXX/18XXX Microcontroller development system with relevant IDE, Interfacing hardware like matrix key pad, seven segment display, LCD module, point LED,switches,I^2Cbased RTC and EPROM, temperature sensor, buzzer etc and programming facility	5
3.	MSP430 Microcontroller development system with relevant IDE, interfacing hardware like matrix key pad, seven segment display, LCD module, point LED, switches,I^2C based RTC and EPROM, temperature sensor, buzzer etc and programming facility/ARM Processor	5
4.	8051 Microcontroller development system with relevant IDE, interfacing hardware like matrix keypad, seven segment display, LCD module, point LED, switches, I^2C based RTC and EPROM, temperature sensor, buzzer etc and programming facility	5
5.	8086 Development trainer with basic interfacing modules	5
6.	TMS320CXXXX DSP based Development trainer	10

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Semester II										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23AET201	Soft Computing and Optimization Techniques	PC	3	3	0	0	3	40	60	100
M23AET202	Embedded System Design	PC	3	3	0	0	3	40	60	100
M23AET203	Hardware-Software Co-Design	PC	3	3	0	0	3	40	60	100
M23AET204	Power Electronics and Applications	PC	3	3	0	0	3	40	60	100
	Professional Elective - II	PE	3	3	0	0	3	40	60	100
	Professional Elective - III	PE	3	3	0	0	3	40	60	100
Practical										
M23AEP201	Electronics System Design Laboratory – II	PC	4	0	0	4	2	60	40	100
M23CEP203	Article Writing and Seminar	CEC	2	0	0	2	1	100	-	100
Total credits to be earned							**21**			

PROFESSIONAL ELECTIVES(PE)										
Semester – II										
Elective – II										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23VDT103	CAD for VLSI Circuits	PE	3	3	0	0	3	40	60	100
M23VDE203	Nano Electronics	PE	3	3	0	0	3	40	60	100
M23AEE201	High Performance Networks	PE	3	3	0	0	3	40	60	100
M23AEE202	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3	40	60	100

Elective – III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
M23AEE203	RF System Design	PE	3	3	0	0	3	40	60	100
M23AEE204	Speech and Audio Signal Processing	PE	3	3	0	0	3	40	60	100
M23VDT201	Device Modeling	PE	3	3	0	0	3	40	60	100

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M23AEE205	Robotics	PE	3	3	0	0	3	40	60	100

M.E.	M23AET201-SOFT COMPUTING ANDOPTIMIZATION TECHNIQUES (Common to AE & VLSI)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand various neural networks and learning methods.
2.	To overview of Fuzzy logic.
3.	To study the concept of Neuro–Fuzzy modeling.
4.	To introduce the optimization techniques.

UNIT-I	NEURAL NETWORKS	9
Machine Learning using Neural Network, Learning algorithms, Supervised Learning Neural Networks – Feed Forward Networks, Radial Basis Function, Unsupervised Learning Neural Networks – Self Organizing map , Adaptive Resonance Architectures, Hopfield network.		

UNIT-II	FUZZY LOGIC	9
Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.		

UNIT-III	NEURO-FUZZY MODELING	9
Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification –Neuro-Fuzzy Control – Case Studies.		

UNIT-IV	CONVENTIONAL OPTIMIZATION TECHNIQUES	9
Introduction to optimization techniques, Statement of an optimization problem, classification, Unconstrained optimization-gradient search method-Gradient of a function, steepest gradient-conjugate gradient, Newton's Method, Marquardt Method, Constrained optimization –sequential linear programming, Interior penalty function method, external penalty function method.		

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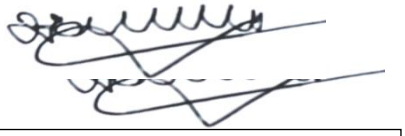
UNIT-V	EVOLUTIONARY OPTIMIZATION TECHNIQUES	9
Genetic algorithm - working principle, Basic operators and Terminologies, Building block hypothesis, Travelling Salesman Problem, Particle swam optimization, Ant colony optimization.		
Total Instructional hours:45		

Course Outcomes: Students will be able to	
CO1	Outline the basics of neural network and learning methods
CO2	Outline the basics of fuzzy logic
CO3	Examine machine learning through Neural Fuzzy concept
CO4	Explain the conventional optimization techniques
CO5	Explain the evolutionary optimization techniques

Text Books	
1.	DavidE.Goldberg,“Genetic Algorithms in Search,Optimization and Machine learning”, Addison wesley, 2009.
2.	George J.Klir and BoYuan,“FuzzySets and FuzzyLogic-Theory and Applications”, PrenticeHall, 1995.

Reference Books	
1.	James A.Freeman and David M.Skapura,“NeuralNetworks Algorithms, Applications,and Programming Techniques”,Pearson Edn.,2003.
2.	Jyh-ShingRogerJang, Chuen-TsaiSun,EijiMizutani,“Neuro-Fuzzy and SoftComputing”, Prentice-Hall of India,2003.



Approved by BoS Chairman

M.E	M23AET202 - EMBEDDED SYSTEM DESIGN (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the overview, design metrics and methodology of embedded systems.
2.	To introduce architecture of single purpose processor.
3.	To understand various protocols of embedded system.
4.	To understand the State machine models.
5.	To introduce software development tools.

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 Data path Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, Dataflow Model, Real-: Hardware/Software Co-Simulation, Reuse: Intellectual Property Cores, Design Process Models.

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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 Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Explain the design challenges and basic metrics of embedded system
CO2	Explain the architecture and pipelining process
CO3	Analyse different protocols
CO4	Examine the 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.

Approved by BoS Chairman

M.E	M23AET203 - HARDWARE-SOFTWARE CO-DESIGN (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To acquire the knowledge about system specification and modelling.
2.	To learn the formulation of partitioning.
3.	To learn the co-synthesis.
4.	To study the different technical aspects about prototyping and emulation.
5.	To introduce the design specification and verification.

UNIT- I	SYSTEM SPECIFICATION AND MODELLING	9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modeling , Co-Design for Heterogeneous Implementation - Single-Processor Architectures with one ASIC and many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation, Requirements for Embedded System Specification.

UNIT- II	HARDWARE / SOFTWARE PARTITIONING	9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph, Formulation of the HW/SW Partitioning Problem, Optimization, HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms.

UNIT- III	HARDWARE / SOFTWARE CO-SYNTHESIS	9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Co-Synthesis Algorithm for Distributed System- Case Studies with any one application**.**

UNIT- IV	PROTOTYPING AND EMULATION	9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments, Future Developments in Emulation and Prototyping ,Target Architecture- Architecture Specialization Techniques ,System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems ,Mixed Systems and Less Specialized Systems.

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UNIT- V	DESIGN SPECIFICATION AND VERIFICATION	9
Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification ,Languages for System-Level Specification and Design System-Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Outline the system specification and modelling
CO2	Explain the partitioning and scheduling Algorithm
CO3	Explain the co-synthesis algorithm
CO4	Compare various architectures od prototyping and emulation
CO5	Analyze about the design specification and validate its functionality by simulation

Reference Books	
1.	Giovanni De Micheli, Rolf Ernst Morgon, “Reading in Hardware/Software Co-Design”, Kaufmann Publishers, 2001.
2.	Jorgen Staunstrup, Wayne Wolf, “Hardware/Software Co-Design”: Principles and Practice”, Kluwer Academic Pub, 1997.
3.	Ralf Niemann, “Hardware/Software Co-Design for Data Flow Dominated Embedded Systems”, Kluwer Academic Pub, 1998.

Approved by BoS Chairman

M.E	M23AET204 - POWER ELECTRONICS AND APPLICATIONS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge of power semiconductor technologies and their advancement in the field of power conversion.
2.	To address the concepts of inverters
3.	To address the underlying concepts of AC to AC converters
4.	To review the concepts of Switched Mode Power Supply.
5.	To address the underlying concepts of different DC to AC converters

UNIT-I	POWER SEMICONDUCTOR DEVICES	9

Introduction - Power Diodes - Power Transistors - Power MOSFETs – IGBTs - Thyristor family: SCR, TRIAC, GTO, IGCT - Static and Dynamic characteristics –Introduction to intelligent power module Protection circuits - Series and parallel connections – Interpretation of power device data sheet

UNIT-II	AC TO DC CONVERTERS	9

Uncontrolled Bridge Rectifiers: Single Phase and Three Phase Uncontrolled Rectifier with R, RL and RLE load - Continuous and discontinuous mode of operation - Average, RMS load voltage and load current, input power factor. Controlled Bridge Rectifiers – Single Phase and Three Phase (no analysis) Half and Fully Controlled Bridge Rectifier with R, RL and RLE load - Effect of free-wheeling diode - Continuous and Discontinuous Mode of operation - Average, RMS load voltage and load current, input power factor – Dual converters – HVDC Transmission. Introduction to Utility Interface Need for utility interface- Principle of operation of PWM rectifier.

UNIT-III	AC TO AC CONVERTERS	9

Single phase full wave controller with R and RL load - Estimation of RMS load voltage, RMS load current and input power factor - Three phase AC voltage controllers (No analysis)- Single phase transformer connection changers- Introduction to cyclo converters- Introduction to AC voltage controller with PWM control.

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UNIT-IV	DC TO DC CONVERTERS	9
Introduction - Time ratio control - Principle of step-up and step-down operation - Two quadrant and four quadrant DC choppers with R, RL and RLE load - Estimation of average load voltage and load current for continuous current operation –Switched mode power Converter – Ideal buck and Boost converter (steady state analysis) – Fly-Back Type Switched Mode Power Supply (no analysis) - SMPS (Half and full bridge)		

UNIT-V	DC TO AC CONVERTERS	9
Types - Voltage source and current source inverters - Single phase bridge inverters - Three phase bridge inverters -PWM Techniques - Control of AC output voltage - Harmonic reduction- UPS.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Select power electronic devices for specific applications.
CO2	Understand the different types of inverters.
CO3	Understand the functioning of the different types of converters
CO4	Understand the concept of Chopper
CO5	Understand the concepts of Inverters and PWM techniques

Text Books	
1.	Rashid M H, "Power Electronics – Circuits, Devices and Applications", 4th Edition, Prentice Hall of India, New Delhi, 2014.
2.	P.S.Bimbhra, "Power Electronics", 4th Edition, Khanna Publishers, New Delhi, 2006.

Reference Books	
1.	Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications, and Design", 3 rd Edition, John Wiley and Sons, Inc., New York, 2003.
2.	Vedam Subramanyam, "Power Electronics", New Age International, New Delhi, 1996.
3.	Joseph Vithayathil, "Power Electronics", Tata McGraw-Hill, New Delhi, 2010.
4.	M.D.Singh and K.B.Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hills Publishing Company Limited, New Delhi, 2006.

Approved by BoS Chairman

PROFESSIONAL ELECTIVES - II

Approved by BoS Chairman

M.E.	M23VDT103- CAD FOR VLSI CIRCUITS (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the VLSI Design methodologies.
2.	To study the algorithms related to placement and partitioning.
3.	To study the various routing and floor planning algorithms.
4.	To learn the synthesis processes understand VLSIdesign automation tools.
5.	To study the high level synthesis.

UNIT-I	INTRODUCTION TO VLSI DESIGN FLOW	9

Introduction to VLSI Design methodologies, Basics of VLSI design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, General purpose methods for combinatorial optimization.

UNIT-II	LAYOUT, PLACEMENT AND PARTITIONING	9

Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning.

UNIT-III	FLOOR PLANNING AND ROUTING	9

Floor planning concepts, Shape functions and floor plan sizing, Types of local routing problems, Area routing, Channel routing, Global routing, Algorithms for global routing.

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UNIT-IV	SIMULATION AND LOGIC SYNTHESIS	9
Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.		

UNIT-V	HIGH LEVEL SYNTHESIS	9
Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, scheduling algorithms, Assignment problem, High level transformations.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Outline the flow of VLSI design
CO2	Explain the algorithms related to placement and partitioning and layout rules
CO3	Outline floor planning and routing
CO4	Explain Simulation and Logic Synthesis
CO5	Examine the hardware models for high level synthesis

Text Books	
1.	N.A. Sherwani, “Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
2.	S.H. Gerez, “Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.

Reference Books	
1.	Sadiq M. Sait, Habib Youssef, “VLSI Physical Design automation: Theory and Practice”, World Scientific, 1999.
2.	StevenM.Rubin,“ComputerAidsfor VLSIDesign”,AddisonWesleyPublishing,1987.

Approved by BoS Chairman

M.E.	M23VDE203-NANOELECTRONICS (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the semiconductor nano devices.
2.	To study the materials involved in nano devices.
3.	To learn the operation of nano thermalsensors.
4.	To understand various materials used in gas sensors.
5.	To study the operation of biosensor.

UNIT-I	SEMICONDUCTOR NANO DEVICES	9

Single-Electron Devices; Nano scale MOSFET – Resonant Tunneling Transistor - Single-Electron Transistors; Nanorobotics and Nano manipulation; Mechanical Molecular Nano devices; Nano computers: Optical Fibers for Nano devices; Photochemical Molecular Devices; DNA-Based Nano devices; Gas-Based Nano devices.

UNIT-II	ELECTRONIC AND PHOTONIC MOLECULAR MATERIALS	9

Preparation – Electroluminescent Organic materials - Laser Diodes - Quantum well lasers:- Quantum cascade lasers- Cascade surface-emitting photonic crystal laser- Quantum dot lasers - Quantum wire lasers:- White LEDs - LEDs based on nanowires - LEDs based on nanotubes - LEDs based on nanorods - High Efficiency Materials for OLEDs- High Efficiency Materials for OLEDs - Quantum well infrared photo detectors.

UNIT-III	THERMAL SENSORS	9

Thermal energy sensors -temperature sensors, heat sensors - Electromagnetic sensors - electrical resistance sensors, electrical current sensors, electrical voltage sensors, electrical power sensors, magnetism sensors - Mechanical sensors - pressure sensors, gas and liquid flow sensors, position sensors - Chemical sensors - Optical and radiation sensors.

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UNIT-IV	GAS SENSOR MATERIALS	9
Criteria for the choice of materials – Experimental aspects– materials, properties, measurement of gas sensing property, sensitivity, Discussion of sensors for various gases,Gas sensors based on semiconductor devices.		

UNIT-V	BIOSENSORS	9
Principles - DNA based biosensors – Protein based biosensors – materials for biosensor applications - fabrication of biosensors - future potential.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Classify the types of Nano devices operation of bio sensor
CO2	Analyze the materials used in Nano device
CO3	Explain the operation of thermal sensor CO4:Examine the operation of gas sensor
CO4	Examine the operation of gas sensor
CO5	Outline the operation of bio sensor

Text Books	
1.	K.E. Drexler,“Nanosystems”, Wiley,1992.
2.	M.C.Petty,“Introduction to Molecular Electronics”,1995.

Reference Books	
1.	W.Ranier,“Nano Electronics and Information Technology ”,Wiley, 2003.

Approved by BoS Chairman

M.E.	M23AEE201- HIGH PERFORMANCE NETWORKS (Common to AE & VLSI)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce various systems related to networks.
2.	To study the applications of multimedia networks.
3.	To learn the concept of advanced networks.
4.	To study the various traffic modeling.
5.	To learn about network security in many layers and network management.

UNIT-I	INTRODUCTION	9
Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing. SONET – DWDM – DSL – ISDN – BISDN, ATM.		

UNIT-II	MULTIMEDIA NETWORKING APPLICATIONS	9
Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism – integrated services – RSVP- differentiated services.		

UNIT-III	ADVANCED NETWORKS CONCEPTS	9
VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS- operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks- P2P connections.		

UNIT-IV	TRAFFIC MODELLING	9
Little's theorem, Need for modeling, Poisson modeling and its failure, Non- poisson models, Network performance evaluation.		

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UNIT-V	NETWORK SECURITY AND MANAGEMENT	9
Principles of cryptography – Authentication – integrity – key distribution and certification – Access control and: fire walls – attacks and counter measures – security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1.		
Total Instructional hours:45		

Course Outcomes: Students will be able to	
CO1	Outline the basic high performance network systems
CO2	Explain the applications of multimedia networks
CO3	Analyse the concepts of advanced networks
CO4	Outline the traffic modelling
CO5	Analyse the network security methods

Text Books	
1.	AunuragKumar,D.MAnjunath,JoyKuri,“Communication Networking”,Morgan Kaufmann Publishers,1st Edition, 2004.
2.	Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet”, fifth edition,Pearson Education, 2006.

Reference Books	
1.	HersentGurle& Petit,“IPTelephony,packet Pored Multimedia communication Systems”, Pearson Education, 2003.
2.	J.F.Kurose&K.W.Ross,“Computer Networking - A topdown approach featuring the internet”Pearson,2nd Edition,2003.

Approved by BoS Chairman

M.E.	M23AEE202 - WIRELESS ADHOC AND SENSOR NETWORKS (Common to AE &VLSI)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basics ofAd-hoc, Sensor Networks and various fundamental and emerging protocols of all layers.
2.	To study about the routing architecture of sensor networks.
3.	To understand the nature and applications of Ad-hoc and sensor networks.
4.	To understand various security practices and protocols of Ad-hoc and Sensor networks.
5.	To understand the basics of Ad-hoc,Sensor Networks and various fundamental and emerging protocols of all layers.

UNIT-I	MAC & TCP IN AD HOC NETWORKS	9

Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wireless Networks – Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview - TCP and MANETs – Solutions for TCP over Ad-Hoc Networks.

UNIT-II	ROUTING IN AD HOC NETWORKS	9

Routing in Ad-Hoc Networks- Introduction-Topology based versus Position based Approaches-Proactive, Reactive, Hybrid Routing Approach-Principles and issues – Location services - DREAM – Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding – Restricted directional flooding- Hierarchical Routing- Issues and Challenges in providing QoS.

UNIT-III	MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS	9

Introduction – Architecture - Single node architecture – Sensor network design considerations – Energy Efficient Design principles for WSNs – Protocols for WSN – Physical Layer : Transceiver Design considerations – MAC Layer Protocols – IEEE802.15.4 Zigbee – Link Layer and Error Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention Based Networking – Transport Protocols & QOS – Congestion Control issues – Application Layer support

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UNIT-IV	SENSOR MANAGEMENT	9
Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - Time synchronization - Localization and positioning – Operating systems and Sensor Network programming – Sensor Network Simulators.		

UNIT-V	SECURITY IN ADHOC AND SENSOR NETWORKS	9
Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software based Anti-tamper techniques – water marking techniques – Defense against routing attacks - Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS.		
Total Instructional hours:45		

Course Outcomes: Students will be able to	
CO1	Explain the protocols developed for adhoc and sensor networks.
CO2	Analyse different routing approaches
CO3	Outline different architecture in ad hoc and sensor networks.
CO4	Build a Sensor network environment for different type of applications
CO5	Analyse about the security in sensor networks

Text Books	
1.	AdrianPerrig,J.D.Tygar, "Secure Broadcast Communication:In Wired and WirelessNetworks",Springer,2006.
2.	Carlos De MoraisCordeiro,Dharma PrakashAgrawal, “Ad Hoc and Sensor Networks:Theory and Applications (2nd Edition),World Scientific Publishing,2011.

Reference Books	
1.	C.SivaRam Murthy and B.S.Manoj,“AdHoc Wireless Networks-Architectures and Protocols”,Pearson Education,2004.
2.	C.K.Toh,“AdHoc Mobile Wireless Networks”, PearsonEducation,2002.

Approved by BoS Chairman

PROFESSIONAL ELECTIVES - III

Approved by BoS Chairman

M.E.	M23AEE203- RF SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the physics and specifications of CMOS.
2.	To learn about impedance matching
3.	To introduce power amplifiers for RF system.
4.	To study the concept of oscillators and mixers.
5.	To learn the concept of PLL.

UNIT-I	CMOSPHYSICS,TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES	9

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise –Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two stepup conversion Transmitter.

UNIT-II	IMPEDANCE MATCHING AND AMPLIFIERS	9

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

UNIT-III	FEEDBACK SYSTEMSAND POWER AMPLIFIERS	9

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation, General model — Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearization Techniques, Efficiency boosting techniques, ACPR metric, Design considerations.

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UNIT-IV	MIXERS AND OSCILLATORS	9
Mixer characteristics, Non-linear based mixers, Quadratic mixers, Multiplier based mixers, Single balanced and double balanced mixers, sub sampling mixers, Oscillators describing Functions, Colpitts oscillators, Resonators, Tuned Oscillators, Negative resistance oscillators, Phase noise.		
UNIT-V	**PLLAND FREQUENCY SYNTHESIZERS**	**9**
Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-Nfrequency synthesizers, Direct Digital Frequency synthesizers.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Outline the physical nature of CMOS in RF system design
CO2	Analyze the impedance matching processing
CO3	Explain the concept of power amplifiers in RF system design
CO4	Build the oscillator for RF system
CO5	Analyze the PLL for RF system

Reference Books	
1.	B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001.
2.	B.Razavi, “RF Microelectronics”, Pearson Education,1997.
3.	JanCrols, Michiel Steyaert, “CMOS Wireless Transceiver Design”, Kluwer Academic Publishers,1997.
4.	Recorded lectures and notes available at http://www.ee.iitm.ac.in/~ani/ee6240/
5.	T.Lee, “Design of CMOS RF Integrated Circuits”,Cambridge,2004.

Approved by BoS Chairman

M.E.	M23AEE204-SPEECH AND AUDIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study basic concepts of processing speech and audio signals.
2.	To study and analyse various M-band filter-banks for audio coding.
3.	To understand audio coding based on transform coders.
4.	To study time and frequency domain speech processing methods.
5.	To learn the predictive analysis of speech.

UNIT-I	MECHANICS OF SPEECH AND AUDIO	9

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds–Phones–Phonemes–Phonetic and Phonemic alphabets– Articulatory features. AbsoluteThreshold of Hearing-Critical Bands-Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non-simultaneous Masking - Perceptual Entropy –Basic measuring philosophy-Subjective versus objective perceptual testing-The perceptual audio quality measure(PAQM)-Cognitive effects in judging audio quality.

UNIT-II	TIME-FREQUENCY ANALYSIS:FILTER BANKS AND TRANSFORMS	9

Introduction - Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters -Tree-Structured QMF and CQF M-band Banks - Cosine Modulated “Pseudo QMF” M-band Banks -Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion-Pre-echo Control Strategies.

UNIT-III	AUDIO CODING AND TRANSFORM CODERS	9

Lossless Audio Coding – Lossy Audio Coding - ISO-MPEG-1A, 2A, 2A-Advaned, 4A Audio Coding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder –Branden burg-Johnston Hybrid Coder-CNET Coders-Adaptive Spectral Entropy Coding–Differential Perceptual Audio Coder-DFT Noise Substitution- DCT with Vector Quantization-MDCT with Vector Quantization.

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UNIT-IV	TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING	9
Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude–Zero crossing Rate–Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods Homomorphic Speech Analysis: Conceptual analysis of Speech –Formant and Pitch Estimation–Homomorphic Vocoders.		
UNIT-V	**PREDICTIVE ANALYSIS OF SPEECH**	**9**
Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method–Covariance method–Solution of LPC equations–Cholesky method–Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods– Application of LPC parameters – Pitch detection using LPC parameters –Formant analysis– VELP–CELP.		
		Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Outline the speech processing concepts
CO2	Explain the filter bank concept
CO3	Compare various coding and coders
CO4	Examine time and frequency domain methods for speech processing
CO5	Explain the predictive analysis of speech

Reference Books	
1.	B.Goldand N.Morgan, "Speech and Audio Signal Processing", Wiley and Sons, 2000.
2.	L.R.Rabiner andR.W.Schaffer,"Digital Processing of Speech Signals", Prentice Hall,1978.
3.	MarkKahrs,Karlheinz Brandenburg,Kluwer, "Applications of Digital Signal Processing to Audio And Acoustics", Academic Publishers.
4.	UdoZölzer, "Digital Audio Signal Processing", Second Edition, John Wiley & sons Ltd

Approved by BoS Chairman

M.E.	M23VDT201-DEVICE MODELLING (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the MOS capacitors and to model MOS Transistors.
2.	To learn about the MOSFET characteristics.
3.	To understand the various CMOS design parameters and their impact on performance of the device.
4.	To study the device level characteristics of BJT transistors.

UNIT-I	MOS CAPACITORS	9

Surface Potential: Accumulation,Depletion,andInversion,ElectrostaticPotentialandCharge Distribution in Silicon, Capacitances in an MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, MOS under Non-equilibrium and Gated Diodes, Charge in Silicon Dioxide and at the Silicon–Oxide Interface, Effect of Interface Traps and Oxide Charge on Device Characteristics, High-Field Effects, Impact ionization and Avalanche Breakdown, Band-to-Band Tunneling, Tunneling into and through Silicon Dioxide, Injection of Hot Carriers from Silicon into Silicon Dioxide, High-Field Effects in Gated Diodes, Dielectric Breakdown.

UNIT-II	MOSFET DEVICES	9

Long-Channel MOSFETs, Drain-Current Model, MOSFET I–V Characteristics, Sub threshold Characteristics, Substrate Bias and Temperature Dependence of Threshold Voltage, MOSFET Channel Mobility, MOSFET Capacitances and Inversion-Layer Capacitance Effect, Short-Channel MOSFETs, Short-Channel Effect, Velocity Saturation and High-Field Transport Channel Length Modulation, Source–Drain Series Resistance, MOSFET Degradation and Breakdown at High Fields.

UNIT-III	CMOS DEVICE DESIGN	9

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MOSFET Scaling, Constant-Field Scaling, Generalized Scaling, Non- scaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Non-uniform Doping, Quantum Effect on Threshold Voltage, Discrete Dopant Effects on Threshold Voltage, MOSFET Channel Length, Various Definitions of Channel Length, Extraction of the Effective Channel Length, Physical Meaning of Effective Channel Length, Extraction of Channel Length by C–V Measurements

UNIT-IV	CMOS PERFORMANCE FACTORS	9

Basic CMOS Circuit Elements, CMOS Inverters, CMOS NAND and NOR Gates, Inverter and NAND Layouts, Parasitic Elements, Source–Drain Resistance, Parasitic Capacitances, Gate Resistance, Interconnect R and C, Sensitivity of CMOS Delay to Device Parameters, Propagation Delay and Delay Equation, Delay Sensitivity to Channel Width, Length, and Gate Oxide Thickness, Sensitivity of Delay to Power-Supply Voltage and Threshold Voltage, Sensitivity of Delay to Parasitic Resistance and Capacitance, Delay of Two-Way NAND and Body Effect, Performance Factors of Advanced CMOS Devices, MOSFETs in RF Circuits, Effect of Transport Parameters on CMOS Performance, Low-Temperature CMOS

UNIT-V	BIPOLAR DEVICES	9

N–P–N Transistors, Basic Operation of a Bipolar Transistor, Modifying the Simple Diode Theory for Describing Bipolar Transistors, Ideal Current–Voltage Characteristics, Collector Current, Base Current, Current Gains, Ideal IC–VCE Characteristics, Characteristics of a Typical n–p–n Transistor, Effect of Emitter and Base Series Resistances, Effect of Base– Collector Voltage on Collector Current, Collector Current Falloff at High Currents, Non- ideal Base Current at Low Currents, Bipolar Device Models for Circuit and Time-Dependent Analyses Basic dc Model, Basic ac Model, Small-Signal Equivalent-Circuit Model, Emitter Diffusion Capacitance, Charge-Control Analysis, Breakdown Voltages, Common-Base Current Gain in the Presence of Base–Collector Junction Avalanche, Saturation Currents in a Transistor, Relation Between BVCEO and BVCBO.

Total Instructional hours:45

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Course Outcomes: Students will be able to	
CO1	Outline the concept of MOS capacitors
CO2	Explain the operation of MOSFET with its characteristics
CO3	Design and model BJT device to desired specifications
CO4	Analyze the performance metrics of CMOS
CO5	Design and model BJT device to desired specifications

Text Books	
1.	BehzadRazavi, “Fundamentals of Micro electronics ”,Wiley Student Edition, 2nd Edition.
2.	JPCollinge,C.A.Collinge,“ Physics of Semiconductor devices”, Springer 2002 Edition.

Reference Books	
1.	Yuan Taur and Tak H. Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, Second Edition.

Approved by BoS Chairman

M.E.	M23AEE205–ROBOTICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand robot locomotion and mobile robot kinematics.
2.	To understand perception in robotics.
3.	To study mobile robot localization
4.	To learn the mobile robot mapping.
5.	To study robot planning and navigation

UNIT - I	LOCOMOTION AND KINEMATICS	9

Introduction to Robotics–key issues in robot locomotion–legged robots–wheeled mobile robots — aerial mobile robots — introduction to kinematics — kinematics models and constraints–robot maneuverability

UNIT-II	ROBOT PERCEPTION	9

Sensors for mobile robots–vision for robotics–cameras–image formation–structure from stereo—structure from motion—optical flow—color tracking—place recognition—range data.

UNIT-III	MOBILE ROBOT LOCALIZATION	9

Introduction to localization–challenges in localization–localization and navigation–belief representation – map representation – probabilistic map-based localization – Markov localization — EKF localization — UKF localization — Grid localization — Monte Carlolocalization–localization in dynamic environments.

UNIT-IV	MOBILE ROBOT MAPPING	9

Autonomous map building–occupancy grip mapping–MAP occupancy mapping–SLAM,–extended Kalman Filter SLAM — graph-based SLAM — particle filter SLAM— sparse extended information filter–fast SLAM algorithm.

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UNIT-V	PLANNING AND NAVIGATION	9
Introduction to planning and navigation–planning and reacting–path planning–obstacle avoidance techniques–navigation architectures–basic exploration algorithms.		
		Total Instructional hours:45

Course Outcomes:Students will be able to	
CO1	Explain robot locomotion, kinematics models and constraints.
CO2	Analyze the vision algorithms for robotics
CO3	Test robot localization techniques
CO4	Test robot mapping techniques
CO5	Analyze the planning and exploration algorithms

Reference Books	
1.	Gregory Dudek and MichaelJenkin,“Computational Principles of Mobile Robotics”, Second Edition,Cambridge University Press,2010.
2.	Howie Chosetet al., “Principles of Robot Motion: Theory, Algorithms, and Implementations”, ABradford Book, 2005
3.	MajaJ. Mataric,“The Robotics Primer”, MIT Press, 2007.
4.	RolandSeigwart, IllahReza Nourbakhsh, and Davide Scaramuzza,“Introduction to autonomous mobile robots”,Second Edition, MIT Press,2011.
5.	SebastianThrun,WolframBurgard, and DieterFox,“Probabilistic Robotics”, MIT Press, 2005.

Approved by BoS Chairman

M.E	M23AEP201- ELECTRONICS SYSTEM DESIGN LABORATORY-II	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To study of 32 bit ARM 7 microcontroller RTOS and its application.
2	To understand testing RTOS environment and system programming
3	To learn wireless network design using embedded systems
4	To learn System design using ASIC.
5	To know use of Verilog and VHDL in sequential digital system modeling

List of Experiments	
Expt.No.	**Description of the Experiments (Any 8 experiments)**
1.	Study of 32 bit ARM 7 microcontroller RTOS and its application
2.	Testing RTOS environment and system programming
3.	Designing of wireless network using embedded systems
4.	Implementation of ARM with FPGA
5.	Design and Implementation of ALU in FPGA using VHDL and Verilog
6.	Modelling of Sequential Digital system using Verilog and VHDL
7.	Flash controller programming-data flash with erase,verify and fusing
8.	System design using ASIC
9.	Design, simulation and analysis of signal integrity
	Total Instructional hours:60

Course Outcomes: Students will be able to	
CO1	Utilize ARM with FPGA
CO2	Demonstrate the designing of ALU in FPGA using VHDL and Verilog
CO3	Outline about the RTOS.
CO4	Examine the flash controller programming
CO5	Explain design, simulation and analysis of signal integrity

Approved by BoS Chairman

LIST OF EQUIPMENT FOR A BATCHOF 30 STUDENTS		
Sl.No.	**Description of the Equipment**	**Quantity required (Nos.)**
1.	ARM7 Development board with RTOS like Linuxor VX works/ PIC Microcontroller	10
2.	Vxworks or Equivalent RTOS /8051 Microcontroller	10
3.	Wireless Modules like Zigbee or equivalent	5
4.	FPGA Board like Spartan 3 EorcycloneII	10
5.	XILNX,Quartus-2	10
6.	Flash Programming Kit (Universal Programmes) 8255 PPI	5
7.	Mentor graphics/Cadence	5
8.	Signal Integrity/TMS320C XXXX DSP based Development trainer	5

Approved by BoS Chairperson

M.E.	M23CEP203-ARTICLE WRITING AND SEMINAR (Common to VLSI & AE)	L	T	P	C
		0	0	2	1

Course Objectives	
1.	In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography(atleast15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the author's contributions and critically analyzing each paper.
6. Preparing a working outline
7. Linking the paper sand preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Activity	Instructions	Submission Week	Evaluation Week
Selection of area of interest and Topic (Stating an Objective)	You are requested to select an area of interest, topic and state an objective	2nd week	**3%** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for 5. Papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)

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Collection of Journal papers in the topic in the context of the objective — collect 20 & then filter	You have to provide a complete list of references you will be using- Based on your objective - Search various digital libraries and Google Scholar When picking papers To read-try to: Pick papers that are Related to each other in Some ways and/or that Are in the same field so That you can write a Meaningful survey out of them, Favour papers from well-known journals and conferences, Favour "first" or "foundational" papers in the field (as indicated in other people"s survey paper),Favour more recent papers, Pick a recent survey of the field so you can quickly Gain an overview, Find relationships with respect to each other and to your topic area (classification Scheme / categorization) Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	**6%**(the list of standard papers and reason for selection)
Reading and notes	Reading Paper Process For each paper form a Table answering the following questions: What is the main topic of the article? What was /were the main issue(s) the author said they want to discuss? Why did the author claim it was important? How does the work build on other's work, in the author's opinion? What simplifying assumptions does the author claim to be making? What did the author do? How did the author claim they were going t o evaluate their work and compare it to	5th week	**8%**(the table given should indicate your understanding of the paper and the evaluation is based on your Conclusions about each paper)

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for first 5 papers	others? What did the author say were the limitations of their research? What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper(from the perspective of your survey)		
Reading and notes for next 5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification /categorization diagram	8th week	**8%**(this component will be evaluated based on the linking and Classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation &Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%(clarity)**
Sections of the paper	Write the sections of your paper based on the classification/categorization diagram in keeping with the Goal so of your survey	11th week	**10%**(this Component will be evaluated based on the linking and classification Among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%**(conclusions–clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%**(formatting, English, Clarity and linking) **4%** Plagiarism Check

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			Report
Seminar	A brief 15 slides on your paper	14th& 15th week	**10%** (based on presentation and Viva-voce)

Course Outcomes: Students will be able to	
CO1	Survey the relevant information
CO2	Outline the importance's
CO3	Formulate the concept
CO4	Compare the data's with existing
CO5	Outline about concluding remarks

Approved by BoS Chairman

Semester III										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory / Theory with Practical										
M23AET301	Advanced Microprocessors and Microcontrollers Architecture	PC	3	3	0	0	3	40	60	100
	Professional Elective–IV	PE	3	3	0	0	3	40	60	100
	Professional Elective–V	PE	3	3	0	0	3	40	60	100
Practical										
M23AEP301	Project Work (Phase I)	PW	12	0	0	12	6	40	60	100
Total credits to be earned							**15**			

Semester IV										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Practical										
M23AEP401	Project Work (Phase II)	PW	24	0	0	24	12	40	60	100
Total credits to be earned							**12**			

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PROFESSIONAL ELECTIVES(PE)										
Semester– III										
Elective – IV										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory / Theory with Practical										
M23AEE301	DSP Processor Architecture and Programming	PE	3	3	0	0	3	40	60	100
M23AEE302	Wavelets and Multi resolution Processing	PE	3	3	0	0	3	40	60	100
M23VDE204	System on Chip Design	PE	3	3	0	0	3	40	60	100
M23VDE305	MEMS and NEMS	PE	3	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES(PE)										
Semester–III										
Elective –V										
Course Code	**Course Name**	**CT**	**Instructional Hours**					**Assessment**		
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
Theory / Theory with Practical										
M23VDE306	Machine Learning and Algorithm design	PE	3	3	0	0	3	40	60	100
M23AEE303	Advanced Digital Image Processing	PE	3	3	0	0	3	40	60	100
M23AEE304	Pattern Recognition	PE	3	3	0	0	3	40	60	100
M23AEE305	Secure Computing Systems	PE	3	3	0	0	3	40	60	100

Approved By BoS Chairman

Semester-III

Approved By BoS Chairman

B.E	M19AET301 - ADVANCED MICROPROCESSORS AND MICROCONTROLLERS ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives

1.	To study 80486 and Pentium processor.
2.	To understand CISC and RISC Architectures.
3.	To learn ARM processor and instruction set.
4.	To introduce the basic features in Motorola microcontrollers
5.	To study about PIC microcontroller.

UNIT- I	80486 AND PENTIUM PROCESSOR	9

80486 PROCESSOR : Basic programming model – Memory organization – Data types – Instruction set - Addressing mode – Address translation – Interrupts – PENTIUM PROCESSOR Introduction to Pentium processor architecture – Special Pentium Registers – Pentium Memory Management – Introduction to Pentium pro processor – Pentium Pro Special Features.

UNIT- II	CISC AND RISC ARCHITECTURE	9

Introduction to RISC architectures: RISC Versus CISC – RISC Case studies: MIPS R4000-SPARC – Intel i860 - IBM RS/6000.

UNIT- III	ARM PROCESSOR	9

Organization of CPU – Bus architecture – Memory management unit - ARM instruction set - Thumb Instruction set- addressing modes – Programming the ARM processor – Introduction to ARM Cortex 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 AND MOTOROLA 68HC11 MICROCONTROLLER	9

Instruction set, addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART. MOTOROLA: CPU Architecture – Instruction set – interrupts-Timers- I2C Interfacing –UART- A/D Converter – PWM, Case Study.

Total Instructional hours: 45

Approved By BoS Chairman

Reference Books	
1.	Andrew Sloss, “ARM System Developers Guide”, Morgan Kaufmann Publishers, 2005. approach”, Morgan Kaufmann / Elsevier, 1997.
2.	Barry B Brey, “The Intel Microprocessor, Pentium and Pentium Pro Processor, Architecture Programming and Interfacing”, Prentice Hall of India, 2002.
3.	Daniel Tabak, “Advanced Microprocessors”, McGraw Hill Inc., 1995.
4.	David E Simon “An Embedded Software Primer”, Pearson Education, 2007.
5.	Gene .H.Miller, “Micro Computer Engineering”, Pearson Education, 2003.
6.	Intel, “Microprocessors”, Vol-I & Vol-II, Intel Corporation, USA, 1992.
7.	John B. Peatman , “Design with PIC Microcontroller” , Prentice hall, 1997.
8.	Mohammed Rafiquzzaman, “Microprocessors and Microcomputer Based System Design”, Universal Book Stall, New Delhi, 1990.
9.	John H.Davis, “MSP 430 Microcontroller basics” Elsevier, 2008.
10.	Steve Furber, “ARM System-on-Chip Architecture”, Pearson Education, 2005.
11.	“ARM7 TDMI Technical Reference Manual”, ARM Ltd., UK, 2004.

Course Outcomes: Students will be able to	
CO1	Outline the basics of 80486 processor.
CO2	Explain the functionalities of CISC and RISC architecture.
CO3	Analyze the functionalities of ARM processor.
CO4	Outline the basic features in Motorola microcontrollers.
CO5	Explain PIC microcontroller and Motorola 68HC11 microcontroller.

Approved By BoS Chairman

PROFESSIONAL ELECTIVE–IV

Approved By BoS Chairman

B.E	M23AEE301 - DSP PROCESSOR ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives

1.	To study Digital Signal Processor basics.
2.	To learn TMS320C5X processor.
3.	To learn TMS320C6X processor.
4.	To study about ADSP Processors.
5.	To study about applications of DSP Processors.

UNIT- I	FUNDAMENTALS OF PROGRAMMABLE DSPs	9

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT- II	TMS320C5X PROCESSOR	9

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT- III	TMS320C6X PROCESSOR	9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing realtime signals.

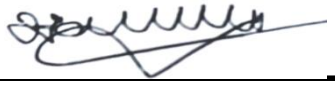
UNIT- IV	ADSP PROCESSORS	9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

UNIT- V	APPLICATIONS OF DSP PROCESSORS	9

Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic equalizer, Adaptive noise cancellation, DTMF signal detection ,Automatic speaker recognition.

Total Instructional hours: 45



Approved By BoS Chairman

Text Books	
1.	Avtar Singh and S. Srinivasan, "Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx", Cengage Learning India Private Limited Delhi 2012.
2.	RulphChassaing, "Digital Signal Processing and Applications with the C6713 and C6416 DSK" A JOHN WILEY & SONS, INC., PUBLICATION, 2005.

Reference Books	
1.	B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", Tata McGraw – Hill Publishing Company Limited, New Delhi, 2003.
2.	TMS320C5416/6713 DSK user manual at https://www.ti.com

Course Outcomes: Students will be able to	
CO1	Outline the basics of Digital Signal Processor
CO2	Examine the Architecture of TMS320C5X Processor
CO3	Examine the Architecture of TMS320C6X Processor
CO4	Outline about the ADSP Processors.
CO5	Study the applications of DSP Processors.

Approved By BoS Chairman

B.E	M23AEE302 - WAVELETS AND MULTIRESOLUTION PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives

1.	To study about the basics of wavelet transform.
2.	To learn continuous wavelet transforms.
3.	To learn Multi Resolution Analysis.
4.	To study about discrete wavelet transform.
5.	To study about applications of wavelet transform.

UNIT- I	INTRODUCTION	9

Vector Spaces - properties - dot product - basis – dimension, orthogonality and orthonormality - relationship between vectors and signals - Signal spaces – concept of Convergence - Hilbert spaces for energy signals - Short Time Fourier Transform.

UNIT- II	CONTINUOUS WAVELET TRANSFORM	9

Wavelet Transform - definition and properties - concept of scale and its relation with frequency - Continuous Wavelet Transform (CWT) - Scaling function and wavelet functions (Daubechies, Coiflet, Mexican Hat, Sinc, Gaussian, Bi-Orthogonal) – Tiling of time -scale plane for CWT.

UNIT- III	MULTI RESOLUTION ANALYSIS	9

Definition of Multi Resolution Analysis (MRA) – Haar basis - Construction of general orthonormal MRA- Wavelet basis for MRA – Continuous time MRA interpretation for the DTWT – Discrete time MRA- Basis functions for the DTWT – PRQMF filter banks.

UNIT- IV	DISCRETE WAVELET TRANSFORM	9

Filter Bank and sub band coding principles - Wavelet Filters - Inverse DWT computation by Filter banks -Basic Properties of Filter coefficients - Choice of wavelet function coefficients - Mallat's algorithm for DWT - Lifting Scheme: Wavelet Transform using Polyphase matrix Factorization – Geometrical foundations of lifting scheme - Lifting scheme in Z –domain.

UNIT- V	APPLICATIONS	9

Signal Compression-Image Compression using DWT – Sequential / Progressive - JPEG 2000 standard - Image denoising - Edge detection and object Isolation and Object Detection - Image Fusion - Haar wavelet packets, Introduction to second generation wavelets.

Total Instructional hours: 45

Approved By BoS Chairman

Reference Books	
1.	Sidney Burvus C, Ramesh A.Gopinath haito, “Introduction to wavelets and wavelet Transform”, Prentice Hall International, 1995.
2.	Gilbert Strang, “Linear Algebra and its Applications”, 3rd Edition.
3.	Goswami J.C, Chan A.K, “Fundamentels of wavelets”, John wiley and sons, 1999.
4.	Strang G, Nguyen T, “Wavelets and Filter Banks”, Wellesley Cambridge Press, 1996.
5.	Vetterli M, Kovacevic J, “Wavelets and Sub-band Coding”, Prentice Hall, 1995.
6.	Mallat S, “Wavelet Signal Processing”, Academic Press, 1996.

Course Outcomes: Students will be able to	
CO1	Illustrate the fundamentals of vectors, signals, Hilbert and Fourier signal spaces.
CO2	Apply continuous wavelet transform for image processing.
CO3	Analyze signals using Multi Resolution Analysis.
CO4	Apply discrete wavelet transform for image processing.
CO5	Assess the different family of wavelets for real-time applications.

Approved By BoS Chairman

M.E.	M23VDE204-SYSTEM ON CHIP DESIGN (Common to VLSI & AE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce SoC concepts.
2.	To study the system level modelling.
3.	To learn the hardware/software co-design principles.
4.	To familiar with system synthesis.
5.	To learn the hardware/software co-verification principles.

UNIT-I	INTRODUCTION	9

Introduction to SoC Design, system level design, methodologies and tools, system hardware: IO, communication, processing units, memories; operating systems: prediction of execution, real time scheduling, embedded OS, middle ware; Platform based SoC design, multiprocessor SoC and Network on Chip, Low power SoC Design.

UNIT-II	SYSTEM LEVEL MODELLING	9

SystemC: overview, Data types, modules, notion of time, dynamic process, basic channels, structure communication, ports and interfaces, Design with examples.

UNIT-III	HARDWARE SOFTWARE CO-DESIGN	9

Analysis, partitioning, high level optimisations, real-time scheduling, hardware acceleration, voltage scaling and power management; Virtual platform models, co-simulation and FPGAs for prototyping of HW/SW systems.

UNIT-IV	SYNTHESIS	9

System synthesis: Transaction Level Modelling (TLM) based design, automaticTLM generation and mapping, platform synthesis; software synthesis: code generation, multi task synthesis, internal and external communication; Hardware synthesis: RTL architecture, Input models, estimation and optimisation, resource sharing and pipelining and scheduling.

Approved By BoS Chairman

UNIT-V	SOC VERIFICATION AND TESTING	9
SoC and IP integration, Verification: Verification technology options, verification methodology, overview: system level verification, physical verification, hardware/software co-verification; Test requirements and methodologies, SoC design for testability - System modelling, test power dissipation, test access mechanism, Case Study.		
Total Instructional hours:45		

Course Outcomes: Students will be able to	
CO1	Outline the basics of SoC design
CO2	Explain the modelling process
CO3	Analyse and design the software hardware models
CO4	Explain the synthesis process
CO5	:Design the test mechanism for SoC test and verification

Text Books	
1.	D.Black,J.Donovan, "System C:From the Ground Up", Springer,2004.
2.	D.Gajski,S.Abdi,A.Gerstlauer,G.Schirner, "Embedded System Design: Modeling, Synthesis, Verification", Springer,2009.

Reference Books	
1.	C.SivaRam Murthy and B.S.Manoj, "AdHoc Wireless Networks—Architectures and Protocols", Pearson Education,2004.
2.	ErikLarson,"Introduction to advanced system-on-chip test design and optimization",Springer,2005.

Approved By BoS Chairman

B.E	M23VDE305 - MEMS AND NEMS	L	T	P	C
		3	0	0	3

Course Objectives

1.	To introduce the concepts of micro-electromechanical devices.
2.	To know the fabrication process of Microsystems.
3.	To know the design concepts of micro sensors.
4.	To know the design concepts of micro actuators.
5.	To familiarize concepts of quantum mechanics and nano systems.

UNIT- I	INTRODUCTION AND FABRICATION OF MEMS	9

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro-accelerometers and Micro fluidics, Materials for MEMS: Silicon, silicon compounds, polymers, metals. Photolithography, Ion Implantation, Diffusion, Oxidation, Dry and wet etching, Bulk Micromachining, Surface Micromachining, LIGA.

UNIT- II	INTRODUCTION AND FABRICATION OF NEMS	9

Introduction to NEMS, Nano scaling, classification of nano structured materials, Applications of nanomaterials. Synthesis routes – Bottom up and Top down approaches. Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation.

UNIT- III	DESIGN OF MEMS SENSORS AND ACTUATORS	9

Acoustic sensor – Quartz crystal microbalance, Surface acoustic wave, Flexural plate wave, shear horizontal; Vibratory gyroscope, Pressure sensors, Electrostatic actuators, piezoelectric actuators, Thermal actuators, Actuators using shape memory alloys, Microgrippers, Micromotors, Microvalves, Micropumps.

UNIT- IV	RF AND BIO MEMS	9

Introduction to RF MEMS technologies: Need for RF MEMS components in communications, space and defense applications, Materials and fabrication technologies, Special considerations in RF MEMS design. Case studies: Micro-switches BioMEMS- Drug delivery, Electronic nose, Bio chip.

UNIT- V	NANOSYSTEMS AND QUANTUM MECHANICS	9

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

Total Instructional hours: 45

Approved By BoS Chairman

Reference Books	
1.	Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw Hill, 2002.
2.	Murty B.S, Shankar P, Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013
3.	Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures",CRC Press, 2002
4.	Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006.
5.	Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press,2012.
6.	Mahalik N P, MEMS, Tata McGraw Hill, 2007.
7.	Manouchehr E Motamedi, MOEMS: Micro-Opto-Electro-Mechanical Systems, SPIE press, First Edition, 2005.

Course Outcomes: Students will be able to	
CO1	Outline the concepts of micro-electromechanical devices
CO2	Explain the fabrication process of Microsystems
CO3	Design the concepts of micro sensors
CO4	Design the concepts of micro actuators
CO5	Explain concepts of quantum mechanics and nano systems

Approved By BoS Chairman

PROFESSIONAL ELECTIVE–V

Approved By BoS Chairman

B.E	M23VDE306 – MACHINE LEARNING AND ALGORITHM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives

1.	To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
2.	To explore the different supervised learning techniques including ensemble methods
3.	To learn different aspects of unsupervised learning and reinforcement learning
4.	To compare the k means and hierarchal clustering technique
5.	To know the selection of algorithm for specific applications.

UNIT- I	INTRODUCTION AND MATHEMATICAL FOUNDATIONS	9

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

UNIT- II	SUPERVISED LEARNING	9

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms

UNIT- III	UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING	9

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning IC.

UNIT- IV	MAIN ALGORITHMS USED IN ML	9

Linear Regression, Decision Trees, K-nearest Neighbour, Collaborative Filtering, Dimensionality Reduction Technique, Logistic Regression, Support Vector Machine.

UNIT- V	NAIVES BAYES	9

Conditional Probability and Its Intuition, Bayes' Theorem, Naive Bayes -With One Feature, Conditional Independence in Naive Bayes, Deciphering Naive Bayes, Introduction - Naive Bayes for Text Classification, Document Classifier - Pre Processing Steps, Document Classifier - Worked out Example, Laplace Smoothing.

Total Instructional hours: 45

Approved By BoS Chairman

Text Books	
1.	APPLIED MACHINE LEARNING by M. GOPAL, MC GRAW HILL
2.	Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020)
3.	Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition

Reference Books	
1.	Introduction To Machine Learning With Python by Andreas C. Müller, SARAH GUIDO, O Reilly Publishing.
2.	Trevor Hastie, Robert Tibshirani, and Jerome Friedman - The Elements of Statistical Learning: Data Mining, Inference, and Prediction - Springer, 2nd edition.

Course Outcomes: Students will be able to	
CO1	Understand the fundamental concepts and mathematical foundations of machine learning and types of problems tackled by ML techniques
CO2	Applying different supervised learning techniques like Regression, Classification and SVM including ensemble methods
CO3	Analyzing different unsupervised learning techniques and reinforcement learning.
CO4	Appreciate the mathematical background behind popular ML algorithms.
CO5	Ensure awareness about importance of conditional algorithms, Classifier and Naive Bayes concepts in ML

Approved By BoS Chairman

B.E	M23AEE303 – ADVANCED DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives

1.	To understand the fundamentals of digital image processing.
2.	To learn concept of color image processing technique.
3.	To learn morphological image processing algorithms.
4.	To learn segmentation algorithms and descriptors for image processing.
5.	To study object recognition and image processing applications.

UNIT- I	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	9

Elements of Visual Perception- Image acquisition, digitization- Histogram - Image enhancement – Spatial filters for smoothing and sharpening – Discrete 2D transforms - DFT, DCT, Walsh-Hadamard, Slant, KL, Wavelet Transform – Haar wavelet.

UNIT- II	COLOR IMAGE PROCESSSING	9

Color Image Fundamentals-Color Models- RGB, CMY, CMYK and HSI Color Models- Pseudocolor Image Processing - Intensity Slicing- Intensity to Color transformations -Basics of Color Image Processing- Color Transformation - Color Image Smoothing and Sharpening- Color Segmentation - Noise in Color Images.

UNIT- III	MORPHOLOGICAL IMAGE PROCESSING	9

Preliminaries- Basic Concepts from Set Theory-Logic Operations Involving Binary Images - Dilation and Erosion –Opening and Closing - Hit-or-Miss Transformation - Basic Morphological Algorithms - Boundary Extraction- Region Filling- Extraction of Connected Components- Convex Hull- Thinning- Thickening- Skeletons- Pruning- - Gray-Scale Morphology, Case Study

UNIT- IV	SEGMENTATION, REPRESENTATION AND DESCRIPTION	9

Edge Detection - Edge Linking and Boundary Detection -Thresholding- Segmentation by Morphological Watershed Segmentation Algorithm - Use of Markers- Representation and Boundary Descriptors, Case Study.

UNIT- V	3D IMAGE VISUALIZATION	9

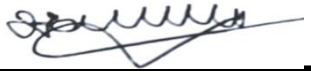
Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

Total Instructional hours: 45

Approved By BoS Chairman

Reference Books	
1.	Rafael C. Gonzalez, "Digital Image Processing", Pearson Education, Inc., 3rd Edition, 2008.
2.	Milman Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Brooks/Cloe, Vikas Publishing House 2nd Edition, 1999.
3.	Khalid Sayood, "Data Compression", Morgan Kaufmann Publishers (Elsevier)., 3rd Edition, 2006.
4.	Rafael C. Gonzalez, Richards E.Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
5.	Willam K.Pratt, "Digital Image Processing", John Wiley, New York, 2002.
6.	Rick S.Blum, Zheng Liu," Multisensor image fusion and its Applications", Taylor & Francis, 2006.

Course Outcomes: Students will be able to	
CO1	Explain about image acquisition, digitization and spatial filters for enhancement
CO2	Outline color image processing techniques
CO3	Apply morphological image processing algorithms
CO4	Apply segmentation algorithms and descriptors for image processing
CO5	Examine neural networks, fuzzy logic, genetic algorithms in object recognition,compression, watermarking and steganography algorithms to images



Approved By BoS Chairman

B.E	M23AEE304 - PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

Course Objectives

1.	To learn about supervised pattern classifiers.
2.	To learn about unsupervised pattern classifiers.
3.	To familiarize about different feature extraction techniques.
4.	To explore the role of Hidden Marko model and SVM in pattern recognition.
5.	To study the application of Fuzzy logic and Neural Network for pattern classifier.

UNIT- I	PATTERN CLASSIFIER	9

Overview of Pattern recognition – Discriminant functions – Supervised learning –Parametric estimation – Maximum Likelihood Estimation – Bayes Theorem – Bayesian Belief Network, Naive Bayesian Classifier.

UNIT- II	CLUSTERING	9

Clustering for unsupervised learning and classification–Clustering concept-Types of Clustering – C Means algorithm –Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters.

UNIT- III	FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION	9

Principle component analysis, Independent component analysis, Linear discriminant analysis, Feature selection through functional approximation – Elements of formal grammars, Syntactic description – Stochastic grammars – Structural Representation, Case Study.

UNIT- IV	HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE	9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection, SVM Applications.

UNIT- V	RECENT ADVANCES	9

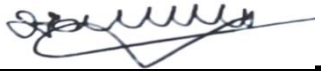
Fuzzy Set Theory, Fuzzy and Crisp Classification, Fuzzy Clustering, – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception-Elementary Neural Network for Pattern Recognition-ADALINE.

Total Instructional hours: 45

Approved By BoS Chairman

Reference Books	
1.	Andrew Webb, “Stastical Pattern Recognition”, Arnold publishers, London, 1999.
2.	C.M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
3.	M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer, 2011.
4.	Menahem Friedman and Abraham Kandel, “Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific publishing Co. Ltd, 2000.
5.	Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992.
5.	R.O. Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2001.
7.	S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press, 2009.

Course Outcomes: Students will be able to	
CO1	Outline the concepts of supervised classifiers.
CO2	Outline the concepts of Clustering.
CO3	Classify the data and identify the patterns.
CO4	Make use of feature set and select the features from given data set.
CO5	Apply fuzzy logic and genetic algorithms for classification problems.



Approved By BoS Chairman

B.E	M23AEE305 - SECURE COMPUTING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

1.	To learn about computer security and management.
2.	To learn the hardware security.
3.	To study about the security in OS and its assembly.
4.	To study advanced computer architecture.
5.	To learn security issues in various types of computing networks.

UNIT- I	COMPUTER SECURITY AND MANAGEMENT	9

Overview of Computer Security, Threats, Malware, Vulnerabilities, Authentication, Access Control, Security Management Models, Security Management Practices, Protection Mechanisms, Legal aspects of security, Ethical Hacking.

UNIT- II	HARDWARE SECURITY	9

Need for Hardware Security, Computer Memory and storage, Bus and Interconnection, I/O and Network Interface, CPU; Side channel Analysis: Power Analysis Attack, Timing Attack, Fault attack. Countermeasures of Side Channel Attack, Secure Hardware Intellectual Properties, Physically Unclonable Functions(PUFs), Secure PUF.

UNIT- III	ASSEMBLY AND OPERATING SYSTEMS SECURITY	9

Opcode, Operands, Addressing Modes, Stack and Buffer Overflow, FIFO and M/M/1 Problem, Kernel, Drivers and OS Security; Secure Design Principles, Trusted Operating Systems, Trusted System Functions.

UNIT- IV	ADVANCED COMPUTER ARCHITECTURE	9

Security aspects: Multiprocessors, parallel processing, Ubiquitous computing, Grid, Distributed and cloud computing, Internet computing, Virtualization.

UNIT- V	SECURITY	9

Design Principles for Secure System, Virtualization and Security ,Distributed Systems Security – Basics **,** Database Security – Basics, Inference Attacks & Data Privacy , Database Security – Multi-Level Secure Databases.

Total Instructional hours: 45

Approved By BoS Chairman

Reference Books	
1.	Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Fourth Edition, Pearson Education, 2007.
2.	Debdeep Mukhopadhyay, Rajat Subhra Chakraborty, “Hardware Security - Design Threats and Safeguards”, CRC Press, 2015.
3.	Michael Whitman, Herbert J. Mattord, “Management of Information Security”, Third Edition, Course Technology, 2010.
4.	Shuangbao Wang, Robert S.Ledley, “Computer Architecture and Security”, Wiley, 2013.
5.	William Stallings, “Network Security Essentials, Applications and Standards”, Dorling Kindersley I P Ltd, Delhi, 2008

Course Outcomes: Students will be able to	
CO1	Outline the concepts of security management.
CO2	Explain about the hardware security.
CO3	Outline the operating system functions.
CO4	Explain the various processing and computing methods.
CO5	Classify the various security issues.

Approved By BoS Chairman

M.E.	M23AEP301 - PROJECT WORK (PHASE I)	L	T	P	C
		0	0	12	6

Course Objectives:

1. To enable a student to do an individual project work this may involve design,modelling, simulation and/or fabrication.
2. To analyse a problem both theoretically and practically.
3. To motivate the students to involve in research activities leading to innovativesolutions for industrial and societal problems.

COURSE DESCRIPTION:

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the third semester and Phase-II during the final semester. Phase-I shall be pursued for a minimum of 12 periods per week and Phase — II in 24 periods per week. In each phase, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Course Outcomes:
Students will be able to

CO1: Identify the area, narrow dine the problem and understand the problem thoroughly and provide an appropriate solution.

CO2: Show the systematic literature survey which helps to build the knowledge in the chosen field by using the existing journal references

CO3: Construct a mathematical model for the system under study.

CO4: Choose and get proficiency over the software for simulation and analysis.

CO5: Utilize the findings of the phase I work in conferences/journals.

Approved By BoS Chairman

Semester-IV

Approved By BoS Chairman

M.E.	M23AEP401 - PROJECT WORK (PHASE II)	L	T	P	C
		0	0	24	12

Course Objectives:

1. To enable a student to do an individual project work this may involve design,modelling, simulation and/or fabrication.
2. To analyse a problem both theoretically and practically.
3. To motivate the students to involve in research activities leading to innovativesolutions for industrial and societal problems.

COURSE DESCRIPTION:

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the third semester and Phase-II during the final semester. Phase-I shall be pursued for a minimum of 12 periods per week and Phase — II in 24 periods per week. In each phase, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Course Outcomes:
Students will be able to

CO1: Identify the area, narrow dine the problem and understand the problem thoroughly and provide an appropriate solution.

CO2: Show the systematic literature survey which helps to build the knowledge in the chosen field by using the existing journal references

CO3: Construct a mathematical model for the system under study.

CO4: Choose and get proficiency over the software for simulation and analysis.

CO5: Utilize the findings of the phase I work in conferences/journals.

Approved By BoS Chairman