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
M23CEP201	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 andInterface Electronics	PC	3	3	0	0	3	40	60	100
M23AET103	Advanced DigitalSystemDesign	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										
M23CEP201	Article Writing and Seminar	CEC	2	0	0	2	1	40	60	100

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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.

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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.
4.	E.O.Doeblin, "Measurement System: Applications and Design", McGraw Hill publications.
5.	Graham Brooker, "Introduction to Sensors for ranging and imaging",Yesdee, 2009.

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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.	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

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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

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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.

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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.

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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

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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

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Professional Elective - I

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M.E.	M23AEE102 - ELECTRO MAGNETIC 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	EMIMITIGATION 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

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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	**EMITEST 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	Outline the basic theory behind EMI
CO2	Explain the coupling process
CO3	Analyze the mitigation techniques
CO4	Outline about different standards
CO5	Compare EMI test methods

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Reference Books	
1.	BemhardKeiser, “Principles of Electromagnetic Compatibility”,3rd Edition, Artech house, Norwood,1986.
2.	ClaytonPaul,“Introduction to Electromagnetic Compatibility”, Wiley Inter science, 2006.
3.	DarylGerke and WilliamKimmel, EDN’s Designer’s Guide to Electro magnetic Compatibility”, Elsevier Science &Technology Books, 2002.
4.	Dr Kenneth L Kaiser,“The Electromagnetic Compatibility Handbook”, CRC Press, 2005.
5.	Electromagnetic Compatibility by Norman Violette, Published by Springer,2013.
6.	Donald R. J, “Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications”, Volume 1 of A Handbook Series on Electromagnetic Interference and Compatibility, White Publisher, Don white consultants Original from the University of Michigan Digitized,6 Dec, 2007.
7.	Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons Inc, Newyork, 2009.
8.	V Prasad Kodali, “Engineering Electromagnetic Compatibility”, IEEE Press, Newyork, 2001.

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PROFESSIONAL ELECTIVE- III

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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.

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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

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