ACADEMIC YEAR (2022-2023)						
			J K K Munirajah college of Technology, T.N.Palayam			Metric No 1.3.2
S.No	Name of the course	course code	programme offering	Contents mapping to		Number of students
				project work	internship	
(2022-2023) Regulation-2021						
1	Project Work I	AP4311	M.E. Applied Electronics	✓	✓	3
2	Project Work II	AP4411	M.E. Applied Electronics	✓	✓	3
3	Semiconductor Devices and Modeling	AP4153	M.E. Applied Electronics	✓		2
4	Industrial Internet of Things	AP4251	M.E. Applied Electronics	✓	✓	3
5	Embedded Systems	AP4203	M.E. Applied Electronics	✓	✓	3

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AP4153 **SEMICONDUCTOR DEVICES AND MODELING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To acquire the fundamental knowledge and to expose to the field of semiconductor theory and devices and their applications.
- To gain adequate understanding of semiconductor device modelling aspects, designing devices for electronic applications
- To acquire the fundamental knowledge of different semiconductor device modelling aspects.

UNIT I MOS CAPACITORS **9**

Surface Potential: Accumulation, Depletion, and Inversion, Electrostatic Potential and Charge Distribution in Silicon, Capacitances in an MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, MOS under Nonequilibrium and Gated Diodes, Charge in Silicon Dioxide and at the Silicon-OxideInterface, 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, Subthreshold 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**

CMOS Scaling, Constant-Field Scaling, Generalized Scaling, Nonscaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Nonuniform 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 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, Nonideal 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.

UNIT V MATHEMATICAL TECHNIQUES FOR DEVICE SIMULATIONS **9**

Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid

generation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explore the properties of MOS capacitors.

CO2: Analyze the various characteristics of MOSFET devices.

CO3: Describe the various CMOS design parameters and their impact on performance of thedevice.

CO4: Discuss the device level characteristics of BJT transistors.

CO5: Identify the suitable mathematical technique for simulation.

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AP4251	INDUSTRIAL INTERNET OF THINGS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using IoT
- To apply the concept of I0T in the real world scenario

UNIT I INTRODUCTION AND ARCHITECTURE OF IoT **9**

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

UNIT II INDUSTRIAL IoT **9**

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

UNIT III IIOT ANALYTICS **9**

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

UNIT IV IOT SECURITY **9**

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

UNIT V CASE STUDY **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, student will be able to

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

CO2: Understand various IoT Layers and their relative importance.

CO3: Realize the importance of Data Analytics in IoT.

CO4: Study various IoT platforms and Security

CO5: Understand the concepts of Design Thinking.

AP4203	EMBEDDED SYSTEMS	L T P C 3 0 2 4

COURSE OBJECTIVES:

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

UNIT I EMBEDDED SYSTEM OVERVIEW 9

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

UNIT II GENERAL AND SINGLE PURPOSE PROCESSOR 9

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

UNIT III BUS STRUCTURES 9

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

UNIT IV STATE MACHINE AND CONCURRENT PROCESS MODELS 9

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

UNIT V EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND RTOS 9

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

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:

1: Insist students to write a requirements form for a smart phone
2: Compare the use of different Microcontrollers for a particular ESD.
3: Application of a protocol for a specified application.
4: Write a Embedded C code for a given task.
5: design an embedded system for any type of real time application

PRACTICAL LIST:

Exercise - 1

Comparative study of software development tools and design steps with respect to FPGA based and Non - FPGA based (defined logic) embedded system development.

(For Example: consider any Spartan FPGA board for FPGA based Embedded System Consider any cortex- M based board for Non – FPGA based Embedded system)

Exercise - 2

Implement adder and decoder logic blocks in any one of the FPGA chip based development board.

Exercise - 3

Design and development of UART protocol logic block in any one of FPGA chip based development board.

Exercise - 4

Consider on board LEDS (any four) and timer logic block of cortex- M board. Write a program which enables LEDS to glow in different timing.

Exercise - 5

Consider on board switches and (2x16) LCD display develop a program which displays the status of switch activation.

Exercise - 6

Demonstrate GPIO based I/O interfacing by considering LM 35 temperature sensor and cortex- M board.

Exercise - 7

Development of one interfacing scheme which transmits data from one cortex- M board to another cortex- M board using on chip CAN logic blocks.

Exercise - 8

Consider on board EPROM IC of Cortex- M board by utilizing on chip I2c logic block transmit data to EPROM IC and receive stored data from EPROM IC.

Exercise - 9

Consider on board LEDs (4 Nos) of Cortex - M board. Demonstrate time management service concept of RTOS for glowing all four LEDS in different timings.

Exercise - 10

Consider two ultrasonic sensors which are interfaced with cortex- M board. Both are located some distance (2 meters) apart vertically so that the system can identify the movement of object in term of distance. consider data reception and display of each sensor as two different tasks by RTOS. Establish a RTOS based system to recognize the height of moving object.

Objective:

a. Able to understand embedded system design flow in FPGA chip based and Non - FPGA chip based embedded development boards.
b. Able to create simple logic blocks in FPGA chip based boards.
c. Able to understand interfacing scheme for Non - FPGA board scheme for Non - FPGA board
d. Able to utilize RTOS functions for interfacing practice

COURSE OUTCOMES:

At the end of the course the student will be:

CO1: Able to design an Embedded system
CO2: Understand a general and single purpose processor
CO3: Explain different protocols

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