

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-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, 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 the device.

CO4: Discuss the device level characteristics of BJT transistors.

CO5: Identify the suitable mathematical technique for simulation.



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(Autonomous)

T.N.Palayam, Gobi (Tk),

Erode (Dt) - 638 506

COURSE OBJECTIVE:

- To provide the students a deep insight in to the working of different switching devices with respect to their characteristics
- To analyze different converters with their applications.
- To study advanced converters and switching techniques implemented in recent technology

UNIT I POWER ELECTRONIC DEVICES AND SEMICONDUCTOR SWITCHES 9

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

UNIT II SCR PERFORMANCE AND APPLICATIONS 9

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

UNIT III INVERTERS AND VOLTAGE CONTROLLERS 9

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

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

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

UNIT V AUTOMATION AND CONTROL 9

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

TOTAL :45 CREDITS**COURSE OUTCOMES:**

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

- CO1:** Describe the characteristics, operation of power switching devices and identify their ratings and applications.
- CO2:** Understand the requirements SCR Protection, Describe the Functioning of SCR their Construction and Performance.
- CO3:** Analyze and Design the Converter Based on SCR for various Industrial Applications.
- CO4:** Demonstrate ability to understand High Frequency, Heating Systems, Timers, Relevant Sensors & Actuator and their Application in Industrial Setting.

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

REFERENCES:

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



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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 IOT 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.

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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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COURSE OBJECTIVES:

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

UNIT I INTRODUCTION TO PRINTED CIRCUIT BOARD 9

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

UNIT II DESIGN RULES FOR PCB 9

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

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

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

UNIT IV INTRODUCTION PRINTED CIRCUIT BOARD PRODUCTION TECHNIQUES 9

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

UNIT V PCB DESIGN FOR EMI/EMC 9

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

SUGGESTED ACTIVITIES:

1. Using any Electronic design automation (EDA) software, Practice following PCB Design steps (Open source EDA Tool KiCad Preferable or equivalent) Example circuit Basic RC Circuit Schematic Design: Familiarization of the Schematic Editor, Schematic creation,

Annotation, Netlist generation Layout Design: Familiarization of Footprint Editor, Mapping of components, Creation of PCB layout Schematic Create new schematic components Create new component footprints.

2. Fabricate single-sided PCB, mount the components and assemble in a cabinet for any one of the circuits mentioned below.
3. Regulator circuit using 7805.
4. Astable or Monostable multivibrator using IC555
5. RC Phase-shift or Wein-bridge Oscillator using transistor.
6. 4 bit binary /MOD N counter using D-Flip flops.
7. Design a 8051 Development board having Power section consisting of IC7805, capacitor, resistor, headers, LED, Serial communication section consisting of MAX 232, Capacitors, DB9 connector, Jumper, LEDs, Reset & Input/ output sections consisting of 89C51 Microcontroller, Electrolytic Capacitor, Resistor, Jumper, Crystal Oscillator, Capacitors.
8. Touch plate switches – transistorized or 555 based
9. Doorbell/cordless bell
10. Clapping switch and IR switch
11. Blinkers
12. Cell charger, battery charger, mobile charger
13. Fire/smoke/intruder alarm
14. Liquid level controller
15. Audio amplifiers

COURSE OUTCOMES:

Upon the completion of this course, students will demonstrate the ability to:

CO1: Appreciate the necessity and evolution of PCB, types and classes of PCB.

CO2: Understand the steps involved in schematic, layout, fabrication and assembly process of PCB design.

CO3: Apply advanced techniques, skills and modern tools for designing and fabrication of PCBs.


CO4: Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.

CO5: Design (schematic and layout) and fabricate PCB for simple circuits.

TOTAL : 45+30=75 PERIODS

REFERENCES

1. Printed circuit board design ,fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill 2006
2. Printed Circuits Handbook, Sixth Edition, by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016
3. Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition 2009.
4. Introduction to System-on-Package, Rao R ,Tummala, & Madhavan Swaminathan, McGraw Hill, 2008
5. EMC and Printed circuit board ,Design theory and layout, Mark I Montrose IEEE compatibility society
6. Electronic Product Design Volume-I by S D Mehta, S Chand Publications
7. Open source EDA Tool KiCad Tutorial: <http://kicad-pcb.org/help/tutorials/>
8. PCB Fabrication user guide page: <http://www.wikihow.com/Create-Printed-Circuit-Boards> , http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication/ ,
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10. PCB Fabrication at home(video): <https://www.youtube.com/watch?v=mv7Y0A9YeUc>,
11. <https://www.youtube.com/watch?v=imQTCW1yWkg>


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