Progressive Education Society's

Modern College of Engineering

Department of Electronics & Telecommunication Engineering

Curriculum Booklet
Final Year
2015-Pattern
Semester -I

Vision of Institute

"To create a collaborative academic environment to foster professional excellence and ethical values"

Mission of the Institute

1. To develop outstanding engineers & professionals with high ethical standards capable of creating and managing global enterprises.
2. To foster innovation and research by providing a stimulating learning environment.
3. To ensure equitable development of students of all ability levels and backgrounds.
4. To be responsive to changes in technology, socio-economic levels and environmental conditions.
5. To foster and maintain mutually beneficial partnerships with alumni and industry.

Vision of Department

To impart holistic Education in Electronics and Telecommunication Engineering to create engineers equipped to meet the challenges of a dynamic, global environment

Mission of Department

1. To impart quality Education in the field of Electronics, Communication and Signal processing, by providing a comprehensive learning experience.
2. To provide avenues to encourage students to continue education in diverse fields.
3. To develop competent Engineers, well-versed in multi-disciplinary fields.
4. To inculcate ethical and professional values in our students to endow society with responsible citizens.

Program Educational Objectives

The graduates of Electronics and Telecommunication Engineering Department of P.E. S's MCOE will

1. Apply design and development skills related to E&TC Engineering to solve real life problems
2. Pursue careers as Entrepreneurs, Engineers or Managers in Private/Government sectors or continue their education in the same or multi-disciplinary fields.
3. Practice ethical standards, adhere to social responsibilities and lead teams of professionals in the global environment.

Program Specific Outcomes

At the time of graduation, the students of the ENTC department of PES's MCOE, will be able to

1. Apply the Knowledge in E&TC engineering to understand, evaluate, design, or implement the electronics, communication, embedded or information systems or sub- systems using conventional or modern tools/techniques
2. Take up jobs in Government or private sectors, undertake research, create jobs or pursue further studies in any of the fields of E&TC, in India or Abroad.
3. Incorporate ethical & social responsibility to complete projects in the E&TC and allied fields and use effective written and oral communication skills to present the work.

Program Outcome

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of

the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11.Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12.Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Structure

Semester I												
Course Code	**Course**	**Teaching SchemeHours / Week**			**Semester Examination Scheme ofMarks**						**Credits**	
		Theory	**Tut**	**Pract**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH/TW**	**PR+OR**
404181	VLSI Design& Technology	3	--	--	30	70	--	--	--	100	3	--
404182	Computer Networks & Security	4	--	--	30	70	--	--	--	100	4	--
404183	Radiation & Microwave Techniques	3	--	--	30	70	--	--	--	100	3	--
404184	Elective I	3	--	--	30	70	--	--	--	100	3	--
404185	Elective II	3			30	70	--	--	--	100	3	--
404186	Lab Practice -I (CNS+ RMT)	--	--	4	--	--	50	--	50	100	--	2

404187	Lab Practice -II (VLSI + Elective I)	--	--	4	--	--	50	50		100	--	2
404188	Project Stage I	-	2	--	--	--	-	--	50	50	--	2
	Audit Course 5	--	--	--	--	--	--	--	--	--	----	
	Total	16	2	8	150	350	100	50	100	750	16	6
										Total Credits		**22**

Elective I	**Elective II**	**Audit Course 5**
1 Digital Image and VideoProcessing	1. Wavelets	1. Green Energy
2. Industrial Drives and Control	2. Electronics Product Design	2. Human Behaviour
3. Embedded Systems & RTOS	3. Optimization Techniques	
4. Internet of Things	4. Artificial Intelligence	
	5. Electronics in agriculture	

1. Name of the Course – VLSI Design and Technology

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	3	-	2

Online/ In-sem	Theory	Practical (Lab practice I)	Oral	Term-work (Lab practice I)	Total Marks	Credit
30	70	50		50	200	-

1.1 Syllabus

Unit I : HDL Design **7 Hrs**

Design Flow, Language constructs, Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, HDL modeling of Combinational, Sequential circuits and FSM. Simulations, Synthesis, Efficient coding styles, Hierarchical and flat designs, Partitioning for synthesis, Pipelining, Resource sharing.

Unit II : Digital design and Issues **6 Hrs**

Sequential synchronous machine design, Moore and Mealy machines, HDL code for Machines, FIFO. Metastability and solutions, Noise margin, Fan-out, Skew, Timing considerations, Hazards, Clock distribution, Clock jitter, Supply and ground bounce, Power distribution techniques, Power optimization, Interconnect routing techniques; Wire parasitic, Signal integrity issues. I/O architecture.

Unit III : PLD Architectures and applications **6 Hrs**

Design Flow. CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications, Applications. The Simulation and Synthesis Tools, FPGA synthesis and implementation.

Unit IV: Digital CMOS circuits **7 Hrs**

N-MOS, P-MOS and CMOS, MOSFET parasitic, Technology scaling, Channel length modulation, Hot electron effect, Velocity saturation, CMOS Inverter, Device sizing, CMOS combinational logic design, Power dissipations, Power delay product, Body Effect, Rise and fall times, Latch Up effect, transmission gates.

Unit V : Application Specific Integrated Circuit **7 Hrs**

Design Flow, Cell design specifications, Spice simulation, AC and DC analysis, Transfer Characteristics, Transient responses, Noise analysis, Lambda rules, Design rule check, Fabrication methods of circuit elements, Layout of cell, Library cell designing for NAND & NOR, Circuit Extraction, Electrical rule check, Layout Vs. Schematic, Post-layout Simulation and Parasitic extraction, Design Issues like Antenna effect, Electro migration effect, Cross talk and Drain punch through, Timing analysis

Unit VI: Testability

Types of fault, Need of Design for Testability (DFT), DFT Guideline, Testability, Fault models, Path sensitizing, Test pattern generation, Sequential circuit test, Built-in Self Test, JTAG & Boundary scan, TAP Controller.

1.2 Course Objectives

1. Explore HDL (Hardware Design Language) based design approach.
2. Describe an overview of System on Chip issues and PLD architectures with advanced features.
3. Explain digital CMOS logic design.
4. Discuss an overview of ASIC design and an importance of testability in logic circuit design.

1.3 Course Outcomes

At the end of the course the Student will be able to:

CO1: Model the fundamental blocks of a VLSI circuits using VHDL.

CO2: Apply knowledge of real time issues for design of digital circuits and its testability.

CO3: Design of digital CMOS circuits for specified applications.

CO4: Describe PLDs and various issues in design of an ASIC.

1.4 Text Books:

1. Charles H. Roth, ―Digital systems design using VHDL‖, PWS.

2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication.

3.Steve Kilts "Advanced FPGA Design Architecture, Implementation and Optimization‖,Wiley.

1.5 Reference Books:

1. E. Weste, David Money Harris, ―CMOS VLSI Design: A Circuit &System Perspective‖, Pearson Publication

2.R. Jacob Baker, ―CMOS Circuit Design, Layout, and Simulation‖, 3E, Wiley-IEEE Press

3.John F. Wakerly, ―Digital Design Principles and Practices‖ , 3E, Prentice Hall

4.M. Morris Mano , ―Digital Design‖, 3E , Pearson

5.CemUnsalan, Bora Tar, ―Digital System Design with FPGA: Implementation Using Verilog and VHDL‖, McGraw-Hill

1.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

www.NPTEL.com, www.xilinx.com

1. Stephen Brown, "Fundamentals of Digital Logic with VHDL Design", McGraw Hill Publication.

2.Douglas Perry, "VHDL Programming by Examples", McGraw Hill Publication.

1.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned	CO Addressed
1.	I	HDL Design	T1,T3,R6	7	**CO1**
2.	II	Digital design and Issues	T1,T2,R4,R7,R8	6	**CO2**

3.	III	PLD Architectures and applications	T1,T2	6	**CO1**
4.	IV	Digital CMOS circuits	R1	7	**CO3**
5.	V	Application Specific Integrated Circuit	T1,R1,R2	7	**CO4**
6.	VI	VLSI Testing and Analysis	T1	6	**CO4**

1.8 Unit wise Lecture Plan

1.8 a. Unit No.-I

Pre-requisites:- Digital Electronics (SE-Semester- I)- Combinational Circuits

Objectives:- Explore HDL (Hardware Design Language) based design approach.

Outcomes:- Model the fundamental blocks of a VLSI circuits using VHDL. (Unit I) (level 3, Apply)

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Sr. No.	Details of the Topic to be covered	References	CO Addressed
1	Design flow	T1: 52-53 OR R3: 241-243	**CO1** 1.4.1-2 2.1.2-2 2.3.1- 2 3.2.2-2
2	Language Constructs, Modeling styles	R6: 4-13	
3	Data objects, Data types, Operators	R6: 14-27	
4	Sequential statements	R6: 28-34	
5	Concurrent statements	R6: 44-59	
6	Packages and Libraries	R6: 78-79	
7	Functions, Procedures, Attributes, Operator overloading, Resolution functions	T1: 389-400	
8	Mealy and Moore machine sequence detector and other state machine examples	T1: 17-28	

9	Compilation, Simulation, and Synthesis	T1: 77-81, 84-87	
10	Hierarchical and flat designs	R6: 123-125	
11	Partitioning for synthesis	T3: 188-190	
12	Resource sharing	T3: 208-210	
13	Pipelining	T3: 211-213	
14	Efficient coding styles	Efficient coding styles.pdf	

Question Bank: Theory

Theory Questions-CO1 (1.4.1-2,2.1.2-2,2.3.1- 2,3.2.2-2)

Q. 1	What is data object? Describe types of data objects.
Q. 2	What are data types in VHDL?
Q. 3	What is entity? What is function of entity in VHDL code?
Q. 4	What is Architecture? What is function of Architecture in VHDL code?
Q. 5	What is Library? What is function of Library in VHDL code?
Q. 6	What is Process? Explain with example.
Q. 7	What is STD_LOGIC? What is STD_ULOGIC? How many and what values are defined by these packages?

Q. 8	Differentiate between function and procedure.

Q.9	What are Attributes? What are different types of Attributes?
Q.10	Explain any three types of Attributes with example.
Q.11	Clk' event is which type of attribute? Explain.
Q.12	What is generate statement? When is it used? Explain with example.
Q.13	What are different types of modeling? Explain with example.
Q.14	Differentiate between signal and variable.
Q.15	What is FSM? Advantages, Disadvantages and applications of FSM.
Q.16	Compare Mealy and Moore machine.
Q.17	Write a VHDL code and test bench for 8:1 MUX using behavioral
	style of modeling
Q.18	Write a VHDL code for 4-bit adder using one bit adder. Use structural
	style of modeling.
Q.19	Draw FSM state diagram for 1011 Moore sequence detector and write

	VHDL code for it.
Q.20	What is a difference between synthesis and simulation?
Q.21	What do you mean by Partitioning ?what is the need of Partitioning.
Q.22	What is the difference between Hierarchical and flat designs
	***HOT**
Q.23	**Write a VHDL code on 4 bit full adder by using Generate Statement**
Q.24	**Write a VHDL code for asynchronous counter by using Structural modeling style**
Q.25	**Write a VHDL code for FIFO by using Function**

1.8 b: Unit No.-II

Pre-requisites:- (Digital Electronics) SE –Semester –I

Unit III - Sequential Circuits

Objectives: - Describe an overview of System on Chip issues and PLD architectures with advanced features.

Outcomes: - Apply knowledge of real time issues for design of digital circuits and its testability. (Unit II and VI) (level 3, Apply)

Sr. No.	Details of the Topic to be covered	References	CO Addressed

1	Sequential synchronous machine design	Any 2nd year DIGITAL ELECTRONICS TEXTBOOK	**CO2** 1.4.1 -3 3.3.1-2
2	Moore and Mealy machines		
3	HDL code for Machines	**R7**:Topic 8.4 (502-513) (Run the programs in XILINX ISE & show)	
4	FIFO	Should be covered in **PRACTICALS**	
5	Metastability and solutions	**T1**:1.10 (30-35)	
6	Noise margin ,Fan-out	**R8 :** (26 -30)	
7	Skew ,Timing considerations	**R8** :10.3.1(46-48),T2:5.4.3(311-314 in PDF search)	
8	Hazards	**R4** : Topic (9.7) (452-457),T1(12-14) **R7 :** Topic (9.6) (656- 663 in PDF search)	
9	Clock distribution	**T2**:7.3.3 (457-460 in PDF search)	
10	Clock jitter	**R8** :10.3.1(50-51)	
11	Supply and ground bounce	Hand-Written Notes Posted on Group	
12	Power distribution techniques	**T2**:7.3.2 (452-454 in PDF search)	
13	Power optimization	**T2**:5.7 (341-342 in PDF search)	
14	Interconnect Routing techniques	**T2**:7.2.2 (443-451 in PDF search)	
15	Wire parasitic	**T2**:2.4.1 (88-94 in PDF search)	

16	Signal integrity issues	**T2 :** 5.3.2 (294-299 in PDF search)1-Phase,2-Phase Clock , Signal Skew	
17	I/O architecture	**T2**:7.5.2 (469-473 in PDF search)	

Question Bank:
Theory Questions –CO2 (1.4.1 -3, 3.3.1-2)

Q. 1	Write short note on Metastability.
Q. 2	Define Mealy and Moore machine with diagram.
Q. 3	Draw FSM state diagram for 1011 Moore sequence detector and write VHDL code for it
Q. 4	Explain power distribution techniques.
Q. 5	Explain the following: i) Supply and ground bounce ii) Clock Skew
Q. 6	What are limitations of single phase clock? Explain with neat schematic.
Q. 7	What is a need of power optimization? Explain in detail.
Q.8	Explain switch box routing.
Q.9	Explain rules of floor planning.
Q.10	Write a note on I/O architecture.

Q.11	Write a short note on wire parasitic.
	***HOT**
Q.12	**How to achieve the EMI immune chip design?Explain the parasitics involved in routing matrix.**
Q.13	**Draw FSM state diagram for 11101 Melay sequence detector and write VHDL code for it.**

1.8 c. Unit No.-III

Pre-requisites:- (Digital Electronics) SE –Semester –I Unit-V- PLA, PAL, PLD etc.

Objectives: - Describe an overview of System on Chip issues and PLD architectures with advanced features.

Outcomes: - Describe PLDs and various issues in design of an ASIC. (Unit III & V) (level 2, Understand)

Sr. No.	Details of the Topic to be covered	References	CO Addressed
1	Design flow	T1: 52-53	**CO4** 1.4.1-2 2.1.3-2 3.2.1-1
2	CPLD Architecture, Features, Specifications, Applications	T1: 156-160 OR R3: 840-849 (XC9500 family)	
3	FPGA Architecture, Features, Specifications, Applications.	T1: 165-185 AND/OR R3: 850-858 (XC400 family) Note: For architecture refer R3	
4	Implementing functions in FPGA	T1: 310-316	

5	FPGA synthesis and implementation.	T1: 339-348	

Question Bank: Theory
Theory Questions –CO4 (1.4.1-2, 2.1.3-2, 3.2.1-1)

Q. 1	What is need of PLD? Explain technologies involved in it.
Q. 2	Differentiate between FPGA and CPLD.
Q. 3	Explain advantages and disadvantages of ASICs.
Q. 4	Draw block diagram and explain the detail architecture of CPLD.
Q. 5	Draw block diagram and explain the detail architecture of FPGA.
	***HOT**
Q.6	**Compare and contrast FPGA and ASIC digital designing.**
Q.7.	**Draw block diagram of 9500 family. Explain features and give specifications**

1.8 d. Unit No.-IV

Pre-requisites:- Digital Electronics (SE-Semester- I)- study of TT L and CMOS

Objectives: - Explain digital CMOS logic design.

Outcomes: - Design of digital CMOS circuits for specified applications. (Unit IV) (level 6, Create)

Sr. No.	Details of the Topic to be covered	References	CO Addressed
1	N-MOS, P-MOS and CMOS, MOSFET	R1: 61-93, 141-142, 181-204, 327-332,	CO3 1.4.1 – 2 3.2.1-2 3.2.2-3
2	Technology scaling, Channel length modulation		
3	Hot electron effect, Velocity saturation, CMOS Inverter		
4	Device sizing, CMOS combinational logic design		
5	Power dissipations, Power delay product,		
6	Body Effect, Rise and fall times, Latch Up effect, transmission gates		

Question Bank: Theory
Theory Paper-CO3 (1.4.1 – 2, 3.2.1-2, 3.2.2-3)

Q. 1	Advantages and disadvantages of CMOS.
Q. 2	How CMOS does act as a switch?
Q. 3	Draw diagram of NAND, NOR, EXOR logic gates using CMOS and explain working.
Q. 4	Draw DC / Transfer characteristics of inverter. Explain all regions with working of NMOS and PMOS transistor.
Q. 5	What is Body Effect?
Q. 6	What is Hot Electron Effect?
Q. 7	What is Noise Margin?

Q. 8	What is Power delay product?

Q. 9	What is transmission gate? Advantages of transmission gate.
Q.10	Draw diagram of 2:1 mux, 4:1 mux, D-ff, xor gate using transmission gate.
Q.11	What is logical effort?
Q.12	Calculate logical effort of inverter, 2-i/p NOR, 2-i/p NAND.
Q.13	Show that $(W/L)_p=3(W/L)_n$. (Derivation)
Q.14	What is DRC? Explain in detail design rules in CMOS VLSI design.
Q.15	What is channel length modulation? How does it affect performance of MOSFET?
	***HOT**
Q.16	**Give the CMOS inverter DC transfer characteristics and operating regions.**
Q.17	**Design 8:1 Mux by using transmission gate.**

1.8 e. Unit No.-V

Pre-requisites:-

Objectives: - Discuss an overview of ASIC design and an importance of testability in logic circuit design.

Outcomes: - Describe PLDs and various issues in design of an ASIC. (Unit III & V) (level 2, Understand)

Sr. No.	Details of the Topic to be covered	References	CO Addressed
1	Design Flow	T1: 52-53 R2: 97-98 AND R1: 632-634 R2: 8-29 R1: 24-26; 27-29	**CO4** 1.4.1-2 2.1.3-2 3.2.1-1
2	Cell design specifications		
3	Spice simulation, AC and DC analysis, Transfer Characteristics, Transient responses, Noise analysis		
4	Lambda based design rules, Gate layouts		
5	Fabrication methods of circuit elements: Resistors: Interdigitated and Common-Centroid layout	R2: 110-113 R2: 114	
6	Fabrication methods of circuit elements: Capacitors		
7	Fabrication methods of circuit elements: MOSFETs	R2: 120-121	
8	Design verification: Electrical rule check, Design rule check Layout Vs. Schematic	R1: 53	
9	Post-layout Simulation and Parasitic extraction	R1: 643	
10	Antenna effect	R1: 133-134	
11	Electromigration effect	R2: 68	
12	Drain Punchthrough	R1: 252	

13	Crosstalk	R2: 71-72	
14	Static Timing Analysis	R1: 640	

Question Bank: Theory
Theory Paper–CO4 (1.4.1-2, 2.1.3-2, 3.2.1-1)

Q. 1	Explain in detail CMOS IC design flow.
Q. 2	Explain briefly cell design specification
Q. 3	What is SPICE.Explain with design flow SPICE simulation
Q. 4	What is need of layout design rules?
Q. 5	Which lambda rules are used for CMOS layout?
Q. 6	List and explain lambda based design rule
Q. 7	List and explain micron rules
Q.8	What is DRC? Explain in detail design rules in CMOS VLSI design.
Q.9	Which lambda rules are used for CMOS layout?
Q.10	List different Design rule checks
	***HOT**

Q.11	**What are the types of gate arrays in ASIC?**
Q.12	**What is the standard cell-based ASIC design?**
Q.13	**What is the full custom ASIC design?**

1.8 f. Unit No.-VI

Objectives:- Discuss an overview of ASIC design and an importance of testability in logic circuit design.

Outcomes:- Apply knowledge of real time issues for design of digital circuits and its testability. (Unit II and VI) (level 3, Apply)

Sr. No.	Details of the Topic to be covered	References	CO Addressed
1	Types of fault	**T1: 339-361**	**CO4** 1.4.1-2 2.1.3-2 3.2.1-1
2	Need of Design for Testability (DFT)		
3	DFT Guideline, Testability, Fault models,		
4	Path sensitizing, Test pattern generation, Sequential circuit test		
5	Built-in Self-Test, JTAG & Boundary scan, TAP Controller.		

Question Bank: Theory
Theory Question –CO4 (1.4.1-2, 2.1.3-2, 3.2.1-1)

Q. 1	Explain different types of faults.

Q. 2	Define fault coverage. Explain logical & physical faults in detail.

Q. 3	What is the need of design for testability? Explain the different electrical faults.
Q. 4	What is controllability & predictability?
Q. 5	What is testability?
Q. 6	Explain: Partial Scan and Full Scan.
Q. 7	What is need of boundary scan? Explain JTAG with various signals involved in detail.
Q. 8	Write short note on JTAG
Q. 9	Write short note on TAP controller.
Q.10	What is BIST? Explain with suitable example.
	***HOT**
Q.11	**What are the scan-based test techniques?**
Q.12	**What is known as boundary scan register?**
Q.13	**What is fault sampling?**

1.9 List of Practical

The objectives of **Lab Practice-II** are to:

1. Demonstrate digital circuit with HDL, simulate, synthesis and prototype in PLDs.

2. Explain CMOS layout design and simulate using '**Micro-wind'** software.

The outcomes of **Lab Practice-II** are to

- Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
- Design and simulate CMOS layout using '**Micro-wind'** software.

List of Experiments:

Sr. No.	Name of Experiment	CO Addressed
A.	**To write VHDL code, simulate with test bench, synthesis, implement on PLD. [Any 4].**	
1	4 bit ALU for add, subtract, AND, NAND, XOR, XNOR, OR, & ALU pass.	**CO1** 1.4.1-2 2.3.1- 3 2.4.2-2 3.2.2-3 5.1.1-3 5.1.2-3
2	Universal shift register with mode selection input for SISO, SIPO, PISO, & PIPO modes	
3	FIFO memory	
4	Keypad interface	
5	LCD interface	
6.	To write a VHDL code for Half adder using structural style of modeling	
7.	To write a VHDL code for 8:1 Multiplexer.	
8.	To write a Verilog code for NAND, NOR Gate.	
B.	**To prepare CMOS layout in selected technology, simulate with and without capacitive load, comment on rise, and fall times.**	
6	Inverter, NAND, NOR gates, Half Adder	**CO2** 1.4.1 -3 3.3.1-2
7	2:1 Multiplexer using logic gates and transmission gates	
8	Single bit SRAM cell	

Oral Questions

Sr. No.	Questions	CO Addressed
1	Explain Data Objects and Data Types.	
2	What are the different modelling styles in VHDL.	
3	Differentiate concurrent and sequential statement	**CO1**
4	What do you mean by: 1. Architecture 2. Entity 3. Process 4. Package	1.4.1-2
5	Explain different types of wait statements with example.	2.1.2-2
6	Differentiate function and procedure with suitable example.	2.3.1- 2
7	Explain VHDL Attributes with suitable example.	3.2.2-2
8	Mention advantages disadvantages of Test bench.	
9	What is VHDL?	
10	Explain Process Statement? What do you mean by Sensitivity List?	
11	Differentiate Moore and Mealy Machine.	
12	Draw FSM for given sequence 110110 (using Moore and Mealy model).	
13	What do you mean by clock skew? What are the different types of clock skew?	
14	What are different techniques for clock distribution?	**CO2**
15	What are routing techniques?	1.4.1 -3
16	Explain differ types of Hazards?	3.3.1-2
17	What is noise Margin?	
18	What do you mean by Fan in and Fan out?	
19	What is Metastability?	
20	What do you mean by supply and Ground Bounce?	
21	Difference between CPLD and FPGA?	**CO1**

22	Mention important features of CPLD.	1.4.1-2
23	Mention important features of FPGA.	2.1.2-2 2.3.1- 2 3.2.2-2
24	Difference between NMOS and PMOS.	**CO3** 1.4.1 – 2 3.2.1-2 3.2.2-3
25	What are the advantages of Technology Scaling?	
26	What do you mean by HOT Electron effect?	
27	What is Body Effect?	
28	Draw transfer characteristics of Inverter?	
29	Advantages of Sizing.	
30	What is transmission gate? Draw 2:1 Mux by using transmission gate.	
31	How you will define W/L ratio for CMOS combinational Logic design?	
32	What do you mean by Power Delay Product?	
33	Explain rise time and Fall time.	
34	What do you mean by ASIC?	**CO4** 1.4.1-2 2.1.3-2 3.2.1-1
35	What is the difference between ASIC and PLDs?	
36	Mention any two Lambda rule.	
37	What are the advantages of Design Rule Check?	
38	Mention design Issues.	
39	Difference between Layout and Schematic.	
40	What are the different types of Faults?	**CO4** 1.4.1-2 2.1.3-2
41	Define :Controllability and Observality	
42	What do you mean by BIST?	

43	What is the need of Testability?	3.2.1-1
44	Draw Fault Models.	
45	Mention Features of JTAG	
46	Draw flow chart for TAP controller.	
47	What is boundary Scanning	
48	What is difference between Testing and Verification?	
49	Draw one example for Stuck-at-1.	
50	Draw one example for Stuck-at-0.	

2. Name of the Subject – Computer Networks and security

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	04	-	02

In-sem	Theory	Practical	Oral	Term work	Total Marks	Credit
30	70	-	25	25	150	4

2.1 Syllabus

Unit I: Introduction to Local Area Networks
TCP/IP Protocol Suit, Media Access Control: Random Access, Controlled Access- Reservation, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet and Fast Ethernet (100 MBPS), Gigabit Ethernet, 10 Gigabit Ethernet. Wireless LAN: Introduction, IEEE 802.11 Projects, Bluetooth

Unit II: Network Layer Part I
Introduction to Network Layer: Network-Layer Services, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding Of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Mobile IP

Unit III: Network Layer Part II
Unicast and Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP. Next Generation IP: IPv6 Addressing, The Ipv6 Protocol, TheICMPv6 Protocol, Transition from IPv4 toIPv6.

Unit IV: Transport Layer
Introduction to Transport Layer: Introduction, Transport-Layer Protocols, Transport Layer Protocols: Introduction, User Datagram Protocol, Transmission Control Protocol, SCTP.

Unit V: Application Layer
Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, FTP, Electronic Mail, Telnet, SSH, DNS. Network Management: Introduction, SNMP.

Unit VI: Network Security
Cryptography & Network Security: Introduction Confidentiality, Other Aspects of Security. Internet Security: Network-Layer Security, Transport-Layer Security, Application-Layer Security, Firewalls.

2.2 Course Objectives

1. Introduce basics of networking and TCP/IP protocol suite.
2. Explain the functions of layers in network model.
3. Explain different networking protocols.
4. Introduce basics of network security and cryptography.

2.3 Course Outcomes

After successfully completing the course students will be able to

CO1. Describe TCP/IP model with protocols.**(Unit-I) (Level-2: Understand)**

CO2. Explain duties of various layers and different protocols involved in computer networking.

(Unit-II, III, IV and V) (Level-2: Understand)

CO3. Analyze the requirements for a given organizational structure to select the appropriate networking architecture. (**Unit-I and II) (Level-4: Analyze)**

CO4. Explain the cryptography and network security. **(Unit-VI) (Level-2: Understand)**

2.4 Text Books:

T1-1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill,5th Edition
T2-2. James F. Kurouse& W. Rouse, "Computer Networking: A Top down Approach", 6th Edition, Pearson Education

2.5 Reference Books:

1. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fourth Edition,2003
2. Wayne Tomasi, "Introduction to Data Communication and Networking", 1/e, Pearson Education
3. Natalia Olifer, Victor Olifer, ―Computer Networks‖ Wiley Student Edition

2.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

www.cisco.com

http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Computer%20networks/New_index1.html

2.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	CO Mapped	PI Mapped	Total Lecture Planned	Books Referred
1	**Introduction to Local Area Networks**	TCP/IP Protocol Suit, Media Access Control: Random Access, Controlled Access-Reservation, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet and Fast Ethernet (100 MBPS), Gigabit Ethernet, 10 Gigabit Ethernet. Wireless LAN: Introduction, IEEE 802.11 Projects, Bluetooth	**CO1, CO3**	**1.4.1-3 2.2.2 -2 2.1.1 -2 3.1.6-2**	**6**	**T1**
2	**Network Layer Part I**	Introduction to Network Layer: Network-Layer Services, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding Of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Mobile IP	**CO2, CO3**	**1.4.1 -3 2.1.1-2 2.1.1 -2 3.1.6-2**	**7**	**T1**
3	**Network Layer Part II**	Unicast and Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols,	**CO2**	**1.4.1 -3 2.1.1-2**	**6**	**T1**

		Inter-domain Multicast Protocols, IGMP. Next Generation IP: IPv6 Addressing, The Ipv6 Protocol, TheICMPv6 Protocol, Transition from IPv4 toIPv6.				
4	**Transport Layer**	Introduction to Transport Layer: Introduction, Transport-Layer Protocols, Transport Layer Protocols: Introduction, User Datagram Protocol, Transmission Control Protocol, SCTP.	**CO2**	**1.4.1 -3** **2.1.1-2**	**6**	**T1**
5	**Application Layer**	Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, FTP, Electronic Mail, Telnet, SSH, DNS. Network Management: Introduction, SNMP.	**CO2**	**1.4.1 -3** **2.1.1-2**	**7**	**T1**
6	**Network Security**	Cryptography & Network Security: Introduction Confidentiality, Other Aspects Of Security. Internet Security: Network-Layer Security, Transport-Layer Security, Application-Layer Security, Firewalls.	**CO4**	**1.4.1-2**	**7**	**T1**

2.8 Unit wise Lecture Plan

2.8 a. Unit No.-I

Pre-requisites:- Information Theory, Coding and Communication Networks

Objectives: - 1. Introduce basics of networking and TCP/IP protocol suite.

2. Explain different networking protocols.

Outcomes: -1. Describe TCP/IP model with protocols.

2. Analyze the requirements for a given organizational structure to select the appropriate networking architecture.

Lecture No.	Details of the Topic to be covered	References
1	TCP/IP Protocol Suit	T1
2	Media Access Control: Random Access,Controlled Access- Reservation, Channelization.	T1
3	Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet (100 MBPS)	T1
4	Gigabit Ethernet, 10 Gigabit Ethernet.	T1
5	Wireless LAN : Introduction, IEEE 802.11 Project	T1
6	Bluetooth	T1

Question Bank: Theory

All Question Mapped with CO1

PI Mapped: 1.4.1-3, 2.2.2 -2,2.1.1 -2 ,3.1.6-2

Q. 1	Draw and Explain TCP/IP Protocol suite.
Q. 2	Explain random access and controlled access methods.
Q. 3	Differentiate different Ethernet Standards.
Q. 4	Explain different wired LAN protocols
Q. 5	Compare different wired LAN protocols
Q. 6	Explain Wireless LAN
Q. 7	Write a short note on Bluetooth

All Question Mapped with CO2

Q. 1	What are the functions of Physical and data link layer?
Q. 2	Explain various protocols used in each layer of TCP /IP protocol suite.

2.8 b. Unit No.-II

Pre-requisites:-Basics of Analog communication, Digital Communication, ITCT

Objectives: 1.-Explain the functions of layers in network model.

2. Explain different networking protocols.

Outcomes: - 1. Describe TCP/IP model with protocols.
2. Analyze the requirements for a given organizational structure to select the appropriate networking architecture .

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Network Layer	T1
2	Network-Layer Services	T1
3	Packet Switching	T1
4	Network-Layer Performance, IPv4 Addresses	T1
5	Forwarding Of IPPackets,Network Layer Protocols: Internet Protocol (IP)	T1
6	ICMPv4, Mobile IP	T1
7	Numerical on IP addresses and subnetting	T1

Question Bank: Theory

All Question Mapped with CO2

PI Mapped: 1.4.1 -3 ,2.1.1-2,2.1.1 -2 ,3.1.6-2

Q. 1	Differentiate Physical Address and Logical Address.
Q. 2	How many network addresses and host addresses are supported by class A, class B networks?

Q. 3	State the goals of Network layer.

All Question Mapped with CO3

Q. 4	What does a router do when it receives a packet with a destination address that it does not have an entry for, in its routing table?
Q. 5	What is the use of TTL in IP header? / What is the router's role in controlling the packet lifetime?
Q. 6	Write the difference between Distance vector routing and Link state routing
Q. 7	How broadcast and multicast address is represented in IP addressing scheme?
Q. 8	What is the difference between IPV4 and IPV6?
Q. 9	Explain the packet format of IPV4

2.8 c. Unit No.-III

Pre-requisites:-Analog communication, Digital Communication

Objectives: -Explain the functions of layers in network model.

Outcomes: - Explain duties of various layers and different protocols involved in computer networking.

Lecture No.	Details of the Topic to be covered	References
1	Unicast and Multicast Routing: Introduction	T1
2	Routing Algorithms, Unicast Routing Protocols	T1
3	Introduction, Multicasting Basics, Intra-domain Multicast Protocols	T1
4	Inter-domain Multicast Protocols, IGMP	T1
5	Next Generation IP:IPv6 Addressing, The Ipv6 Protocol	T1
6	TheICMPv6 Protocol, Transition From IPv4 toIPv6	T1

Question Bank: Theory

All Question Mapped with CO3

PI Mapped: 1.4.1 -3 , 2.1.1-2

Q. 1	Write a short note on Ipv6 Protocol
Q. 2	Explain Inter-domain Multicast Protocols
Q. 3	Explain Unicast and Multicast Routing
Q. 4	Explain Routing Algorithms
Q. 5	Explain Unicast Routing Protocols
Q. 6	Explain ICMPv6 Protocol
Q. 7	Explain the process of Transition From IPv4 toIPv6
Q. 8	Explain the packet format of IPV6
Q. 9	Explain the packet format of ICMPv6

2.8 d. Unit No. -IV

Pre-requisites:- Analog communication, Digital Communication

Objectives: -To make the students understand functions and role of Transport layer, types of protocols.

Outcomes: -Understand the functionality and importance of Transport Layer in TCP IP protocol Suite

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Transport Layer	T1
2	Transport-Layer Protocols	T1
3	Datagram Protocol(UDP)	T1

4	Transmission Control protocol (TCP),	T1
5	SCTP	T1
6	Comparison of UDP,TCP,SCTP	T1

Question Bank: Theory

All Question Mapped with CO2

PI Mapped: 1.4.1 -3 , 2.1.1-2

Q. 1	What is the maximum case of UDP datagram?
Q. 2	Give all Transport layer services?
Q. 3	Describe the SCTP protocol
Q. 4	Compare TCP, UDP and SCTP
Q. 5	What is the method to improve QoS?
Q. 6	What is the service provided by TCP?
Q. 7	Describe the UDP protocol and discuss the difference between UDP and TCP
Q. 8	Explain the design issues of transport layers

2.8 e. Unit No.-V

Pre-requisites:- NIL

Objectives: -Explain the functions of layers in network model.

Outcomes: -Explain duties of various layers and different protocols involved in computer networking.

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Application Layer	T1

2	Standard Client Server ProtocolsWorld Wide Web and HTTP,FTP	T1
3	Electronic Mail, Telnet	T1
4	SSH, DNS	T1
5	Network Management: Introduction	T1
6	SNMP	T1

Question Bank: Theory

All Question Mapped with CO2

PI Mapped: 1.4.1 -3 , 2.1.1-2

Q. 1	Which protocol support email and give details about that protocol?
Q. 2	What are the functions of Telnet?
Q. 3	What are the functions of DNS?
Q. 4	Explain in detail about the working principles of Simple Network Management Protocol (SNMP)
Q. 5	What are the functions of SSH?
Q. 6	What is meant by FTP?
Q. 7	Why network management is required?

2.8 f. Unit No.-VI

Pre-requisites:- NIL

Objectives: - Introduce basics of network security and cryptography.

Outcomes: - Explain the cryptography and network security.

Lecture No.	Details of the Topic to be covered	References
1	Cryptography & Network Security	T1
2	Introduction Confidentiality	T1
3	Other Aspects Of Security	T1
4	Internet Security	T1
5	Network-Layer Security	T1
6	Transport-Layer Security	T1
7	Application-Layer Security, Firewalls	T1

Question Bank: Theory

All Question Mapped with CO4

PI Mapped: 1.4.1-2

Q. 1	Define cryptography and network security
Q. 2	What is cipher text and Plain text?
Q. 3	List the network security services.
Q. 4	What are the different aspects of security?
Q. 5	Explain Symmetric key Algorithm / symmetric key cryptography.
Q. 6	Explain Internet layer security.
Q. 7	Explain Application layer security.
Q. 8	Explain transport layer security.
Q. 9	What is firewall?

2.9 Lab Practice-I (404186)

Course Objective(Practical)

- Explain installation and configuration of protocols in TCP/IP protocol suite.
- Demonstrate encryption and decryption algorithms for cryptography.

Course Outcome(Practical)

After successfully completing the course students will be able to,

CO1. Demonstrate installation and configuration of protocols in TCP/IP protocol suite.**(Expt. No. 1-6, 8) (Level 2, Understand)**

CO2. Apply encryption and decryption algorithms for cryptography. **(Expt. No. 7) (Level 3, Apply)**

List of Practical

Sr. No.	Name of the Practical	CO Addressed	PI Mapped
1	Implementation of LAN using suitable multiuser Windows operating System	**CO1**	**1.4.1-3 2.4.2-35.1.1 -2**
2	Installation and configuration of Web server, FTP Server.	**CO1**	
3	Study of DNS, SMTP & POP3	**CO1**	
4	Installation and configuration of DHCP server.	**CO1**	
5	Study of IP Addresses subnetting and CIDR	**CO1**	
6	Study of Network Protocol Analyzer tool/software.	**CO1**	
7	Write a program for Encryption and Decryption	**CO2**	**1.4.1-3 2.4.2-3 5.1.1 -2**
8	Simulating LAN using suitable network simulator(Packet Tracer)	**CO1**	**1.4.1-3 2.4.2-35.1.1 -2**

Oral Questions

Questions	CO Addressed
1) What is a Link?	CO1
2) What are the layers of the OSI reference model?	
3)What is the backbone network?	
4) What is a LAN?	
5) What is a node?	
6) What are routers?	
7) What is a point to point link?	
8) What is anonymous FTP?	
9) What is a subnet mask?	
10) What is the maximum length allowed for a UTP cable?	
11) What is data encapsulation?	CO1
12) Describe Network Topology	
13) What is a VPN?	
14) Briefly describe NAT	
15) What is the job of the Network Layer under the OSI reference model?	
16) How does a network topology affect your decision to set a network?	
17) What is RIP?	
18) What are the different ways of securing a computer network?	
19) What is NIC?	
20) What is WAN?	
21) What is the importance of the OSI Physical Layer?	CO4
22) How many layers are there under TCP/IP?	
23) What are proxy servers, and how do they protect computer networks?	
24) What is the function of the OSI Session Layer?	

25) What is the importance of implementing a Fault Tolerance System?	
26) What does 10Base-T mean?	
27) What is a private IP address?	
28) What is NOS?	
29) What is DoS?	**CO3**
30) What is OSI, and what role does it play in computer networks?	
31) What is the purpose of cables being shielded and having twisted pairs?	
32) What is the advantage of address sharing?	
33) What are MAC addresses?	
34) What is the equivalent layer or layers of the TCP/IP Application layer in terms of the OSI reference model?	
35) How can you identify the IP class of a given IP address?	
36) What is the main purpose of OSPF?	**CO4**
37) What are firewalls?	
38) Describe star topology	
39) What are gateways?	
40) What is the disadvantage of a star topology?	
41) What is SLIP?	
42) Give some examples of private network addresses.	
43) What is tracert?	
44) What are the functions of a network administrator?	
45) What is the main disadvantage of a peer to peer network?	**CO2**
46) What is a Hybrid Network?	
47) What is DHCP?	
48) What is the main job of the ARP?	
49) What is TCP/IP?	
50) How can you manage a network using a router?	

3.Name of the Course: Radiation and Microwave Techniques (404183)

Weekly WorkLoad (in Hrs.)	Lecture	Tutorial	Practical
	4	-	2

Online/ In-sem.	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70		50	50		

3.1 Syllabus

Unit I: Fundamental Theory of Radiation and Radiating Elements **8 Hrs**

Fundamental equations for free space propagation, Friis transmission equation, Definition of antenna, radiation mechanism and types of antenna, performance parameters such as radiation pattern, directivity, gain, efficiency, half power beam width, bandwidth, polarization, input impedance, radiation efficiency, effective length, effective area, radiation sphere

Unit II: Radiating Elements and Arrays **7 Hrs**

Comparison of various radiating elements such as infinitesimal dipole, small dipole, finite length dipole and half wavelength dipole, analytical treatment of these elements. Planar, log periodic and YagiUda antenna. Types of arrays, two element array, N-element array, uniform amplitude uniformly spaced linear broadside and end-fire array.

Unit III: Transmission lines and Waveguides **6Hrs**

General solution for TEM, TE and TM waves. Analysis of coaxial line and rectangular waveguides. Analysis of rectangular cavity resonators and their applications, Strip-lines: Structural details, types and applications.

Unit IV: Passive Microwave Components **6Hrs**

Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee. Ferrite composition, characteristics and Faraday rotation principle. Construction, working principle and scattering analysis of isolator, circulator and directional coupler. Construction and operation of gyrators.

Unit V: Active Microwave Components **6Hrs**

Limitations of conventional tubes, O and M type classification of microwave tubes, re-entrant cavity, velocity modulation. Construction, operation, performance analysis and applications of -Single cavity and two cavity klystron, Cylindrical wave magnetron and Helix traveling wave. Construction, working principle and applications of two terminal microwave devices such as tunnel diode, Gunn Diode, PIN Diode, Schottky Barrier Diode and Varactor.

Unit VI: Microwave Systems and Microwave Measurement Techniques 6Hrs

Microwave terrestrial and satellite communication system and industrial applications of microwaves such as microwave heating, thickness and moisture measurement, medical application such as microwave diathermy. Microwave measurement devices such as slotted line, tunable detector, VSWR meter, power meter, and their working principles. Microwave measurement techniques to measure S-parameters, frequency, power, attenuation, phase shift, VSWR, impedance. Radiation hazards and protection

3.3 Course Objectives

- To **introduce** the fundamentals of different radiating antenna elements and arrays.
- To **illustrate** the concept of wave propagation through waveguides.
- To **explain** the principle and construction of active and Passive Microwave Devices
- **To describe** microwave systems, microwave applications and microwave measurement techniques

3.4 Course Outcomes

At the **end** of the course the student will be able to,

1. **Calculate** the performance parameters of radiating elements and antenna arrays by using fundamentals of radiation theory (BTL-3) (Unit 1,2)
2. **Analyze** the microwave transmission lines and rectangular cavity resonator (BTL-4) (Unit 3)
3. **Describe** the construction and working of passive and active microwave devices. (BTL-2) (Unit 4,5)
4. **Explain** Microwave Systems, applications and it's measurement techniques (BTL-2) (Unit 6)

3.4 Text Books:

1. C.A. Balanis, ―Antenna Theory - Analysis and Design", John Wiley.
2. Samuel Y. Liao, ―Microwave Devices and Circuits‖, 3rd edition, Pearson
3. Annapurna Das and Sisir K. Das, ―Microwave Engineering", Second edition, Tata McGraw Hill.

3.5 Reference Books:

1. David M. Pozar, ―Microwave Engineering", Fourth edition, Wiley.
2. Ahmad Shahid Khan, ―Microwave Engineering : Concepts and Fundamentals
3. K. D. Prasad, ―Antenna &Wave Propagation‖, SatyaPrakashan, New Delhi.
4. M. Kulkarni, ―Microwave and Radar engineering‖, 3rd edition, Umesh Publication
5. E.C. Jordon and E.G. Balman, ―Electromagnetic Waves and Radiation Systems‖, Prentice Hall India.

3.6 Reference Web Links/ Research Paper/ Referred Book other than mentioned in Syllabus:

A1. Rizzi, "Microwave Engineering-Passive Circuits", PHI
A2. Shevgaonkar, "Electromagnetic waves", TMH
A3. NPTEL COURSES: 1) EM Theory 2) Basic Tools for MWE 3) MWIC

3.7 Teaching Plan

Overview of Teaching Plan

Unit	Broad Topics Covered	Total Lectures Planned	CO Addressed
1.	Fundamental Theory of Radiation and Radiating Elements	8 Hrs	**CO1** 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
2.	Radiating Elements and Arrays	7 Hrs	**CO1** 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
3.	Transmission lines and Waveguides	6 Hrs	**CO2** 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
4.	Passive Microwave Components	6 Hrs	**CO3** 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
5.	Active Microwave Components	6 Hrs	**CO3**

			1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
6.	Microwave Systems and Microwave Measurement Techniques	6 Hrs	**CO4** 1.4.1, 2.2.2

Individual Hour wise plan:

Lecture. No.	Unit	Topics to be covered
1	1	Fundamental equations for free space propagation,
2	1	Friis transmission equation, Definition of antenna,
3	1	radiation mechanism and types of antenna,
4	1	performance parameters such as radiation pattern,
5	1	directivity, gain, efficiency,
6	1	half power beam width, bandwidth, polarization,
7	1	input impedance, radiation efficiency,
8	1	effective length, effective area, radiation sphere.
9	2	Comparison of various radiating elements such as infinitesimal dipole,
10	2	
11	2	small dipole, finite length dipole and half wavelength dipole,
12	2	analytical treatment of these elements.
13	2	Planar, log periodic and Yagi-Uda antenna.
14	2	Types of arrays, two element array, N-element array,
15		uniform amplitude uniformly spaced linear broadside and end-fire array.
16	3	Introduction to Microwaves, History, Spectrum, Applications,
17	3	General Solution for Rectangular W/G, Parameters,
18	3	Co-axial Lines, Resonators
19	3	Analysis of rectangular cavity resonators and their applications,
20	3	strip-lines: Structural details, types and applications.
21	3	strip-lines: Structural details, types and applications.
22	4	Passive Microwave Components introduction
23	4	Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee.
24	4	Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee.
25	4	Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee.

26	4	Ferrite composition, characteristics and Faraday rotation principle. Construction, working principle and scattering analysis of isolator, circulator and directional coupler.
27	4	Construction and operation of gyrators.
28	5	Active Microwave Components introduction, Limitations of conventional tubes,
29	5	O and M type classification of microwave tubes, re-entrant cavity, velocity modulation.
30	5	Construction, operation, performance analysis and applications of - Single cavity and two cavity klystron,
31	5	Cylindrical wave magnetron and Helix traveling wave.
32	5	Construction, working principle and applications of two terminal microwave devices such as tunnel diode, Gunn Diode, PIN Diode, Schottky Barrier Diode and Varactor.
33	5	Construction, working principle and applications of two terminal microwave devices such as tunnel diode, Gunn Diode, PIN Diode, Schottky Barrier Diode and Varactor.
34	6	Microwave Systems and Microwave Measurement Techniques introduction.
35	6	Microwave terrestrial and satellite communication system and industrial applications of microwaves such as microwave heating,
36	6	thickness and moisture measurement, medical application such as microwave diathermy.
37	6	Microwave measurement devices such as slotted line, tunable detector, VSWR meter,
38	6	power meter, and their working principles. Microwave measurement techniques to measure S-parameters, frequency, power, attenuation, phase shift,
39	6	measurement of VSWR, impedance. Radiation hazards and protection.

3.8 Unit wise Lecture Plan

3.8 a.Unit-I

Fundamental Theory of Radiation and Radiating Elements

Prerequisites:- Electromagnetic and Transmission lines (TE semester I)

Objectives: - To **introduce** the fundamentals of different radiating antenna elements and arrays.

Outcomes: - After successfully completing the course students will be able to

- **Calculate** the performance parameters of radiating elements and antenna arrays by using fundamentals of radiation theory (BTL-3)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Introduction,	**T1, R3**	CO1 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
2	Radiation Mechanism.	**T1, R3**	
3	Types of Antenna.	**T1, R3**	
4	Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity.	**T1, R3**	
5	Gain, antenna efficiency, half power beam width, bandwidth, antenna polarization.	**T1, R3**	
6	Input impedance, antenna radiation efficiency, effective length, effective area, reciprocity.	**T1, R3**	
7	Numerical based on all above topics.	**T1, R3**	
8	Numerical based on all above topics.	**T1, R3**	

Question Bank: Theory

CO1-PI-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

Q.1	What is an antenna?
Q.2	Explain antenna parameter radiation pattern with the help of illustrative diagrams and mathematical expression and their significance.
Q.3	Define the term Isotropic with relevant mathematical expression and diagram.
Q.4	Define the term Omni directional with relevant mathematical expression and diagram.
Q.5	Explain the antenna parameter beam width with the help of illustrative diagram, relative diagram and mathematical expression.
Q.6	Explain the three field regions defined for the antenna with an illustrative diagram and also explain the field properties of each region.

Q.7	Define the term Far field with relevant mathematical expression and diagram.

Q.8	Explain the antenna parameter antenna gain with the help of illustrative diagram, relevant diagram and mathematical expression.
Q.9	Explain the antenna parameter antenna gain with the help of illustrative diagram, relevant diagram and mathematical expression.
Q.10	Explain the antenna parameter antenna efficiency with the help of illustrative diagrams, relevant diagrams and mathematical expression.
Q.11	Explain the antenna parameter effective aperture with the help of illustrative diagram and mathematical expression and their significance.
Q.12	Define the antenna polarization and explain linear, circular, elliptical polarization with relevant expression and illustrative diagram.
Q.13	What is beam efficiency and a stray factor?
Q.14	Explain the antenna parameter directivity with the help of illustrative diagram, relevant diagram and mathematical expression.

Q.15	What are the different radiation properties of an antenna?
Q.16	Explain the antenna parameter input impedance with the help of illustrative diagram, relevant diagram and mathematical expression

Q.17	What is beam area? Give the mathematical expression.
Q.18	Explain the antenna parameter radiation resistance with the help of illustrative diagram and mathematical expression and their significance.
Q.19	Explain relationship between radian and steradian.
	Question Bank: Tutorial – CO1(1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2)
Q.1	An antenna has radiation resistance of 72 Ω, a loss resistance of 8 Ω and power gain of 12 dB. Determine antenna efficiency and its directivity.
Q.2	An antenna has loss resistance of 20 ohm, power gain of 50 and directivity of 80. Determine its radiation resistance.
Q.3	A half-wave dipole having a radiation resistance of 75Ω and loss resistance of 15Ω is connected to the load through a transmission line such that the reflection coefficient is 0.75. Calculate the effective area given that the operating frequency is 100 MHz.
Q.4	Consider a lossless horn antenna with directivity of 20 dB. At a frequency of 10 GHz calculate (i) the maximum effective aperture (ii) the maximum power received when incident power density is 2 * 10– 3 (W/m2).
Q.5	Prove that the far electric and magnetic fields produced by a short dipole are one-half of the corresponding fields produced by an infinitesimal (Hertzian) dipole having the same length and current. What will be the radiation resistance of the short dipole as compared to that of the infinitesimal dipole?

Multiple Choice Questions
(CO1 - 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2)

1) According to Webster's dictionary, what is an antenna?
   a. Impedance matching device
   b. Sensor of electromagnetic waves
   c. Transducer between guided wave & free space wave
   d. Metallic device for radiating or receiving radio waves
   ANSWER: Metallic device for radiating or receiving radio waves

2) Under which conditions of charge does the radiation occur through wire antenna?
   a. For a charge with no motion
   b. For a charge moving with uniform velocity with straight & infinite wire
   c. For a charge oscillating in time motion
   d. All of the above
   ANSWER: For a charge oscillating in time motion

3) In a non-isotropic directional antenna, which radiating lobe axis makes an angle of 180° w.r.t. major beam of an antenna?
   a. Minor lobe
   b. Side lobe
   c. Back lobe
   d. None of the above
   ANSWER: Back lobe

4) At which angles does the front to back ratio specify an antenna gain?
   a. 0° & 180°
   b. 90° & 180°
   c. 180° & 270°
   d. 180° & 360°
   ANSWER: 0° & 180°

5) Which among the following defines the angular distance between two points on each side of major
   lobe especially when the radiation drops to zero?
   a. Half power beam width (HPBW)
   b. First null beam width (FNBW)
   c. Side lobe level (SLL)
   d. Front to back ratio (FBR)
   ANSWER: First null beam width (FNBW)

6) If an observation point is closely located to the source, then the field is termed as _____
   a. Induced
   b. Radiated
   c. Reflected
   d. Far-field
   ANSWER: Induced

7) Which waveform plays a crucial role in determining the radiation pattern of the dipole/wire antennas?
   a. Current
   b. Voltage
   c. Frequency
   d. Phase
   ANSWER: Current

8) How are the infinitesimal dipoles represented in terms of antenna length and signal wavelength?
   a. $l \leq (\lambda /50)$
   b. $(\lambda/50) < l \leq (\lambda /10)$
   c. $l = \lambda/2$
   d. None of the above
   ANSWER: $l \leq (\lambda /50)$

9) In flared transmission line, the radiation phenomenon increases due to _____ in flaring
   a. Increase
   b. Decrease
   c. Stability
   d. None of the above
   ANSWER: Increase

10) Which pattern is generated due to plotting of square of amplitude of an electric field?
   a. Field Pattern
   b. Voltage Pattern
   c. Power Pattern
   d. All of the above
   ANSWER: Power Pattern

11) In an electrically small loops, the overall length of the loop is _____ one-tenth of a wavelength.
   a. Less than
   b. Equal to
   c. Greater than
   d. None of the above
   ANSWER: Less than

12) On which factor/s do/does the radiation field of a small loop depend?
   a. Shape
   b. Area
   c. Both a and b
   d. None of the above
   ANSWER: Area

13) From the radiation point of view, small loops are _____radiators

a. Poor
b. Good
c. Better
d. Excellent
ANSWER: Poor

14) According to the directivity of a small loop, which value of 'θ' contributes to achieve the maximum
value of radiation intensity (Umax)?
a. 0°
b. 90°
c. 180°
d. 270°
ANSWER: 90°

3.8 b. Unit-II

Radiating Elements and Arrays

Prerequisites:-NA

Objectives: - To **introduce** the fundamentals of different radiating antenna elements and arrays.

Outcomes: - After successfully completing the course students will be able to

Calculate the performance parameters of radiating elements and antenna arrays by using fundamentals of radiation theory (BTL-3)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Analysis of Linear and Loop antennas: Infinitesimal dipole,	T1	CO1 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
2	Analysis of Linear and Loop antennas: small dipole	T1	
3	Finite length dipole and half wave length dipole,	T1	
4	Complete Analytical treatment of all these elements.	T1	
5	Antenna Arrays: Two element array, pattern multiplication N-element linear array,	T1	
6	Uniform amplitude and spacing, broad side and end-fire array	T1	

7	Log Periodic Antenna, YagiUda Antenna Array.	T1	

Question Bank: Theory –

CO1(1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2)

Q. 1	Derive the expression for radiation resistance of Infinitesimal Dipole Antenna.
Q. 2	Derive the expression for radiation resistance of Small Dipole Antenna.
Q. 3	Find following terms for Small Dipole Antenna: i. Specify the current ii. Vector Magnetic Potential iii. Far field components of Electric and Magnetic fields iv. Radiation density, Radiation Intensity. v. Radiated Power, Radiation Resistance. vi. Directivity vii. Radiation Pattern
Q. 4	Find following terms for Half Wave Dipole Antenna: i. Specify the current ii. Vector Magnetic Potential iii. Far field components of Electric and Magnetic fields iv. Radiation density, Radiation Intensity. v. Radiated Power, Radiation Resistance. vi. Directivity vii. Radiation Pattern
Q. 5	Derive the expression for radiation resistance of Infinitesimal Dipole.
Q. 6	Derive the expression for Input Impedance of Small Dipole.
Q. 7	What is an array? Explain its working principle.
Q. 8	What are the array configurations?
Q. 9	What are the controlling parameters of an array?
Q. 10	What is a linear and uniform array?

Q. 11	Derive the expression for array factor N-element linear array considering the first element at reference.
Q. 12	What is the significance of an array factor?
Q. 13	Describe the principles of broadside array.
Q. 14	Draw and explain the radiation pattern of the broadside array.
Q.15	Give the expressions of properties of the broadside array.
Q.16	Describe the principles of end-fire array.
Q.17	Draw and explain the radiation pattern of an end-fire array.
Q.18	Give the expressions for different properties of an end-fire array.
Q.19	Give the expressions for directivity of different type of an array.
Q.20	Explain the principle of pattern multiplication with an illustrative diagram.

Q.21	Explain log periodic antenna.
Q.22	With the help of structural details, dimensions, radiation pattern, specifications, features and applications, explain the folded dipole antenna.
Q.23	What is Yagi-Uda Antenna? Explain its construction and properties with reference to directivity, bandwidth and principle of operation.
Q.24	Draw the radiation pattern for 6-element linear broad side array considering the interelement spacing to be half wavelength.
	Question Bank: Tutorial – CO1(1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2)
Q. 1	Calculate the radiation resistance of a double turn and eight turn small circular loop when radius of loop is $\lambda/10$ and the medium is free space. Calculate its efficiency if loss resistance is 25Ω.
Q. 2	For an array of four isotropic sources along the z-axis separated by a distance of $\lambda/2$ and a progressive phase shift alpha=0. Find I) Null directions II) Directions of maxima

	III) Directions of side lobe maxima IV) Half power beam width (HPBW) V) First null beam width (FNBW) VI)Side lobe level(SLL) VII) Rough normalized field pattern.
Q. 3	Derive mathematical expression for power density and radiation intensity of half wave dipole antenna and draw radiation pattern of half wave dipole antenna in E and H Plane.
Q. 4	Design a four element ordinary endfire array with the element spacing along the z-axis a distance d apart and with the maximum of the array factor directed toward theta=0. For a spacing of d= λ /2between the elements, find the I) Progressive phase excitation between the elements II) Null directions III) Maxima directions IV) FNBW V) HPBW.
Q. 5	Draw the radiation pattern of an end-fire linear array of eight elements with half wavelength uniform spacing and uniform amplitude distribution. Find the side lobe, null directions.
Q. 6	An end-fire array with element spacing at λ /2 and with axes of elements at right angles to the line of array is required to have directivity of 36. Determine the array length and the width of the major lobe.

Multiple Choice Question

CO1(1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2)

1) In which kind of array configuration, the element locations must deviate or adjust to some non planar surface like an aircraft or missile?

a. Linear
b. Planer
c. Conformal
d. All of the above
ANSWER: Conformal

2) What is the nature of the radiation pattern of an isotropic antenna?

a. Spherical
b. Dough-nut
c. Elliptical
d. Hyperbolic

ANSWER: Spherical

3) In a broadside array, all the elements in the array should have similar _____excitation along with similar amplitude excitation for maximum radiation.
a. Phase
b. Frequency
c. Current
d. Voltage
ANSWER: Phase

4) Which among the following is regarded as a condition of an ordinary endfire array?
a. $\alpha < \beta d$
b. $\alpha > \beta d$
c. $\alpha = \pm\beta d$
d. $\alpha \neq \pm\beta d$
ANSWER: $\alpha = \pm\beta d$

5) Which mode of propagation is adopted in HF antennas?
a. Ionospheric
b. Ground wave
c. Tropospheric
d. All of the above
ANSWER: Ionospheric

6) For which band/s is the space wave propagation suitable over 30 MHz?
a. VHF
b. SHF
c. UHF
d. All of the above
ANSWER: All of the above

7) If the tower antenna is not grounded, which method of excitation is/are applicable for it?
a. Series
b. Shunt
c. Both a and b
d. None of the above
ANSWER: Series

8) In ungrounded antennas, if an excitation is applied directly across the base insulator, then on which
factor/s would the voltage across the insulator depend?
a. Power delivered to antenna
b. Power factor of impedance
c. Both a and b
d. None of the above
ANSWER: Both a and b

9) Which among the following exhibits perpendicular nature in TEM wave?
   a. Electric field
   b. Magnetic field
   c. Direction of propagation
   d. All of the above
   ANSWER: All of the above

10) Which equations are regarded as wave equations in the frequency domain for lossless media?
   a. Maxwell's
   b. Lorentz
   c. Helmholtz
   d. Poisson's
   ANSWER: Helmholtz

11) If the magnetic field component of a plane wave in a lossless dielectric is H = 50 sin (2π x 106 t –
6x) azmA/m , what will be the wave velocity?
   a. 1.047 x 106 m/s
   b. 1.257 x 106 m/s
   c. 2.50 x 106 m/s
   d. 3 x 106 m/s
   ANSWER: 1.047 x 106 m/s

12) In an electrical circuit, which nature of impedance causes the current & voltages in phase?
   a. Reactive
   b. Resistive
   c. Capacitive
   d. Inductive
   ANSWER: Resistive

13) Which type of ground wave travels over the earth surface by acquiring direct path through air from
transmitting to receiving antennas?
   a. Surface wave
   b. Space wave
   c. Both a & b
   d. None of the above
   ANSWER: Space wave

14) After which phenomenon/phenomena do the waves arrive at the receiving antenna in ionospheric
propagation?
   a. Reflection or Scattering
   b. Refraction
   c. Diffraction

d. All of the above
ANSWER: Reflection or Scattering

15) By which name/s is an ionospheric propagation, also known as?
a. Sea wave propagation
b. Ground wave propagation
c. Sky wave propagation
d. All of the above
ANSWER: Sky wave propagation

16) According to Snell's law in optics, if a ray travels from dense media to rarer media, what would be its direction w.r.t the normal?
a. Towards
b. Away
c. Across
d. Beside
ANSWER: Away

17) Which mechanism/s is/are likely to occur in mid-frequency operation corresponding to ionospheric region?
a. Only Reflection
b. Only Refraction
c. Partial reflection & refraction
d. None of the above
ANSWER: Partial reflection & refraction

18) Which among the following plays a primary role in generation of conduction current in an ionosphere due to presence of electric field?
a. Ions
b. Motion of electrons
c. Neutral molecules
d. None of the above
ANSWER: Motion of electrons

19) Which type of wire antennas are also known as dipoles?
a. Linear
b. Loop
c. Helical
d. All of the above
ANSWER: Linear

20) Which antennas are renowned as patch antennas especially adopted for spacecraft applications?
a. Aperture

b. Microstrip
c. Array
d. Lens
ANSWER: Microstrip

21) Which conversion mechanism is performed by a parabolic reflector antenna?
a. Plane to spherical wave
b. Spherical to plane wave
c. Both a and b
d. None of the above
ANSWER: Spherical to plane wave

22) Which antenna radiating region/s has/have independent nature of angular field distribution over the
distance from the antenna?
a. Reactive near-field region
b. Fresnel region
c. Fraunhofer region
d. All of the above
ANSWER: Fraunhofer region

23) Sterdian is a measurement unit of _____
a. Point angle
b. Linear angle
c. Plane angle
d. Solid angle
ANSWER: Solid angle

24) According to the geometry, how many steradians are present in a full sphere?
a. $\pi/2$
b. π
c. 2π
d. 4π
ANSWER: 4π

25) The vector magnetic potential shows the inverse relationship with its ____
a. Source
b. Distance of point from the source (R)
c. Both a and b
d. None of the above
ANSWER: Distance of point from the source (R)

3.8 c. Unit No.-III

Pre-requisites: -Vector Calculus and Solutions of Partial Differential Equations, Field Theory

Objective: To **illustrate** the concept of wave propagation through waveguides.

Outcome: At the end of the course the Student will be able to:

Analyze the microwave transmission lines, rectangular cavity resonator (Unit 3)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Introduction to Microwaves, History, Spectrum, Applications,	T2 R1	**CO2** 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
2	General Solution for Rectangular W/G, Parameters,	T2 T1	
3	Co-axial Lines, Resonators	T2 T1	
4	Analysis of rectangular cavity resonators and their applications,	T2 R1	
5	strip-lines: Structural details, types and applications.	T2 T1	
6	strip-lines: Structural details, types and applications.	T2 T1	

Question Bank: Theory – CO2

Theory Paper (CO2 -1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2)

Q.1	Why is there a need to use waveguides at microwave frequencies? Compare Waveguides with two wire transmission lines. (9M)
Q.2	What are the IEEE recommended microwave band designations? (4M)
Q.3	Describe in detail the advantages of microwaves. (8M)
Q.4	What are the major applications of microwaves in various fields? (8M)
Q.5	Explain the wave propagation in TE mode in rectangular waveguide with the help of general wave equations and derive the expressions for the field components. Why cannot TEM waves exist in a rectangular waveguide? (10M)

Q.6	Draw the field pattern for TE10 mode in rectangular waveguide. (4M)
Q.7	Derive the expression for the cut off frequency in rectangular waveguide. (8M)
Q.8	Derive the relation between λ_o ,λ_g and λ_c. (4M)
Q.9	Define and explain the following terms. Derive the expressions for the same. a) Guide wavelength b) Group Velocity c) Phase velocity (10M)
Q.10	Explain the concept of dominant mode and degenerate mode in rectangular waveguide. (4M)
Q.11	What are cavity resonators? Give their applications. (8M)

Question Bank: Tutorial-

CO2-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

Q.1	When the dominant mode is propagated in an air filled rectangular waveguide, the guide wavelength for a frequency of 9000MHz is 4 cm. Calculate the breadth of the guide.
Q.2	Determine the cut-off wavelength for the dominant mode of the rectangular waveguide of breadth 10 cm. For a 2.5 GHz signal propagated in dominant mode in this waveguide; calculate the guide wavelength, group and phase velocities.
Q.3	The broad dimension of a guide is 2.286cm. the frequency is 8.5 GHz. Find the (a) possible modes (b) cut-off frequencies (c) guide wavelength.
Q.4	A rectangular waveguide has a= 4 cm, b= 3 cm as its sectional dimensions. Find all the modes that will propagate at 5000 MHz.
Q.5	The TE10 mode is propagated in a rectangular waveguide of dimensions a = 6 cm and b = 4 cm. By means of a travelling detector the distance between maxima and minima is found as 4.55 cm. Find the frequency of the wave.

Q.6		A rectangular waveguide has dimensions of 2.585 cm. Determine the guide wavelength, phase constant and phase velocity at a wavelength of 4.5 cm for the dominant mode.

Q.7		A rectangular waveguide with dimensions of 2*3 cm operates at TE11 mode at 10 GHz. Determine the characteristic wave impedance.
Q.8		Show that for TE01 mode, a frequency of 6 GHZ will pass through a waveguide of dimensions a= 1.5 cm, b= 1 cm if a dielectric with relative permittivity 4, is inserted into the waveguide.

Multiple Choice Questions
CO2-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

1. The relationship between inductance and capacitance per unit length and characteristic impedance of a transmission line is
   A. Zo = 1/17.6
   B. Zo = "DT
   C. Zo = .167j,
   D. Zo = 2n147
   Ans:: B

2. The characteristic impedance of a twin-lead cable commonly used for TV lead-in is nearly
   A. 1 ki2
   B. 100 LI
   C. 10 L2
   D.300
   Ans:: D

3. If a transmission line is terminated with a resistance equal to its characteristic impedance
   A. the line loss will be maximum
   B. the input impedance will be twice the terminating resistance
   C. the standing wave ratio will be minimum
   Ans: C

4. Transmission of power to a load over a transmission line achieves optimum value when standing-wave ratio (SWR) becomes
   A. 2 : 1
   B. 1 : 2
   C. 1: 1
   D. 2 : 2
   Ans:: C

5. A Smith chart is used for solving

A. propagation problems
B. transmission line problems
C. antenna problems
D. sag problems
Ans:: A

6. The value ofSWR for a transmission line of characteristic impedance Zo when feeding a load of impedance ZL is
   A. SWR = Zo ? ZL
   B. SWR = Zo / ZL
   C. SWR = Zo + ZL
   D. SWR = ZL / Zo
   Ans:: D

7. A transmission line having Zo = 75 ohm is delivering power to a 300 1 load. Its SWR is
   A. 1 : 4
   B. 4 : 1
   C. 1 : 2
   D. 2 : 1
   Ans:: B

8. If maximum voltage reading on the above line is 50 V, the minimum voltage reading would be volt.
   A.25
   B.12.5
   C.6.25
   D.37.5
   Ans:: B

9. Regarding the reflection coefficient (Kr) of a transmission line, which statement is not correct? It is the ratio of
   A. reflected voltage to the incident voltage
   B. reflected current to the incident current
   C. reflected power to the incident power
   D. characteristic impedance to load impedance
   Ans:: C

10. For perfect match between line and load, value of Kr should be
    A.0
    B.1
    C. between 0 and 1
    D. more than unity
    Ans:: A

11. In a transmission line, the ratio of reflected power to incident power is given bY

A. Kr
B. 1/K1
C. 1/I(2
D. Kr2
Ans:: D

12. The reflection coefficient resulting from mismatching a 50 LI load and a 150 n transmission line is

A.0.5
B.2
C.37.5
D. 1/75
Ans:: A

13. If a SWR of 4 : 1 exists on a line, then its reflection coefficient is

A.0.8
B.0.6
C.0.25
D.1.67
Ans:: B

14. If a SWR of 4 : 1 exists on a line, percentage reflected power is

A.36
B.60
C.66.7
D.40
Ans:: A

15. If a SWR of 4 : 1 exists on a line, percentage power absorbed by the load is

A.40
B.60
C.64
D.33.3
Ans:: C

16. A transmission line of 50 ohm characteristic impedance is terminated in a resistive load of 100 ohm. The voltage reflection coefficient equals

A.3
B.2
C.1
D.0
Ans:: D

17. A quarter-wave transformer is

A. a two-winding conventional transformer having core length equal to X/4
B.an auto-transformer having total wiring length equal to X/4

C. a segment of transmission line near the load end which is equal in length to one-quarte of wavelength of the signal on the line
D. an ordinary transformer used to connect load and line at a distance of X/4 from the input end.
Ans:: C

18. Regarding stubs, which statement is not correct?
A. stubs are used for eliminating standing waves on a transmission line
B. they are usually placed in parallel with the transmission line close to the load end of the line
C. they are nothing else but short sections of the transmission line either open-circuited or short circuited
D. generally, they are longer than X/2
Ans:: D

19. Indicate the FALSE statement. Higher the value of SWR of a transmission line,
A. greater the mismatch between line and load
B. greater the power loss
C. more the noise
D. higher the velocity factor
Ans:: D

3.8 d Unit No.-IV

Passive Microwave Components

Pre-requisites:- Electromagnetics and Transmission lines (TE semester I)

Objectives: - To understand theory of passive components of microwave systems

Outcomes: - **Analyze** the working of passive microwave components. (ANALYSIS)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Construction, working principle and scattering analysis of passive microwave components such as E-plane Tee	T2 and R4	**CO3** 1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
2	Construction, working principle and scattering analysis of passive microwave components such as H-plane Tee.	T2 and R4	
3	Construction, working principle and scattering analysis of passive microwave components such as magic tee.	T2 and R4	

4	Ferrite composition, characteristics and Faraday rotation principle. Construction, working principle and scattering analysis of isolator,	T2 and R4	
5	Construction, working principle and scattering analysis of circulator and Construction and operation of gyrator.	T2 and R4	
6	Construction, working principle and scattering analysis of directional coupler.	T2 and R4	

Question Bank: Theory –

CO3-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

Q. 1	Describe construction and operation of the E- plane Tee, H-plane Tee, Two-hole Directional coupler.
Q.2	What are the main properties of Magic Tee? Describe the various applications of Magic Tee.
Q.3	What is the principle of Faraday's Rotation? Describe various microwave devices that make use of Faraday's rotation principle. (2M+6M+6M+6M)
Q.4	What are Strip lines and Micro strip lines? Give their advantages and limitations.
Q.5	What are the various types of micro strip lines? (4M)
Q.6	What are Parallel Strip lines, Coplanar Strip lines, Shielded Strip Line?

Multiple Choice Questions

CO3-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

1. H-plane Tee is also called as
   a) series tee b) shunt tee c) magic tee d) none on these
   Ans**: b) shunt tee**

2.It is called H plane tee because the plane of auxiliary arm is _____ to the Plane of magnetic Field of
dominant TE10 mode.
   a) parallel b) perpendicular c) vertical d) all of these

Ans **: a) parallel**

3. E-plane Tee is also called as..
a) shunt tee b) magic tee c) both a and b d) series tee
Ans: **d) series tee**

4. The properties of E-Plane Tee can be defined by its ___ matrix.
a) [S]3x3 b) [S]2x2 c) [S]2x3 d) all of these
Ans: **a) [S]3x3**

5. The ports 1 and 2 are__ out of phase with each other
a) 90° b) 270° c) 180° d) 360°
Ans: **c) 180°**

6. An E-H Plane Tee junction is called as
a) Magic Tee b) Hybrid c) 3dB coupler d) all of these
Ans**: d) all of these**

7. The properties of E-H Plane Tee can be defined by its [S]4×4 matrix.
a) [S]4×4 b) [S]3×3 c) [S]2× 2 d) [S]1×1
Ans: **a) [S]4×4**

8. In which Tee Parallel port and Series port are available
a) magic tee b) H plane tee c) E plane tee d) directional coupler
Ans: **a) magic tee**

9.What are the applications of Hybrid Tee
a) measurement of unknown impedance b) as duplexer c) as a mixer d) all of these
Ans**: d) all of these**

10.The exceptional passive microwave components are :
a) Ferrite isolator b) circulator c) Directional coupler d) Gyrator
Ans : **a) Ferrite isolator**

11.ferrite have _____ conductivity
a)high b)low c)both a and b d)none of these
Ans: **a) low**

12.These materials have _____ permeability in _____ directions.
a)same, different b)same, same c) different, different d)none of these
Ans**: c) different, different**

13.For lossless two-port devices:
a)Reflections at both ports are not identical b) Reflections at both ports are identical
c)Reflection only at single port d) None of above
Ans **: b) Reflections at both ports are identical**

14.All components are connected by transmission lines with dimensions in the order of
a)Ohm b)farad c)Siemens d)Lambda
Ans: **d)Lambda**

17.At Millimeter and submillimeter wavelengths free space propagation provides
a)lowest losses b)highest loss c)medium loss d)None of above
Ans: **a)lowest losses**

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18. __used to reduce standing waves caused by components with a bad matching.
a)ferrite b)isolator c) circulator d)attenuators
Ans : **d)Attenuators**

19.-------, a 4-port device, input port 1 is isolated from port 4.
a)isolator b)directional Coupler c)H plane tee d)None of above
Ans **: b)directional Coupler**

20. Directional coupler which factors include for microwave power measurement purpose
a)incident power b) reflected power c) VSWR values d)all of above
Ans: **d)all of above**

21. State whether True or False : Ferrites can be magnetized permanently by an external magnetic field
a)True b)False
Ans : **a)True**

3.8 e. Unit-V

Active Microwave Components

Prerequisites:- Electromagnetics and Transmission lines (TE semester I)

Objectives: - To understand theory of active components of microwave systems

Outcomes: - **Describe & Compare** the principles of working of Microwave tubes and Devices for generating microwaves. (KNOWLEDGE, EVALUATION)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Limitations of conventional tubes, O and M type classification of microwave tubes, re-entrant cavity, velocity modulation.	T2, R1, R3 and R4	CO3-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2
2	Construction, operation, performance analysis and applications of -Single cavity klystron.	T2, R1, R3 and R4	
3	Construction, operation, performance analysis and applications of two cavity klystron,	T2, R1, R3 and R4	

4	Construction, operation, performance analysis and applications of Cylindrical wave magnetron and Helix traveling wave.	T2, R1, R3 and R4	
5	Construction, operation, performance analysis and applications of Construction, working principle and applications of two terminal microwave devices such as tunnel diode, Gunn Diode, PIN Diode.	T2, R1, R3 and R4	
6	Construction, working principle and applications of two terminal microwave devices such as Schottky Barrier Diode and Varactor.	T2, R1, R3 and R4	

Question Bank: Theory – CO3-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

Q.1	What are the limitations of the conventional tubes at the microwave frequencies? (8M)
Q.2	On what basis the microwave tubes are classified? Give classification of the microwave Tubes in detail. (8M)
Q.3	Give the constructional details and describe the operation of the Reflex Klystron with suitable diagrams. Give its applications. (10M)
Q.4	What is the mechanical and electronics tuning of the Reflex Klystron? What is the use of it? Give the formula for calculation of the electronic tuning range.(6M)
Q.5	What is velocity modulation and bunching process? Explain the Construction and principle of operation of the two cavity klystron amplifier.(8M)
Q.6	What is a slow wave structure? What is its significance? Explain the various types with suitable diagram.(6M)
Q.7	Give construction and operation of helix Traveling Wave Tube (TWT) with suitable diagram. Compare Helix TWT with Two cavity Klystron amplifier.(10M)
Q.8	What are M-type tubes? Explain the different types of Magnetron. (4M)
Q.9	Give the construction and principle of operation of 8 cavity cylindrical traveling wave magnetron. Give Hull cut-off equation.(10M)
Q.10	Explain the phase focusing effect in the PI mode of operation in Magnetron. Give its o/p characteristics and applications. (8M)

Question Bank: Tutorial CO3-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

Q. 1	A reflex klystron operates at the peak of n= 1 or ¾ mode. The dc input power is 40 mW and the ratio of V1 over Vo is 0.278. a) Determine the efficiency of the reflex klystron. b) Find the total output power in mW. c) If 20% of the power delivered by the electron beam is dissipated in the cavity walls, find the power delivered to the load.
Q.2	A two cavity Klystron amplifier has following specifications. Beam Voltage: V0 = 900V Beam Current: I0 = 30 mA Frequency: f = 8 GHz Gap spacing in either cavity: d = 1mm Spacing between centers of cavities: L = 4 cm Effective shunt impedance: R_{sh} + 40 K Ohm Determine, a. The electron velocity b. The dc electron transit time c. The input voltage for maximum output voltage d. The voltage gain in dB
Q.3	An X-band pulsed cylindrical Magnetron has Vo= 30 KV, Io= 80 A, Bo= 0.01 Wb/sq.m, a= 4 cm, b= 8cm. Calculate (a) Cyclotron angular frequency (b) Cut-off Voltage and (c) cut-off magnetic flux density.
Q.4	A reflex klystron operates at the peak of n= 2 mode with beam voltage V0= 300V. Beam current Io= 20 mA, signal voltage V0 = 40V. Determine (i) the input power in the watts, (ii) the output power in the watts and (iii) efficiency.

Multiple Choice Questions CO3-1.1.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2

1. Extended interaction oscillator is a _____ beam oscillator that is similar to klystron.

   a) Linear beam b) Crossed beam c) Parallel beam d) M beam

   Answer: a

2. Magnetrons are microwave devices that offer very high efficiencies of about 80%.

   a) True b) False

   Answer: a

3. Klystron amplifiers have high noise output as compared to crossed field amplifiers.

a) True b) False
Answer: b

4. _____ is a microwave device in which the frequency of operation is determined by the biasing field strength.

a) VTM b) Gyratron c) Helix BWO d) None of the mentioned
Answer: b

5. A PIN diode consists of _____number of semiconductor layers.

a) Three b) Two c) Four d) One
Answer: a

6. The material out of which PIN diode is made is:

a) Silicon b) Germanium c) GaAs d) None of the mentioned
Answer: a

7. The behavior of a PIN diode is entirely different from normal diodes at all frequency of operation.

a) True b) False
Answer: b

8. The junction resistance and capacitance of the intrinsic region in a PIN diode are connected_____ in the equivalent circuit of PIN diode.

a) Series b) Parallel c) Connected across package capacitance d) None of the mentioned
Answer: b

9. The resistance of the PIN diode with positive bias voltage:

a) Increases b) Decreases c) Remains constant d) Insufficient data
Answer: b

10. Silicon and germanium are called _____ semiconductors.

a) direct gap b) indirect gap c) band gap d) indirect band gap

Answer: b

3.8 f. Unit-VI

Microwave Systems and Microwave Measurement Techniques

Pre-requisites: Basic Lab Practices in Microwaves

Objective: To **Introduce** the microwave applications and the Various techniques and Principles of High frequency wave Generation and Measurement

Outcomes: At the end of the course the Student will be able to:
Select and Demonstrate techniques used in a typical Microwave measurement system and Explain the Microwave applications. (Application)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Microwave terrestrial and satellite communication system and industrial applications of microwaves such as microwave heating, thickness and moisture measurement, medical application such as microwave diathermy.	T3 & R4	
2			
3	Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement and frequency measurements techniques.		CO4 1.4.1, 2.2.2
4	Power measurement and Attenuation measurement techniques		
5	Phase shift measurement and VSWR measurement techniques		
6	Impedance measurement, Radiation hazards and protection.		

Question Bank: Theory - CO 5

Theory Paper CO4 - 1.4.1, 2.2.2

Q. 1	Write a short Note on the followings.(6M each) a. Slotted line b. Tunable detector c. VSWR meter d. Power Meter e. Phase shift measurement technique
Q.2	Explain with a suitable diagram the Microwave terrestrial Communication system.

Q.3	Explain with a suitable diagram the Microwave satellite Communication system. Also elaborate the concept of link budget and free space path loss.
Q.4	What is the mechanism of microwave heating? Explain the working of the microwave oven with a schematic diagram.
Q.5	Write a short note on following microwave industrial applications 1)Thickness measurement 2)Moisture Content Measurements 3)Microwave Diathermy

Q.6	Explain in detail the technique of S-Parameters measurements using microwave test bench. (6M)

Q.7	Explain in detail the electronics and mechanical technique of microwave frequency measurement. (6M)

Q.8	What are the various techniques of microwave power measurement? Explain each with a suitable diagram. (10M)

Q.9	What are the various techniques of attenuation measurements at microwave frequencies? (8M)

Q.10	What is VSWR? Explain the techniques of measurement of high and low VSWR using a microwave test bench set up.

Q.11	What are the various techniques of impedance measurement at microwave frequencies? Explain each with a suitable diagram. (9M)

Q.12	What are the various microwave radiation hazards and techniques to protect from it (6M)

3.9 List of Practical

Sr.No.	Name of the Practical	CO addressed
1	To measure the radiation pattern, return loss, impedance, gain, beam width of dipole antenna and folded dipole antenna at microwave frequency	CO1
2	Design, simulate and compare the performance of two element broad side and end fire array antenna	CO1
3	Study of microwave components and equipment.	CO1, CO2
4	Reflex Klystron as a Microwave source in the laboratory and plot its mode characteristics.	CO4

5	Measurement of the free space wavelength of the microwave (for TE 10 mode) with the help of the X-band microwave test bench and verify with its theoretical calculation.	CO5
6	Study of Gunn Diode & PIN Modulator as a Microwave source. Plot the V-I characteristics.	CO4
7	Verification of Port Characteristics of Microwave Tees (E, H, E-H Planes).	CO3
8	Verification of Port Characteristics of Directional Coupler. Calculation of coupling factor, insertion loss and directivity.	CO3
9	Verification of Port Characteristics of Isolator and Circulator. Calculation of insertion loss and isolation in dB.	CO3
10.	Design of Micro-strip Antenna using CST Software	CO1, CO2

4.Name of the Course: Electronic Product Design (404185)

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	3	-	-

Online/ In-sem	Theory End Sem	Practical	Oral	Term-work	Total Marks	Credit
30	70	-	-	-	100	3

4.1 Syllabus

Unit I : Introduction to Electronic Product Design (6L):
Man machine dialog and Industrial design, user-centered design, five element of successful design, cognition, ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

Unit II : Hardware Design & testing methods (6L):
Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

Unit III :Software Design and Testing methods (6L):
Types of Software. Waterfall model of software development. Models, metrics and software Limitations. Risk abatement and failure preventions. Software bugs and testing. Good programming practice. User interface .Embedded, Real time software.

Unit IV : PCB design (6L):
Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stackup assignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection, Guard Band implementation.

Unit V : Product Debugging and testing (6L):
Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier,

Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification. EMI & EMC issues.

Unit VI : Documentation (6L):
Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.

4.2 Course Objectives

1. To introduce the stages of product (hardware/ software) design and development.
2. To explain the different considerations of analog, digital and mixed circuit design.
3. To acquaint with methods of PCB design and different tools used for PCB Design.
4. To understand the importance of testing in product design cycle. `
5. To explain the processes and importance of documentation.
6. To create awareness about the overall obligations with respect to Electronic product Design and help students understand their moral responsibilities while working in the field.

4.3 Course Outcomes

At the end of the semester Student will be able to

1. Describe the product design from designer and user point of view.(I)
2. Explain the stages involved in hardware and software designing for system development.(II,III,IV)
3. Describe different testing methods and debugging processes for system.(II,III,V)
4. Explain importance and processes of documentation.(VI)

4.4 Text Books

1. Kim Fowler," Electronic Instrument Design" Oxford university press.
2. Robert J. Herrick, "Printed Circuit board design Techniques for EMC Compliance", Second edition, IEEE press.

4.5 Reference Books

1. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley Publication
2. J C Whitakar," The Electronics Handbook", CRC press.

4.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

1. www.nptel.ac.in

2.www.nptelvideos.in

4.7 Teaching Plan and CO Mapped

Overview of Teaching Plan:

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned	CO Mapped
1	I	Introduction to Electronic Product Design	T1	6L	1
2	II	Hardware Design & testing methods	R1	6L	2,3
3	III	Software Design and Testing methods	T1,R1	6L	2,3
4	IV	PCB design	T2	6L	2
5	V	Product Debugging and testing	T1,R2	6L	3
6	VI	Documentation	T1	6L	4

4.8 Unit wise Lecture Plan

4.8 a. Unit No I

Introduction to Electronic Product Design

Pre-requisites:-

Sr.No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year

1	Knowledge of specifications of Analog & Digital Components	Basic Electronics	F.E
2	Knowledge of various electronic operating parameters	Electronic devices and circuits	S.E.
3	Knowledge of specifications of product and fundamental safety measures by implementation of prototype model	Employability skills in mini projects	T.E

Objectives: To Teach

1. User Centered design
2. Various elements of successful design
3. Packaging factors and safety

Outcomes: Students will be able to

1. Explain the product design from designer and user point of view.
2. Explain Different elements of successful design
3. Explain Packaging factors and Safety

Lecture No.	Details of the Topic to be covered	References
1	Man machine dialog and Industrial design, user-centered design,	T1
2	five element of successful design, cognition, ergonomics	T1
3	Packaging and factors, design for manufacture, assembly and disassembly,	T1
4	Wiring, temperature, vibration and shock. Safety	T1
5	noise, energy coupling, grounding	T1
6	Filtering and shielding.	T1

Question Bank: Theory

Q.1	Explain in detail five elements of Successful design	CO 1
Q.2	Describe significance of user centered design with example	CO 1
Q.3	Explain design for Manufacture, Assembly and disassembly	CO 1
Q.4	give short note on Packaging and Enclosure	CO 1
Q.5	What are the types of products in electronic product design	CO 1
Q.6	Man- Machine dialogue and industrial design	CO 1
Q.7	State importance of vibration and shock safety	CO 1
Q.8	Explain the terms Safety, Noise, Grounding, Shielding and filtering	CO 1
Q.9 Q.10	With the help of neat block diagram , explain different stages of an electronics product development .what will be the effect on development ,if we skip any one stage?	CO 1
Q.11	**What are the different product approvals required while developing electronic product?**	CO 1
Q.12	**Explain the circuits used for protection of electronic products**	CO 1

4.8 b. Unit No II

Hardware Design & testing methods

Pre-requisites

Sr.No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	Selection criteria of Microcontrollers, and required interfacing devices , knowledge of embedded systems	Microcontrollers, Advance Processors	T.E

Objectives : To Teach

1. Hardware Design and testing Process

Outcomes: Students will be able to

1. Explain Different Hardware models

2. Explain Different test procedures and testing methods

Lecture No.	Details of the Topic to be covered	References
1	Design process. Identifying the requirements, formulating specifications	R1
2	design specifications, Specifications verses requirements,	R1
3	System partitioning, Functional design, architectural design, Functional model verses architectural model	R1
4	Prototyping. Performance and Efficiency measures.	R1
5	Formulating a test plan, writing specifications , Test procedure and test cases, Egoless design, design reviews.	R1
6	Module debug and test: black box test, white box test, grey box test	R1

Question Bank: Theory

Q.1	Write short note on black box ,white box and gray box test	CO 3
Q.2	Explain in detail specifications verses requirements	CO 2
Q.3	Explain in detail functional model and architecture model	CO 2
Q.4	Explain egoless design in detail	CO 2
Q.5	what is prototyping explain in detail	CO 2
Q.6	Explain Performance and efficiency measures what is system partitioning?	CO 3
Q.7	describe formulation of test plan, test procedure and test cases required for testing	CO 3
Q.8	Case study : Detail hardware design process for any electronic product	CO 2

4.8 c. Unit No.-III

Software Design & testing methods

Pre-requisites

Sr.No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	Selecting a programming language by comparing programming languages, knowledge of programming	Fundamentals of programming language, Data structure and algorithms, Object oriented programming	FE,S.E
2	Microcontroller programming, basic steps for software development	Assembly Language Programming and Embedded C Programming	T.E

Objectives:-To Teach

1. Types of software and different models of software development

2. Software testing

Outcomes:-Students will be able to

1. Explain process of software designing and testing for system development

Lecture No.	Details of the Topic to be covered	References
1	Types of Software. Waterfall model of software development	T1,R2
2	Models, metrics and software	T1,R2
3	Risk abatement and failure preventions	T1,R2
4	Software bugs and testing	T1,R2
5	Good programming practice	T1,R2
6	User interface .Embedded, Real time software	T1,R2

Question Bank: Theory

Q.1	State different types of software. Explain waterfall model of software development with suitable example	CO 2
Q.2	write short note on Models, metrics and software limitations	CO 2
Q.3	What is Risk abatement and failure preventions in software deign	CO 3
Q.4	Explain about Software bugs and testing	CO 3
Q.5	What is good programming practice.	CO 2
Q.6	What is Embedded and Real time software explain its significance with example	CO 2
Q.7	**What is the difference between algorithm and flowchart? What are standard practices in software design and maintenance**	CO 2

4.8 d. Unit No IV

PCB Design

Pre-requisites

Sr.No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	Basic Types of PCBs and PCB design Knowledge	Employability Skills in Mini Project	T.E

Objectives: To Teach

1. Different safety measures in PCB design

Outcomes: Students will be able to

1. State Special design considerations in PCB design

Lecture No.	Details of the Topic to be covered	References
1	Fundamental Definitions, Standards	T2
2	Routing Topology Configurations, Layer Stackup assignment	T2
3	Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning	T2

4	Critical frequencies, Bypassing and decoupling	T2
5	Design techniques for ESD Protection	T2
6	Guard Band implementation.	T2

Question Bank: Theory

Q.1	Explain configurations of routing topologies in PCB layout designing	CO 2
Q.2	Explain importance of grounding methodologies ,Compare those technologies	CO 2
Q.3	Write Short note on 1. Image Planes 2. Functional Partitioning	CO 2
Q.4	Write Short note on 1.Bypassing and decoupling capacitors 2.Impedance matching	CO 2
Q.5	Explain Design technique for ESD protection	CO 2
Q.6	What are design techniques used to prevent crosstalk	CO 2
Q.7	**Explain circuits used for noise removal in case of high frequency circuits**	CO 2

4.8 e Unit No V

Product Debugging and Testing

Pre-requisites

Sr.No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	Knowledge of active components, active devices, operational amplifiers	Basic Electronics, Electronic Devices and Circuits, Integrated Circuits	F.E,S.E
2	Knowledge of equipment's used for troubleshooting	Electronic Measuring Instruments and tools	S.E
3	System behavioral knowledge	Employability skills in mini project	T.E

Objectives : To Teach

1. Techniques for troubleshooting for system

Outcomes: Students will be able to

1. Describe different testing methods, test specification and debugging processes for system.

Lecture No.	Details of the Topic to be covered	References
1	Steps of Debugging, Techniques for troubleshooting	T1
2	characterization, Electromechanical components, passive components	T1
3	active components, active devices, operational amplifier	T1
4	Analog-Digital Conversion, Digital Components,	T1
5	Inspection and test of components, Simulation,	T1
6	Prototyping and testing, Integration, validation and verification	T1

Question Bank: Theory

Q.1.	Write short note on 1.Active Components 2.Passive components 3.Electromechanical Components	CO 3
Q.2.	What are the steps for debugging	CO 3
Q.3.	Compare different types of ADC's with respect to Parameters, Resolution, Conversion time, Power dissipation, Errors	CO 3
Q.4	Explain Validation and verification in electronic product design with suitable flow chart	CO 3
Q.5.	Explain techniques required for trouble shooting	CO 3
Q.6.	write short note on EMI & EMC issues.	CO 3
Q.7	**Case Study: Any electronic product testing with required details of equipment's used for testing process involved in hardware and software**	CO 3

4.8 f. Unit No:VI

Documentation

Pre-requisites

Sr.No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	Technical writing skills	Employability Skills in mini Projects	TE

Objectives: To Teach

1. Types of documentation, Methods of documentation

Outcomes: Students will be able to

1. Describe different documentation methods and techniques

Lecture No.	Details of the Topic to be covered	References
1	Definition, need, and types of documentation	T1
2	Records, Accountability, and Liability	T1
3	Audience. Preparation, Presentation, and Preservation of documents	T1
4	Methods of documentation	T1
5	Visual techniques, Layout of documentation, Bill of material.	T1

Question Bank: Theory

Q.1	What is the role of Documentation in product design and development	CO 4
Q.2	What are the types of documentations? Explain each one in brief	CO 4
Q.3	Explain how visual techniques can be used while preparing the document	CO 4
Q.4	What is the importance of a bill of material? Explain with proper product example	CO 4
Q.5	Explain Audience. Preparation, Presentation, and Preservation of documents	CO 4
Q.6	Explain Visual Techniques required for documentation	CO 4

Q.7	Explain Methods of documentation	CO 4
Q.8	**Represent any electronic product idea in the form of poster in terms of Features, Methodology, Block diagram ,Expected results etc.**	CO 4