SYLLABUS

(With effect from 2013-2014)
Out Come Based Education

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2013–14)
ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ

V and VI Semester

Bachelor Degree
in
Electronics and Communication Engineering

P.E.S. College of Engineering

Mandya - 571 401, Karnataka
(An Autonomous Institution Affiliated to VTU, Belagavi)
Grant -in- Aid Institution
(Government of Karnataka)
Accredited by NBA, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running eight undergraduate and eight Postgraduate programs. It consists of six M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE), has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted the semester structure with OBE scheme and grading system.

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of 2013-14.Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project is included in all undergraduate programs.

Dr.H.V.RAVINDRA
Dean (Academic)
Professor,
Dept. of Mechanical Engg.

B.DINESH PRABHU
Deputy Dean (Academic)
Associate Professor,
Dept. of Automobile Engg.

Vision

"An institution of high repute, imparting quality education to develop innovative and humane engineers"

Mission

"Committed to develop students potential through high quality teaching- learning processes and state-of-the art infrastructure"

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

About the Department

In the department, the B.E degree was started in 1972 and the M.Tech degree in 2006 , the Ph.D and M.Sc (by research) programmes in 2004. Currently, the strength of teaching faculty is 29 and that of non-teaching staff is 14. The present intake of B.E course is 120 and that of M.Tech course is 24. The teacher - student ratio is 1:16. The department has a research centre under VTU, with 4 research guides and 17 research students. During the last five years, the department has published 15 technical papers in international journals and 10 technical papers in national journals. The department has awarded Ph.D degree to 14 scholars. So far, the department has organized one international and one national conference.

Vision

Developing high quality engineers with sound technical knowledge, skills and ethics in order to meet the global technological and societal demands in the area of Electronics and Communication engineering.

Mission

- Developing high quality graduates and post-graduates of Electronics and Communication Engineering with modern technical knowledge, professional skills and attitudes in order to meet industry and society demands.
- Developing graduates with an ability to work productively in a team with professional ethics and social responsibility.
- Developing highly employable graduates and post graduates who can meet industrial requirements and bring innovations.
- Moulding the students with foundation knowledge and skills to enable them to take up post-graduate programmes and research programmes at the premier institutes.
- Providing students with an excellent academic ambience to instill leadership qualities, character moulding and life-long learning necessary for a successful professional career.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

(A) Programme Educational Objectives (PEOs)

The Bachelor of Engineering Programme in Electronics and Communication Engineering [B.E. (E&C)] during four years term, aims to

I. Provide the students with strong fundamental and advanced knowledge in mathematics, science and engineering with respect to Electronics and Communication Engineering discipline with an emphasis to solve engineering problems

II. Prepare the students through well - designed curriculum to excel in bachelor degree programme in E&C Engg. In order to engage in teaching or industrial or any technical profession and to pursue higher studies

III. Train students with intensive and extensive engineering knowledge and skill so as to understand, analyze, design and create novel products and solutions in the field of electronics and communication engineering.

IV. Inculcate in students the professional and ethical attitude, effective communication skills, team spirit, multidisciplinary approach and ability to relate engineering issues to broader social context.

V. Provide students with an excellent academic environment to promote leadership qualities, character moulding and lifelong learning as required for a successful professional career.

(B) Programme Outcomes (POs):

The BACHELOR OF ENGINEERING Programme in Electronics and Communication Engineering [B.E. (E&C)] must demonstrate that its graduates have

a) An ability to apply knowledge of mathematics, science and engineering to develop both analog and digital electronic and communication circuits and systems including software and hardware entities.
b) An ability to design and construct analog and digital electronic circuits, and to conduct experiments on them to analyze and interpret data.
c) An ability to design simulate and fabricate electronic and communication systems, Components, devices as well as to design and simulate the analog and digital processes of physical world.
d) An ability to function effectively as an individual and as a member of engineering teams of electrical, computer, information, automobile, mechanical and other disciplines.
e) An ability to identify, formulate and solve the problems of both analog and digital electronic and communication circuits and systems including software and hardware entities.
f) An understanding of professional and ethical responsibility at local, national and international levels.
g) An ability to effectively communicate orally and in writing on social and technical occasions in local and global scenarios.
h) The broad education to understand the impact of engineering solutions in a global and societal context.
i) An ability to engage in independent and lifelong learning in the broad context of technological change.
j) A knowledge of contemporary issues at local , national and international levels.
k) An ability to use the techniques, skills and modern engineering hardware and soft ware tools which are necessary for engineering practice.

These programme outcomes (POs) are achieved through an array of courses. To ensure the achievement of POs, the course learning outcomes (CLOs) are so formulated that they address the POs.

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

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Department of Electronics & Communication Engineering.

V Semester B.E. SCHEME OF TEACHING AND EXAMINATION 2013- 14

Sl. No	Course Code	Course Title	Teaching Dept.	Hours/ Week L:T:P:H	Credits	Examination Marks			Exam Duration in hours
						CIE	SEE	Total Marks	
1.	P13EC51	Entrepreneurship Development and Management (OS)	E&C	2:2:0:4	3	50	50	100	3
2.	P13EC52	Digital Signal Processor and Applications(HC)	E&C	4:0:0:4	4	50	50	100	3
3.	P13EC53	Information Theory and Coding (HC)	E&C	4:0:0:4	4	50	50	100	3
4.	P13EC54	Digital Communication Theory(HC)	E&C	4:0:0:4	4	50	50	100	3
5.	P13EC55	Digital CMOS VLSI Design(HC)	E&C	4:0:0:4	4	50	50	100	3
6.	P13EC56	Optical Communication Systems (HC)	E&C	4:0:0:4	4	50	50	100	3
7.	P13ECL57	Digital Signal Processing Laboratory	E&C	0:0:3:3	1.5	50	50	100	3
8.	P13ECL58	Optical and Analog Communication Laboratory	E&C	0:0:3:3	1.5	50	50	100	3
9	P13HU59	Professional and Efficient Avocation-I (PEA-I)	HS&M	2:0:0:2	0	(50)	---	---	---
10	P13EC510	Industry Interaction-II	E&C	0:0:1:1	0	(50)	--	--	---
Total					26	400	400	800	

L**:** Lecture, T: Tutorial, P: Practical, H:Hrs/Week, CIE: Continuous Internal Evaluation, SEE: Semester End Examination, C: Credits

HC: Hard Core (4Credits) -5 Courses, **OS**: Other subject (3 Credits) – 1 Course One Hour Lecture= Two Hours Tutorial / Practical = 1 Credit

VI Semester B.E. .) SCHEME OF TEACHING AND EXAMINATION 2013- 14

Sl. No	Course Code	Course Title	Teaching Dept.	Hours/ Week L:T:P:H	Credits	Examination Marks			Exam Duration in hours
						CIE	SEE	Total Marks	
1.	P13EC61	Analog CMOS VLSI Design(HC)	E&C	4:0:0:4	4	50	50	100	3
2.	P13EC62	Computer Communication Networks(PS)	E&C	4:0:0:4	4	50	50	100	3
3.	P13EC63	Microwave Devices and Integrated Circuits(HC)	E&C	4:0:0:4	4	50	50	100	3
4.	P13EC64	Digital Image Processing(HC)	E&C	4:0:0:4	4	50	50	100	3
5.	P13EC65	Digital Design using Verilog HDL((HC)	E&C	4:0:0:4	4	50	50	100	3
6.	P13EC66	Elective-I Group-A (OS) **	E&C	2:2:0:4	3	50	50	100	3
7.	P13ECL67	Verilog HDL Laboratory	E&C	0:0:3:3	1.5	50	50	100	3
8.	P13ECL68	Microwave and Digital Communication Laboratory	E&C	0:0:3:3	1.5	50	50	100	3
9	P13HU69	Professional and Efficient Avocation-I (PEA-II)*	HS&M	2:0:0:2	0	(50)	---	---	
10	P13EC610	Mini Project-II*	E&C	0:0:1:1	0	(50)	--	--	
Total					26	400	400	800	

L**:** Lecture, T: Tutorial, P: Practical, H:Hrs/Week, CIE: Continuous Internal Evaluation, SEE: Semester End Examination, C: Credits

HC: Hard Core (4Credits) -4 Courses **OS**: Other subject (3 Credits) – 1 Course **PS**: Professional subject (4Credirs)- 1Course

One Hour Lecture= Two Hours Tutorial / Practical = 1 Credit

* PEA-I, Industry visit and interaction-II, PEA-II, Mini Project: All students shall have to pass this mandatory learning courses before completion of VII-Semester

**** List of Electives-I (Group-A)**

Sl.No.	Course Code	Elective Course Title
1.	P13EC661	Programming in C++
2.	P13EC662	Radar and Navigational Aids
3.	P13EC663	Multicore Processing
4.	P13EC664	Control System

EVALUATION SCHEME

Scheme	Weightage	Marks	Event Break Up				
			Test I	Test II	Quiz I	Quiz II	Assignment
CIE	50%	50	35	35	5	5	10
SEE	50%	100	Questions to Set: 10		Questions to Answer: 5		

Scheme of SEE Question Paper (100 Marks)

Duration: 3Hrs	Marks: 100	Weightage: 50%

- Each of the two questions set shall be so comprehensive as to cover the entire contents of the unit.
- There will be direct choice between the two questions within each Unit
- Total questions to be set are 10. All carry equal marks of 20
- The number of subdivisions in each main question shall be limited to three only
- Number of questions to be answered by students is 5

Course Title : ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT			
Course Code: P13EC51	**Semester : V**	**L-T-P-H: 2 – 2 – 0-4**	**Credits:3**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs	**Weightage :CIE:50% SEE:50%**		

Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic knowledge of Entrepreneurship and Management.
2. Explain the managerial responsibilities in a typical Engineering career.
3. Provide the understanding of the various functions of technology management.
4. Highlight the nature of technical professionals and the factors for effective motivation.
5. Outline the concepts of entrepreneurship
6. Provide the knowledge of central and state level institutions / agencies supporting small–business enterprises.
7. Illustrate the procedure for setting up of a small scale industrial unit.

Course Content

UNIT – I

Entrepreneurship: Evolution and concept of entrepreneurship, Entrepreneurship today, Types of entrepreneurship, Intrapreneurship, Entrepreneurial competencies, Capacity building for entrepreneurs

Entrepreneurial Development and Training: Entrepreneurial environment, Models of entrepreneurial development, Entrepreneurial motivation, Entrepreneurship training methods, the process of entrepreneurial development

Women Entrepreneurs: Women's entrepreneurship in Asia, Women's entrepreneurship in India, Challenges faced by women entrepreneurs, Strategies for the development of women entrepreneurs, Institutions supporting women entrepreneurs in India, Special bank schemes promoting women's entrepreneurship, Women entrepreneur from around the world, Women entrepreneurs in India, Women's empowerment through entrepreneurship

Text 1: Chapters 1, 2 and 3. Pages 2– 18, 21– 40, 43– 67. **11 Hrs**

UNIT – II

Identification of Business Opportunities: Introduction, Mobility of entrepreneurship, Business opportunities in India, Models for opportunity evaluation

Project Management and Financing: Project manager, Project life cycle, Project scheduling, Project management software, Capital budgeting, Generating an investment project proposal, Project analysis, Market analysis, Technical analysis, Financial analysis, Economic analysis, Ecological analysis, Project evaluation and selection, Project financing, Project implementation phase, Capital structure and cost of capital, Detailed project report

Institutions Supporting Business Enterprises: Central level institutions, State level institutions, other institutions

Text 1: Chapters 6, 7 and 9. Pages 110– 127, 131– 155, 204– 228 **11 Hrs**

UNIT – III

Introduction to Engineering Management:

Engineering and Management: Preview, Engineering, Management, Engineering Management: A Synthesis.

Historical Development of Engineering Management: Preview, Origins, The Industrial Revolution, Management Philosophies, Scientific Management, Administrative Management, Behavioral Management, Other Contributions.

Functions of Technology Management:

Planning and Forecasting: Preview, Nature of Planning, The Foundation for Planning, Some Planning Concepts, Forecasting, Stratergies for Managing Technology.

Decision Making: Preview, Nature of Decision Making, Management Science, Tools for Decision Making, Computer–Based Information Systems, Implementation.

Text 2: Chapters 1, 2, 3 and 4. Pages 1 to 106. **10 Hrs**

UNIT – IV

Functions of Technology Management (Continued):

Organizing: Preview, Nature of organizing, Traditional Organization Theory, Technology and Modern Organization Structures, Teams.

Some Human Aspects of Organizing: Preview, Staffing Technical Organizations, Authority and Power, Delegation, Committees and meetings.

Motivating and Leading Technical People: Preview, Motivation, Leadership, Motivating and Leading Technical Professionals.

Controlling: Preview, The Process of Control, Financial Controls, Nonfinancial Controls.

Text 2: Chapters 5, 6, 7 and 8. Pages 107 to 196. **10 Hrs**

UNIT – V

Managing Your Engineering Career:

Achieving Effectiveness as an Engineer: Preview, Getting Off to the Right Start, Charting Your Career, Communicating Your Ideas, Staying Technically Competent, Professional Activity

Managerial and International Opportunities for Engineers: Preview, Management and the Engineer, International management.

Special Topics in Engineering Management: Preview, Women and Minorities in Engineering and Management, Managing Your Time, Professional Ethics and Conduct, Future Considerations in Engineering and Management.

Text 2: Chapters 16, 17 and 18. Pages 391 to 486. **10 Hrs**

TEXT BOOKS:

1. "Entrepreneurship Development and Small Business Enterprises", Poornima M. Charantimath, 2nd Edition, Pearson Education
2. "Managing Engineering and Technology", Lucy C. Morse and Daniel L. Babcock, 3rd Edition, PHI

REFERENCE BOOKS:

1. "Essentials of management", Koontz, Weirich, 9th Edition, Tata McGraw Hill, Publication year 2012
2. "Entrepreneurship", Arya Kumar, Dorling Kindersley (India) Pvt., Publication year 2012
3. "Entrepreneurship", Rajeev Roy, 2nd Edition, Oxford University Press

Course Outcome (CO)

After learning all the units of the course, the student is able to

01 Outline the evolution and concepts of entrepreneurship. – L1 (Unit – I)
02 Explain the concept of project management. – L2 (Unit – II)
03 Describe the origins of engineering management. – L1 (Unit – III)
04 Explain the balance sheets, income statements and ratios. – L2 (Unit – IV)
05 Explain the importance of ethics in engineering. – L2 (Unit – V)
06 Describe the situations where conflict of interest may arise. – L1 (Unit – V)

Topic Learning Outcomes

After learning all the topics of UNIT– I, the student is able to

01 Explain the concept of entrepreneur. – L2
02 Discuss the evolution of the concept of entrepreneurship. – L2
03 Illustrate the various sources of innovation, with examples. – L3
04 Examine the factors that motivate people to go into business. – L4
05 Discuss the necessity of entrepreneurial motivation for a successful entrepreneurial career. – L2
06 Explain the factors that motivate people to become entrepreneurs. – L2
07 Discuss the concept, objectives and stages of entrepreneurship development programmes (EDPs). – L2
08 Discuss the importance of women entrepreneurs. – L2
09 Explain the factors and strategies needed for the development of women entrepreneurs in India. – L2
10 Outline the growth of women entrepreneurs in India. – L1

After learning all the topics of UNIT– II, the student is able to

01 Analyze the difference between an idea and an entrepreneurial opportunity. – L4
02 Explain the factors to be considered for generating business ideas. – L5
03 Identify the major changes that create opportunities for entrepreneurs. – L2
04 Explain the John Mullin's seven– domain framework. – L2
05 Discuss the six broad phases of capital budgeting. – L2
06 Illustrate the schematic diagram of the project feasibility study. – L4
07 Sketch the schematic diagram depicting the formalities for setting up a business enterprise. – L3
08 Solve the numerical problems on project management and financing. – L3
09 Describe the institutional set up for entrepreneurial development of India. – L2
10 Explain the role of national– level training institutes in conducting EDPs. – L2

After learning all the topics of UNIT– III, the student is able to

01 Define the management, engineering and engineering management. – L1
02 Explain the need for engineers in management. – L2
03 Describe the various roles of a manager according to Henry Mintzberg. – L2
04 Explain the five functions of managers according to Henry Fayol. – L2
05 Interpret the F. W. Taylor's contribution to management. – L3
06 Recognize the contribution of Gilberth's to management. – L1
07 Illustrate the planning/decision making process. – L3
08 Interpret the Peter Drucker's concept of management by objectives. – L3
09 Summarize the strategies for managing technology. – L2
10 Explain the technological forecasting. – L2

After learning all the topics of UNIT– IV, the student is able to

01 List the legal forms of organization and explain them. – L1
02 Describe the factors determining effective span of control. – L2
03 Analyze the Woodward and Aston studies related to standardized organizational environment. – L4
04 Discuss the strategy you propose to use in your personal career to assure you will remain in demand in a changing, competitive world. – L2
05 Discuss the impact of information revolution on organizations. – L2
06 Describe the assignment, delegation and accountability. – L2
07 List the barriers to delegation for engineers. – L1
08 Explain the leadership styles as proposed by Tannenbaum and Schmidt. – L2
09 Explain the Douglas McGregor's Theory X and Theory Y postulates with respect to motivation. – L2
10 Differentiate between the scientists and the engineers. – L4

After learning all the topics of UNIT– V, the student is able to

01 Discuss the core concepts in engineering ethics. – L2
02 Summarize the ethical problems in industrial practice. – L2
03 Analyze the "career stages" of Super and /or those of Dalton and Thomspson. – L4
04 Define the Communication and explain the importance of communication. – L1
05 List the career problems of the woman engineer? – L1
06 List the six stages of multi– nationalization according to Jacoby. – L1
07 Explain the Japanese management styles. – L2
08 Discuss the various International trade agreements. – L2
09 Discuss the management in developing countries. – L2
10 Explain the need for engineers in top management. – L2

Review Questions

1. Explain how an entrepreneur differs from a manager.
2. Explain the characteristics of a successful entrepreneur.
3. Discuss the development methods of achievement motivation.
4. Discuss the challenges in the path of women's entrepreneurship.
5. List the institutions supporting women's entrepreneurship in India.
6. Describe the various types of entrepreneurial development programmes available in India.
7. Classify the business opportunities based on origin, application, user or source and external sources of change.
8. Explain how "solving a problem" can create a business opportunity.
9. Describe the institutional set up for entrepreneurial development of India.
10. Discuss the need for institutional support for MSME.
11. Discuss the need for institutional support for MSME.
12. Explain the functions of District Industries Centers.
13. Identify the three types of skills needed by an effective manager as conceived by Robert L.Katz
14. Describe how the relative need of the three types of skills vary with the level of management.
15. Discuss the function of managers at various management levels.
16. Defend the Max Weber's model of bureaucracy.
17. Summarize the Hawthorne studies.
18. Discuss the Henri Fayol's advice to the future engineers.
19. Solve the numerical problems on planning and forecasting.

20. List the three occasions for decision as cited by Chester Barnard.
21. Explain why the Barnard thought that the third category is most important.
22. Explain the difference between "optimizing" and "sufficing" in making decisions.
23. Distinguish between the routine and non–routine decisions.
24. Solve the numerical problems on decision making.
25. Discuss the three questions posed by Peter Drucker to help identify the key activities.
26. Explain the decision analysis and relation analysis according to Peter Drucker.
27. Discuss the various patterns of departmentation?
28. Explain the process of hiring technical professionals.
29. Interpret the job requisition/description. Illustrate a typical job requisition.
30. Interpret the orientation, training and appraising performance.
31. Explain the acceptance theory of authority.
32. List the sources of power and explain them.
33. Describe the committees and meetings.
34. 34.Illustrate the Blake and Mouton's Leadership grid.
35. Summarize the Frederick Herzberg's two factor theory.
36. List the David McClelland's trio of needs and explain them.
37. Sketch the Victor Vroom's Expectancy theory.
38. Illustrate the steps involved in the control process
39. List the characteristics of effective control systems.
40. Describe the budgeting process.
41. Solve the numerical problems on financial control.
42. Explain the three types of forces that a manager should consider as proposed by Tannenbaum and Schmidt.
43. Outline the various motivation theories
44. Label the Abraham Maslow's hierarchy of needs.
45. Summarize the B.F.Skinner's behaviour modification theory.
46. Explain the Rosenbaum's five strategic dimensions of technical leadership.
47. Illustrate the communications process model.
48. List the various communication tools of special importance to the engineer.
49. Identify the threats to staying technically competent.
50. List the difference between engineers and engineer managers.

Lesson Plan

UNIT – I

Period No. **Topics**

1. **Entrepreneurship:** Evolution and concept of entrepreneurship,
2. Entrepreneurship today, Types of entrepreneurship, Intrapreneurship,
3. Entrepreneurial competencies, Capacity building for entrepreneurs
4. Entrepreneurial environment, Models of entrepreneurial development,
5. Entrepreneurial motivation, Entrepreneurship training methods,
6. the process of entrepreneurial development
7. Women's entrepreneurship in Asia, Women's entrepreneurship in India, Challenges faced by women entrepreneurs, 8. Strategies for the development of women entrepreneurs, Institutions supporting women entrepreneurs in India
8. Special bank schemes promoting women's entrepreneurship, Women entrepreneur from around the world,
9. Women entrepreneurs in India, Women's empowerment through entrepreneurship

UNIT – II

Period No. Topics

1. Identification of Business Opportunities: Introduction, Mobility of entrepreneurship,
2. Business opportunities in India, Models for opportunity evaluation
3. Project Management and Financing: Project manager,
4. Project life cycle, Project scheduling, Project management software,
5. Capital budgeting, Generating an investment project proposal,
6. Project analysis, Market analysis, Technical analysis, Financial analysis,
7. Economic analysis, Ecological analysis, Project evaluation and selection,
8. Capital structure and cost of capital Detailed project report
9. Project financing, Project implementation phase,
10. Supporting Business Enterprises: Central level institutions,
11. State level institutions
12. Other institutions

UNIT – III

Period No. Topics

1. Introduction to Engineering Management: Engineering and Management: Preview, Engineering,
2. Management, Engineering Management: A Synthesis.
3. Historical Development of Engineering Management: Preview, Origins, The Industrial Revolution, Management Philosophies,
4. Scientific Management, Administrative Management, Behavioural Management, Other Contributions.
5. Functions of Technology Management: Planning and Forecasting: Preview, Nature of Planning,
6. The Foundation for Planning, Some Planning Concepts, Forecasting,
7. Strategies for Managing Technology. Decision Making: Preview, Nature of Decision Making,
8. Management Science, Tools for Decision Making,
9. Computer–Based Information Systems,
10. Implementation.

UNIT – IV

Period No. Topics

1. Functions of Technology Management (Continued): Organizing: Preview, Nature of organizing,
2. Traditional Organization Theory, Technology and Modern Organization Structures, Teams.
3. Some Human Aspects of Organizing: Preview, Staffing Technical Organizations,
4. Authority and Power, Delegation, Committees and meetings.
5. Motivating and Leading Technical People: Preview, Motivation,
6. Leadership, Motivating and Leading Technical Professionals.
7. Controlling: Preview, The Process of Control,
8. Financial Controls,
9. Nonfinancial Controls.

UNIT – V

Period No. Topics

1. Managing Your Engineering Career: Achieving Effectiveness as an Engineer: Preview,
2. Getting Off to the Right Start, Charting Your Career,
3. Communicating Your Ideas, Staying Technically Competent,
4. Professional Activity
5. Managerial and International Opportunities for Engineers: Preview, Management and the Engineer,
6. International management.
7. Special Topics in Engineering Management: Preview,
8. Women and Minorities in Engineering and Management,
9. Managing Your Time,
10. Professional Ethics and Conduct,
11. Future Considerations in Engineering and Management.

Course Articulation Matrix (CAM)

Sl. No	Course Outcome – (CO)		Program outcome (ABET/NBA-(3a-k)										
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
01	Outline the evolution and concepts of entrepreneurship. – (Unit – I)	L1	M	M	L								
02	Explain the concept of project management. –(Unit – II)	L2	M	H									
03	Describe the origins of engineering management. –(Unit – III)	L1	M	M	L								
04	Explain the balance sheets, income statements and ratios. – (Unit – IV)	L2	M	H									
05	Explain the importance of ethics in engineering. –(Unit – V)	L2	M	M	L								
06	Describe the situations where conflict of interest may arise. –(Unit – V)	L1	M	L									
L-Low, M-Moderate, H-High													

Course Assessment Matrix (CAM)

Sl. No	Course Outcome – CO		Program outcome (ABET/NBA-(3a-k)										
			a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
01	Outline the evolution and concepts of entrepreneurship. – (Unit – I)	L1	1	2	1								
02	Explain the concept of project management. –(Unit – II)	L2	2	3									
03	Describe the origins of engineering management. –(Unit – III)	L1	2	2	1								
	Explain the balance sheets, income statements and ratios. – (Unit – IV)	L2	2	1									
05	Explain the importance of ethics in engineering. –(Unit – V)	L2	2	2	3								
06	Describe the situations where conflict of interest may arise. –(Unit – V)	L1	2	3									
1-Low, 2-Moderate, 3-High													

Course Title : DIGITAL SIGNAL PROCESSOR AND APPLICATIONS			
Course Code: P13EC52	Semester : V	L-T-P-H: 4 – 0 – 0-4	Credits:4
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		Weightage :CIE:50% SEE:50%	

Prerequisite course for:
1. Embedded and Real Time Systems – P13EC73

Course Learning Objectives (CLOs)

This course aims to
1. Provide the understanding of architecture, programming and interfacing of commercially available Digital Signal Processor.
2. Explain the effective use of Digital Signal Processor in system implementation.
3. Adopt the MATLAB tools in DSP applications.
4. Provide the understanding of architecture features of TMS320C54XX.
5. Describe the programming of TMS320C54XX for several basic DSP algorithms.
6. Explain the interfacing procedure to use programmable Digital Signal Processor.
7. Discuss the applications of programmable DSP devices.

Course Content

UNIT – I

Architectures for Programmable DSP Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.
Text: 4.1 to 4.10 **10 Hrs**

UNIT – II

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal–processing Devices, Data Addressing Modes of TMS32OC54xx DSPs, Data Addressing Modes of TMS32OC54xx Processors, Memory Space of TMS32OC54xx Processors, Program Control, TMS32OC54xx Instructions and programming, On–chip Peripherals, Interrupts of TMS32OC54xx Processors, Pipeline Operation of TMS32OC54xx Processors.
Text: 5.1 to 5.10 **10 Hrs**

UNIT – III

Implementation of Basic DSP Algorithms: Introduction, the Q– notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID controller, Adaptive Filters, 2–D Signal Processing.
Implementation of FFT Algorithms: Introduction, an FFT Algorithm for DFT Computation, Overflow and Scaling, Bit–Reversed Index Generation, an 8 Point FFT Implementation on the TMS32OC54xx, Computation of Signal Spectrum.
Text: 7.1 to 7.10 and 8.1 to 8.7 **11 Hrs**

UNIT – IV

Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA).

Interfacing and Applications of DSP Processor: Introduction, Synchronous Serial Interface, A Multichannel Buffered Serial Port (McBSP), McBSP Programming, A CODEC Interface Circuit, CODEC Programming, A CODEC–DSP Interface example.
Text: 9.1 to 9.8 and 10.1 to10.7 **11 Hrs**

UNIT – V

Applications of Programmable DSP Devices: Introduction, A DSP system, DSP Based Bio– telemetry Receiver, A Speech Processing System, An Image Processing System, A Position control system for a hard disk drive, DSP based Power meter.
Text: 11.1 to 11.7 **10 Hrs**

TEXT BOOK:
"Digital Signal Processing", Avatar Singh and S. Srinivasan, Thomson Learning, 2004.

REFERENCE BOOKS:
1. "Digital Signal Processing", A practical approach, Ifeachor E. C.,Jervis B. W Pearson– Education, PHI/ 2002
2. "Digital Signal Processors", B Venkataramani and M Bhaskar TMH, 2002
3. "Architectures for Digital Signal Processing", Peter Pirsch John Weily, 2007

Course Outcomes

After learning all the units of the course, the student is able to

01 Explain the architecture and memory of DSP. – L2 (Unit – I)
02 Describe the programming of DSP TMS320C54XX. – L1 (Unit – II)
03 Explain the implementation of FFT algorithms. – L2 (Unit – III)
04 Discuss the interfacing of memory & parallel I/O peripherals to DSP. – L2 (Unit – IV)
05 Discuss the applications of programmable DSP. – L2 (Unit – V)
06 Discuss the Concept of an Image Processing System. – L2 (Unit – V)

Topic Learning Outcomes

After learning all the topics of UNIT– I, the student is able to

01 Explain the basic architectural Features of DSP. – L2
02 Describe the DSP computational building blocks –L1
03 Explain the bus structures and memory of DSP. – L2
04 Discuss the different addressing modes used in DSP. – L2
05 Explain the operation of address generation unit. – L2
06 Explain the execution of programs in DSP. – L2
07 Explain the Speed Issues related to the DSP Architecture. – L2

After learning all the topics of UNIT– II, the student is able to

01 Discuss the various commercially available DSP devices. – L2
02 Explain the memory organization of TMS320C54XX. – L2
03 Describe the different addressing mode of TMS320C54XX. – L1
04 Describe the Memory Space of TMS320C54XX Processors. – L1
05 Describe the program control in DSP. – L1
06 Discuss the instruction set of TMS320C54XX. – L2
07 Explain the programming of TMS320C54XX. – L2
08 Explain the on– chip peripherals of TMS320C54XX. – L2
09 Explain the Pipeline operation of TMS320C54XX. – L2

After learning all the topics of UNIT– III, the student is able to

01 Describe the Q– notation used in MATLAB. – L1
02 Write the program of IIR filters using MATLAB tool. – L3
03 Explain the concept of interpolation and decimation in filters. – L2
04 Explain the concept of PID Controller, Adaptive Filters, 2–D Signal Processing. – L2
05 Explain the FFT algorithm used for DFT computation. – L2
06 Describe the butterfly computation structure. – L1
07 Explain the overflow and scaling problem. – L2
08 Explain the bit reversed index generation in DFT Computation. – L2
09 Explain the 8– point FFT implementation on TMS320C54XX. – L2

After learning all the topics of UNIT– IV, the student is able to

01 Explain the memory space organization in TMS320C54XX. – L2
02 Discuss the different external bus interfacing signals. – L2
03 Explain the interfacing of memory to TMS320C54XX. – L2
04 Explain the interfacing of parallel and programmed I/O to TMS320C54XX. – L2
05 Explain the interfacing of interrupts and I/O to TMS320C54XX. – L2
06 Explain the operation of DMA in TMS320C54XX. – L2
07 Discuss the synchronous serial interface to TMS320C54XX. – L2
08 Explain the Multichannel Buffered Serial Port (McBSP) and Programming. – L2
09 Explain the CODEC–DSP interface Example. – L2

After learning all the topics of UNIT– V, the student is able to

01 Explain the concept of DSP system. – L2
02 Explain the application of DSP in biotelemetry receiver. – L2
03 Explain the application of DSP in speech processing system. – L2
04 Explain the application of DSP in image processing system. – L2
05 Discuss the Image processing System. – L2
06 Explain the concept of Position Control System for a Hard Disk Drive. – L2
07 Explain the application of DSP–Based Power Meter. – L2

Review Questions

1. Explain the detail study of TMS320C54XX. – L2 (Unit – II)
2. Discuss the implementation of basic DSP algorithms. – L2 (Unit – III)
3. Explain the synchronous serial interface to DSP. – L2 (Unit – IV)
4. Discuss the different interrupts used in TMS320C54XX. – L2
5. Discuss the different addressing modes of TMS320C54XX. – L2
6. Write the program of FIR filters using MATLAB tool. – L3
7. Explain the CODEC interface circuit and CODEC Programming. – L2
8. Explain the basic architectural Features of DSP. – L2
9. Describe the DSP computational building blocks –L1
10. Explain the bus structures and memory of DSP. – L2
11. Discuss the different addressing modes used in DSP. – L2
12. Explain the operation of address generation unit. – L2
13. Explain the execution of programs in DSP. – L2
14. Explain the Speed Issues related to the DSP Architecture. – L2
15. Discuss the various commercially available DSP devices. – L2
16. Explain the memory organization of TMS320C54XX. – L2

17. Describe the different addressing mode of TMS320C54XX. – L1
18. Describe the Memory Space of TMS320C54XX Processors. – L1
19. Describe the program control in DSP. – L1
20. Discuss the instruction set of TMS320C54XX. – L2
21. Explain the programming of TMS320C54XX. – L2
22. Explain the on– chip peripherals of TMS320C54XX. – L2
23. Explain the Pipeline operation of TMS320C54XX. – L2
24. Describe the Q– notation used in MATLAB. – L1
25. Write the program of IIR filters using MATLAB tool. – L3
26. Explain the concept of interpolation and decimation in filters. – L2
27. Explain the concept of PID Controller, Adaptive Filters, 2–D Signal Processing. – L2
28. Explain the FFT algorithm used for DFT computation. – L2
29. Describe the butterfly computation structure. – L1
30. Explain the overflow and scaling problem. – L2
31. Explain the bit reversed index generation in DFT Computation. – L2
32. Explain the 8– point FFT implementation on TMS320C54XX. – L2
33. Explain the memory space organization in TMS320C54XX. – L2
34. Discuss the different external bus interfacing signals. – L2
35. Explain the interfacing of memory to TMS320C54XX. – L2
36. Explain the interfacing of parallel and programmed I/O to TMS320C54XX. – L2
37. Explain the interfacing of interrupts and I/O to TMS320C54XX. – L2
38. Explain the operation of DMA in TMS320C54XX. – L2
39. Discuss the synchronous serial interface to TMS320C54XX. – L2
40. Explain the Multichannel Buffered Serial Port (McBSP) and Programming. – L2
41. Explain the CODEC–DSP interface Example. – L2
42. Explain the concept of DSP system. – L2
43. Explain the application of DSP in biotelemetry receiver. – L2
44. Explain the application of DSP in speech processing system. – L2
45. Explain the application of DSP in image processing system. – L2
46. Discuss the Image processing System. – L2
47. Explain the concept of Position Control System for a Hard Disk Drive. – L2
48. Explain the application of DSP–Based Power Meter. – L2
49. Describe the Programmability, Program Execution and Speed Issues of DSP architecture. – L1
50. Describe clipping autocorrelation pitch detector with a neat block diagram – L1

Lesson Plan

UNIT – I

Period No.	Topics
1.	Architectures for Programmable DSP Devices: Introduction
2.	Basic Architectural Features
3.	DSP Computational Building Blocks
4.	Bus Architecture and Memory
5.	Data Addressing Capabilities
6.	Address Generation Unit
7.	Programmability and Program Execution
8.	Programmability and Program Execution
9.	Speed Issues,
10.	Features for External Interfacing

UNIT – II

Period No. Topics

11. Programmable Digital Signal Processors: Introduction
12. Commercial Digital Signal– processing Devices
13. Data Addressing Modes of TMS32OC54xx DSPs
14. Data Addressing Modes of TMS32OC54xx Processors
15. Memory Space of TMS32OC54xx Processors
16. Program Control
17. TMS32OC54xx Instructions and programming
18. On–chip Peripherals
19. Interrupts of TMS32OC54xx Processors
20. Pipeline Operation of TMS32OC54xx Processors

UNIT – III

Period No. Topics

21. Implementation of Basic DSP Algorithms: Introduction
22. The Q– notation, FIR Filters
23. IIR Filters, Interpolation Filters
24. Decimation Filters, PID controller
25. Adaptive Filters, 2–D Signal Processing
26. Implementation of FFT Algorithms: Introduction
27. An FFT Algorithm for DFT Computation
28. Overflow and Scaling
29. Bit–Reversed Index Generation
30. An 8 Point FFT Implementation on the TMS32OC54xx
31. Computation of Signal Spectrum

UNIT – IV

Period No. Topics

32. Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction
33. Memory Space Organization
34. External Bus Interfacing Signals
35. Memory Interface
36. Parallel I/O Interface, Programmed I/O
37. Interrupts and I/O, Direct Memory Access (DMA)
38. Interfacing and Applications of DSP Processor: Introduction
39. Synchronous Serial Interface
40. A Multichannel Buffered Serial Port (McBSP), McBSP Programming
41. A CODEC Interface Circuit
42. CODEC Programming, A CODEC–DSP Interface example.

UNIT – V

Period No. Topics

43. Applications of Programmable DSP Devices: Introduction
44. Introduction
45. A DSP system
46. DSP Based Bio– telemetry Receiver
47. DSP Based Bio– telemetry Receiver
48. A Speech Processing System
49. An Image Processing System
50. A Position control system for a hard disk drive
51. A Position control system for a hard disk drive
52. DSP based Power meter.

Course Articulation Matrix(CAM)

Sl. No	Course Outcome – CO		Program outcome (ABET/NBA-(3a-k)										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the architecture and memory of DSP. – (Unit – I)	L2	L	M	H								
02	Describe the programming of DSP TMS320C54XX. – (Unit – II)	L1	L	M	H								
03	Explain the implementation of FFT algorithms.– (Unit – III)	L2	L	M	H								
04	Discuss the interfacing of memory & parallel I/O peripherals to DSP. – (Unit – IV)	L2	L	M									
05	Discuss the applications of programmable DSP. – (Unit – V)	L2	L	M	H								
06	Discuss the Concept of an Image Processing System. – (Unit – V)	L2	L	M									
L-Low, M-Moderate, H-High													

Course Assessment Matrix (CAM)

Sl. No	Course Outcome – CO		Program outcome (ABET/NBA-(3a-k)										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the architecture and memory of DSP. – (Unit – I)	L2	1	2	3								
02	Describe the programming of DSP TMS320C54XX. – (Unit – II)	L1	1	2	3								
03	Explain the implementation of FFT algorithms.– (Unit – III)	L2	1	2	3								
04	Discuss the interfacing of memory & parallel I/O peripherals to DSP. – (Unit – IV)	L2	1	2									
05	Discuss the applications of programmable DSP. – (Unit – V)	L2	1	2	3								
06	Discuss the Concept of an Image Processing System. – (Unit – V)	L2	1	2									
1-Low, 2-Moderate, 3-High													

Course Title : INFORMATION THEORY AND CODING			
Course Code: P13EC53	**Semester : V**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

This Course forms a prerequisite course for

1. Computer Communication Networks – P13EC62
2. GSM Communication and Networks – P13EC 74
3. Satellite Communication – P13EC81

Course Learning Objectives (CLOs)

This course aims to

1. Provide the knowledge of information theory and source coding theorem.
2. Analyze the efficient data compression methods and describe the most efficient compression method.
3. Develop the channel model and channel capacity theorem.
4. Describe the linear block code and parity check matrix.
5. Explain the probability of error correction, hamming codes and cyclic codes.
6. Explain the matrix description of convolution codes, decoding of convolution codes & concept of trellis coded modulation.

Course Content

UNIT – I

Source Coding 1: Introduction to Information theory, Uncertainty and Information, Average Mutual Information and Entropy, Information Measures for Continuous Random Variables, Source coding theorem.

Source Coding 2: Huffman Coding, Arithmetic Coding, The Lempel– Ziv Algorithm, Run Length Encoding and the PCX format, Introduction to Image Compression, The JPEG standard for Lossless Compression, the JPEG standard for Lossy Compression.

Text: 1.1 to 1.5, 1.6, 1.8, 1.9, 1.10, 1.14 to 1.16 **11 Hrs**

UNIT – II

Channel Capacity and coding: Introduction, channel Models, Channel Capacity, Information Capacity Theorem, the Shannon Limit, and Random Selection of Codes.

Text: 2.1 to 2.3, 2.5, 2.6, 2.8 **10 Hrs**

UNIT – III

Linear Block Codes for Error Correction 1: Introduction to Error Correcting Codes, Basic Definitions, and Matrix Description of Linear Block codes, Equivalent Codes, Parity Check Matrix, and Decoding of a Linear Block Code.

Linear Block Codes for Error Correction 2: Syndrome Decoding, Error Probability after Coding (Probability of Error correction), Perfect Codes, Hamming Codes, Optimal Linear Codes, and Maximum Distance Separable (MDS) Codes.

Text: 3.1 to 3.6, 3.7 to 3.10, 3.12, 3.13 **10 Hrs**

UNIT – IV

Cyclic Codes : Introduction to Cyclic Codes, Polynomials, The Division Algorithm for Polynomials, A Method for Generating Cyclic Codes, Matrix Description of Cyclic Codes, Quasi– cyclic Codes and Shortened Cyclic Codes, Burst Error Correction, Fire codes, Golay Codes.

Text: 4.1 to 4.9 **10 Hrs**

UNIT – V

Convolutional Codes: Introduction to Convolution Codes, Tree Codes and Trellis Codes, Polynomial Description of Convolutional Codes (Analytical Representation), Distance Notions for Convolutional Codes, the Generating Function, Matrix Description of Convolutional Codes, Viterbi Decoding of Convolutional Codes.

Trellis Coded Modulation: Introduction to TCM, the Concept of Coded Modulation, Mapping by Set partitioning, Underboeck's TCM Design Rules, TCM Decoder.

Text: 6.1 to 6.7, 7.1 to 7.5 **11 Hrs**

TEXT BOOK:

"Information Theory, Coding and Cryptography", Ranjan Bose, 2rd Edition. Tata McGraw Hill– 2008

REFERENCE BOOKS:

1. "Introduction to communication systems", K. Sam Shanmugam, John Wiley & Sons.
2. "Communication systems", Simon Haykin, John Wiley, 4th Ed.
3. "Elements of Information Theory", Thomas M. Cover, Joy A. Thomas, 2nd edition, John wiley

Course Outcome

After learning all the units of the course, the student is able to

01 Describe the entropy and average mutual information. – L2 (Unit – I)
02 Explain the source coding theorem. – L2 (Unit – I)
03 Describe the JPEG standard for lossy & lossless compression. – L2 (Unit – I)
04 Estimate the capacity of communication channel. – L2 (Unit – II)
05 Explain the linear block codes and its decoding. – L2 (Unit – III)
06 Discuss the cyclic codes, fire codes and golay codes. – L2 (Unit – IV)
07 Compute the convolution codes and trellis code. – L3 (Unit – V)
08 Explain the concept of coded modulation & TCM decoder. – L2 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT– I, the student is able to

01 Describe the concept of Entropy and Average Mutual Information. – L2
02 Explain the concept of Information theory. – L2
03 Apply the concept of Uncertainty and Information. – L3
04 Develop the expressions for Average Mutual Information and Entropy. – L5
05 Analyze the Information Measures for Continuous Random Variables. – L4
06 Describe the Source coding theorem. – L1
07 Solve the problems on various coding techniques. – L3
08 Describe the Huffman Coding and solve problems on the same. – L2
09 Describe the arithmetic Coding and solve problems on the same. – L1
10 Describe the Lempel– Ziv Algorithm and solve problems on the same. – L1
11 Describe the Run Length Encoding and solve problems on the same. – L1
12 Analyze the JPEG standard for Lossless and lossy Compression. – L4

After learning all the topics of UNIT– II, the student is able to

1. Apply the theorems on channel capacity and Shannon limit. – L3
2. Explain the concept of channel Models. – L2
3. Solve the problems on channel capacity and Shannon limit. – L3
4. Analyze the Random Selection of Codes. – L4

After learning all the topics of UNIT– III, the student is able to

01 Solve the various problems on linear block codes for error correction. – L3
02 Explain the concept of Error Correcting Codes. – L2
03 Describe the matrix representation of Linear Block codes. – L2
04 Explain the concept of Equivalent Codes and Parity Check Matrix. – L2
05 Analyze the Decoding of a Linear Block Code. – L4
06 Analyze the concept of Syndrome Decoding. – L4
07 Describe the Error Probability after Coding (Probability of Error correction). – L2
08 Illustrate the Perfect Codes. – L4
09 Solve the problems on Hamming Codes. – L3
10 Explain the concept of Optimal Linear Codes and Maximum Distance Separable (MDS) Codes. – L2

After learning all the topics of UNIT– IV, the student is able to

01 Solve the problems on cyclic codes. – L3
02 Explain the concept of Cyclic Codes. – L2
03 Define the Polynomials. – L1
04 Illustrate the Division Algorithm for Polynomials. – L3
05 Define the Method for Generating Cyclic Codes. – L1
06 Illustrate the Matrix Description of Cyclic Codes. – L3
07 Analyze the concept of Quasi– cyclic Codes and Shortened Cyclic Codes. – L4
08 Explain the concept Burst Error Correction, Fire codes and Golay Codes. – L2

After learning all the topics of UNIT– V, the student is able to

01 Explain the concept of convolutional codes for encoding. – L2
02 Describe the Tree Codes and Trellis Codes. – L2
03 Analyze the Polynomial Description Of Convolutional Codes. – L4
04 Define the Distance Notions for Convolutional Codes. – L1
05 Describe the Matrix representation of Convolutional Codes. – L1
06 Analyze the Viterbi Decoding of Convolutional Codes. – L4
07 Describe the trellis coded modulation techniques. – L2
08 Analyse the Concept of Coded Modulation. – L4
09 Define the Mapping by set partitioning. – L1
10 Illustrate the Underboeck's TCM Design Rules. – L3
11 Describe the TCM Decoder. – L2

Review Questions

01 Apply the concept of Uncertainty and Information.
02 Justify that self information content of a message is a logarithm function of its probability of emission.
03 Explain the concept of Information theory.
04 Find an expression for average information content of symbols in long independent sequences.
05 State and prove kraft inequality.
06 Describe the Source coding theorem.
07 Describe the JPEG standard for lossy & lossless compression.
08 Describe the Huffman Coding.
09 Describe the Lempel– Ziv Algorithm.
10 Describe the arithmetic Coding.

11 Describe the Run Length Encoding.
12 Apply the theorems on channel capacity and Shannon limit.
13 Explain the concept of channel Models.
14 Analyze the Random Selection of Codes.
15 State and prove Shannon Hartley law.
16 Derive an expression for the upper limit on channel capacity as the band width tents to ∞.
17 Derive information capacity theorem.
18 Explain channel capacity for MIMO systems.
19 Explain the concept of Error Correcting Codes.
20 Explain the concept of Equivalent Codes and Parity Check Matrix.
21 Analyze the Decoding of a Linear Block Code.
22 Describe the Error Probability after Coding (Probability of Error correction).
23 Illustrate the Perfect Codes.
24 Explain concept of syndrome decoding.
25 Explain the concept of Optimal Linear Codes and Maximum Distance Separable (MDS) Codes.
26 Describe perfect code and Hamming code.
27 Define the Polynomials.
28 Analyze the concept of Quasi– cyclic Codes and Shortened Cyclic Codes.
29 Explain the concept Fire codes and Golay Codes.
30 Define the Polynomials.
31 Illustrate the Division Algorithm for Polynomials.
32 Explain the matrix description of convolution code.
33 Describe the Tree Codes and Trellis Codes.
34 Illustrate burst error correction .
35 Explain the concept of convolutional codes for encoding.
36 Analyze the Polynomial Description Of Convolutional Codes.
37 Define the Distance Notions for Convolutional Codes.
38 Explain the method for generating cyclic codes.
39 Explain cyclic code & their generation from generating polynomials.
40 Analyse the Concept of Coded Modulation.
41 Describe the Tree Codes and Trellis Codes.
42 Define the Mapping by set partitioning.
43 Illustrate the Underboeck's TCM Design Rules.
44 Describe the TCM Decoder.
45 Compute the convolution codes and trellis code.
46 Define the Distance Notions for Convolutional Codes.
47 Draw &explain the general structure of TCM encoder that processes m input bits.
48 List advantages & applications of viterbi decoding of convolution codes.
49 Explain the concept of Trellis coded modulation & its demodulation.
50 Define free Euclidean distance and asymptotic coding gain.

Lesson Plan

UNIT – I

Period No. Topics

1. Source Coding 1: Introduction to Information theory,
2. Uncertainty and Information,
3. Average Mutual Information and Entropy,
4. Information Measures for Continuous Random Variables,
5. Source coding theorem.
6. Source Coding 2: Huffman Coding, Arithmetic Coding,
7. The Lempel– Ziv Algorithm,
8. Run Length Encoding and the PCX format,
9. Introduction to Image Compression,
10. The JPEG standard for Lossless Compression,
11. The JPEG standard for Lossy Compression.

UNIT – II

Period No. Topics

12. Channel Capacity and coding:
13. Introduction,
14. Channel Models,
15. Channel Capacity,
16. Information Capacity Theorem,
17. Theorem,
18. The Shannon Limit,
19. Shannon Limit,
20. And Random Selection of Codes.
21. Random Selection of Codes

UNIT – III

Period No. Topics

22. Linear Block Codes for Error Correction 1:
23. Introduction to Error Correcting Codes,
24. Basic Definitions, and Matrix Description of Linear Block codes,
25. Equivalent Codes,
26. Parity Check Matrix, and Decoding of a Linear Block Code.
27. Linear Block Codes for Error Correction 2:
28. Syndrome Decoding, Error Probability after Coding (Probability of Error correction),
29. Perfect Codes, Hamming Codes,
30. Optimal Linear Codes,
31. Maximum Distance Separable (MDS) Codes.

UNIT – IV

Period No. Topics

32. Cyclic Codes : Introduction to Cyclic Codes,
33. Polynomials,
34. Division Algorithm for Polynomials,
35. A Method for Generating Cyclic Codes,
36. Matrix Description of Cyclic Codes,
37. Quasi– cyclic Codes and Shortened Cyclic Codes,
38. Codes and Shortened Cyclic Codes
39. Burst Error Correction,
40. Fire codes,
41. Golay Codes.

UNIT – V

Period No. Topics

42. Convolutional Codes: Introduction
43. Introduction to Convolution Codes,
44. Tree Codes and Trellis Codes,
45. Polynomial Description of Convolutional Codes (Analytical Representation),
46. Distance Notions for Convolutional Codes,
47. Generating Function,
48. Matrix Description of Convolutional Codes,
49. Viterbi Decoding of Convolutional Codes.
50. Trellis Coded Modulation: Introduction to TCM, the Concept of Coded Modulation,
51. Mapping by Set partitioning,
52. Underboeck's TCM Design Rules, TCM Decoder.

Course Articulation Matrix(CAM)

Sl. No	Course Outcome – CO		Program outcome (ABET/NBA-(3a-k)										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the architecture and memory of DSP. – (Unit – I)	L2	L	M	H								
02	Describe the programming of DSP TMS320C54XX. – (Unit – II)	L1	L	M	H								
03	Explain the implementation of FFT algorithms.– (Unit – III)	L2	L	M	H								
04	Discuss the interfacing of memory & parallel I/O peripherals to DSP. – (Unit – IV)	L2	L	M									
05	Discuss the applications of programmable DSP. – (Unit – V)	L2	L	M	H								
06	Discuss the Concept of an Image Processing System. – (Unit – V)	L2	L	M									
L-Low, M-Moderate, H-High													

Course Assessment Matrix(CAM)

Sl. No	Course Outcome – CO		Program outcome (ABET/NBA-(3a-k)										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the architecture and memory of DSP. – (Unit – I)	L2	1	2	3								
02	Describe the programming of DSP TMS320C54XX. – (Unit – II)	L1	1	2	3								
03	Explain the implementation of FFT algorithms.– (Unit – III)	L2	1	2	3								
04	Discuss the interfacing of memory & parallel I/O peripherals to DSP. – (Unit – IV)	L2	1	2									
05	Discuss the applications of programmable DSP. – (Unit – V)	L2	1	2	3								
06	Discuss the Concept of an Image Processing System. – (Unit – V)	L2	1	2									
1-Low, 2-Moderate, 3-High													

Course Title : DIGITAL COMMUNICATION THEORY			
Course Code: P13EC54	**Semester : V**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs		**Weightage :CIE:50% SEE:50%**	

Prerequisite course for

1. Computer Communication Networks – P13EC62
2. Satellite Communication – P13EC81

Course Learning Objectives (CLOs)

This course aims to

1. Provide the understanding of the various phenomena related to random process and its applications in digital communication.
2. Analyze the sampling theorem.
3. Highlight the Differences between the ideal and practical sampling.
4. Provide the understanding the quantization, quantizers and companding of signals in PCM system.
5. Outline the principle of DM, ADM, DPCM systems and quantization.
6. Outline the polar, bipolar and Manchester code and their properties.
7. Explain the causes for the occurrence of ISI and advantages of pulse shaping & correlation coding.
8. Explain the band pass modulation schemes of ASK, FSK, PSK, QPSK and MSK.

Course Contents

UNIT– I

Introduction to Random process: Random variables, CDF, PDF, Stastical averages, Random Process, Mean, correlation and covariance Functions, Properties of Auto Correlation functions , Ergodicity, Power spectral density, Gaussian process.

Text 1: 2.5, 2.5, 2.8, 2.10, 2.11, 2.12, 2.14, 2.16, 2.17 **11 Hrs**

UNIT– II

Sampling process: Sampling theorem (ideal sampling), Statement of sampling theorem, Quadrature sampling of Band pass signals, Signal distortion and sampling, Sampling procedure Practical aspects of sampling and signal recovery, Natural sampling, (Ordinary samples of finite duration),Flat top sampling, Practical Sample and Hold circuit.

Text 1: 5.1, 5.3, 5.4, 5.6 to 5.10. **10 Hrs**

UNIT– III

Modulation: PAM, TDM, Applications, PCM, Quantization noise and SNR, Robust quantization, DPCM, DM, Quantization noise in DM, ADM.

Text 2: 4.6 to 4.7, 5.1 to 5.6. Text 1: 6.8 and 6.9. **10 Hrs**

UNIT– IV

Base– Band Shaping for Data Transmission: Discrete PAM signals, Power spectra of discrete PAM signals. ISI, Nyquist's criterion for distortion less base– band binary transmission, correlative coding, eye pattern, base– band M– ary PAM systems, adaptive equalization for data transmission.

Text 2: 6.1 to 6.8 **11 Hrs**

UNIT– V

Digital Modulation Techniques: Digital Modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques. Non– coherent binary modulation techniques.

Text 2: 7.1 to 7.4 **10 Hrs**

TEXT BOOKS:

1. "Digital communication", Dr. K.N. Hari Bhatt & Dr. D. Ganesh Rao, Sanguine Publishers, 2edition, 2006.
2. "Digital Communication", Simon Haykin, John Wiley, 2008.

REFERENCE BOOKS:

1. "Digital and Analog Communication Systems", K. Sam Shanmugam, John Wiley, 1996.
2. "Digital communications, Bernard Sklar", Pearson education 2007.
3. "Digital Communication", P.Ramakrishna Rao Tata Mc graw Hill 2011.
4. "Digital Communications", John G. Proakis, Masoud Salehi, Mc Graw Hill, 5th edition, 2008.

Course Outcome (CO)

After learning all the units of the course, the student is able to

01 Define the random process, "stationarity", "ergodicity" & "white noise". – L1 (Unit – I)
02 Explain the quadrature sampling process of band pass signals. – L2 (Unit – II)
03 Formulate the quantization noise and SNR for different types of quantization. – L5 (Unit – III)
04 Explain the different discrete PAM signals. – L2 (Unit – IV)
05 Explain the eye pattern in data transmission system, correlation coding and adaptive equalizations. – L2 (Unit – IV)
06 Explain the coherent binary modulation techniques and non coherent binary modulation techniques. – L2 (Unit – V)

Topic Learning Outcomes

After learning all the topics of UNIT– I, the student is able to

01 Define the random process. – L1
02 Estimate the mean and autocorrelation function of given process. – L2
03 Define the "stationarity", "ergodicity" and "white noise". – L1
04 State the properties of PSD. – L1
05 Estimate the PSD of given stationary process. – L2

After learning all the topics of UNIT– II, the student is able to

01 State the meaning and implications of sampling theorem pertaining to band limited low pass signals. – L2
02 Compare the different methods of sampling, their merits and demerits. – L4
03 Calculate the minimum sampling rate required for the signal reconstruction. – L4
04 Explain the Quadrature sampling process of band pass signals. – L2
05 Describe the natural sampling and flat–top sampling. – L2

After learning all the topics of UNIT– III, the student is able to

01 Illustrate the concept of TDM. – L3
02 Explain the block diagram of a baseband PCM system, DPCM, DM and ADM. – L3
03 Formulate the quantization noise and SNR for different types of quantization. – L5

04 Explain the robust (non–uniform) quantization. – L2
05 Discuss the choice of appropriate step size for delta modulation. – L2
06 Define the companding of signals. – L1

After learning all the topics of UNIT– IV, the student is able to

01 Explain the different discrete PAM signals. – L2
02 Compare the PSD for binary Liv code. – L4
03 Explain the causes for occurrence of ISI. – L2
04 Explain the eye pattern in data transmission system, correlation coding and adaptive equalizations. – L2

After learning all the topics of UNIT– V, the student is able to

01 Differentiate the digital modulation formats. – L4
02 Explain the coherent binary modulation techniques and non coherent binary modulation techniques. – L2
03 Compare the various digital modulation schemes with reference to their probability error and their bandwidth efficiency. – L4
04 Describe the coherent quadrature modulation techniques. – L2

Review Questions

01 State the properties of PSD and also determine the PSD of given stationary process.
02 Illustrate the concept of TDM.
03 Define the random process.
04 Estimate the mean and autocorrelation function of given process.
05 Define the "stationarity", "ergodicity" and "white noise".
06 Sketch the block diagram of a baseband PCM system and explain.
07 Explain the causes for occurrence of ISI.
08 Describe the coherent quadrature modulation techniques.
09 Explain the causes for occurrence of ISI.
10 Explain the eye pattern in data transmission system, correlation coding and adaptive equalizations.
11 Explain the coherent binary modulation techniques and non coherent binary modulation techniques.
12 Compare the various digital modulation schemes with reference to their probability error and their bandwidth efficiency.
13 Explain the block diagram of a baseband PCM system.
14 Explain the block diagram of a DPCM transmitter and receiver.
15 Explain the block diagram of a DM and ADM.
16 Explain the robust (non–uniform) quantization.
17 Discuss the step size for delta modulation.
18 Define the companding of signals.
19 State and explain sampling theorem for band limited low pass signals.
20 Calculate the minimum sampling rate required for the signal reconstruction.
21 Explain the Quadrature sampling process of band pass signals.
22 Describe the natural sampling.
23 Explain flat–top sampling
24 Explain the difference between cross talk and intersymbol interference.
25 What is Quantization error? How does it depend upon the step size?
26 Explain with the help of block diagram that the Adaptive Delta modulation system reduces the slop error at the expense of quantization error?

27 Draw the wave forms comparing the response of the ADM and DM.
28 Explain the PCM technique and evaluate the expression for SNR in PCM.
29 What important functions are performed by the regenerator in PCM?
30 A voice frequency signal band limited to 3Mhz is transmitted with the use of the DM system. The pulse repetition frequency is 30,000 pulses per second, and the step size in 40mv.determine the maximum possible speech signal amplitude to avoid a slop overload.
31 What are optimum and matched filters? Find there transfer functions?
32 Is it true that in matched filter error probability depends on signal energy and not on wave shape? Explain.
33 To transmit a bit sequence 10011011, draw the resulting waveform using:- Unipolar RZ; Unipolar NRZ; Bipolar RZ ; Manchester(split phase) .
34 Derive the expression for the Nyquist criterion for distortion less baseband transmission in the absence of noise.
35 What is gram Schmitt orthogonalization procedure? Explain?
36 Explain the geometric representation of signals.
37 Explain the working of QPSK with the help of block diagram.
38 Determine the probability of error of PSK system and their required bandwidth.
39 Determine the probability of error of FSK system and their required bandwidth.
40 Derive the expression for bit error probability of a Coherent ASK system.
41 State the advantages & demerits of digital communication.
42 Draw the block diagram of digital communication system and explain.
43 Compare uniform and non-uniform quantization.
44 What is slope overload? How it is reduced?
45 List the inferences made from the eye pattern.
46 Explain μ-Law and A-Law with equations.
47 Explain concept of ideal sampling. Derive the interpolation formula.
48 Explain Maximum likely hood receiver for AWGN channel.
49 With related diagrams and equations, explain the operation of a Non-coherent receiver using matched filter.
50 Differentiate between the transmitters of QPSK and MSK.

Lesson Plan

UNIT– I

Period No. Topics

1. Introduction to Random process:
2. Random process, Random variables
3. CDF, PDF
4. CDF, PDF
5. Stastical average, Mean
6. covariance Functions
7. correlation, Properties of Auto Correlation functions
8. Properties of Auto Correlation functions
9. Power spectral density
10. Power spectral density
11. Gaussian process, Ergodicity

UNIT– II

Period No. Topics

12. Statement of sampling theorem, Sampling process:
13. Sampling theorem
14. Sampling theorem
15. Quadrature sampling of Band pass signals
16. Signal distortion and sampling
17. Practical aspects of sampling and signal recovery
18. Natural sampling
19. Flat top sampling
20. Flat top sampling
21. Practical Sample and Hold circuit.

UNIT– III

Period No. Topics

22. Introduction to Modulation
23. PAM
24. TDM
25. PCM
26. Quantization noise
27. SNR
28. Robust quantization
29. DPCM
30. DM
31. Quantization noise in DM, ADM.

UNIT– IV

Period No. Topics

32. Base– Band Shaping for Data Transmission
33. Band Shaping for Data Transmission
34. Discrete PAM signals,
35. Power spectra of discrete PAM signals.
36. Power spectra of discrete PAM signals.
37. ISI
38. Nyquist's criterion for distortion less base– band binary transmission
39. Correlative coding
40. Eye pattern
41. Base– band M– ary PAM systems,
42. Adaptive equalization for data transmission.

UNIT– V

Period No. Topics

43. Digital Modulation Techniques:
44. Digital Modulation formats
45. Digital Modulation formats
46. Coherent binary modulation techniques
47. Coherent binary modulation techniques
48. Coherent quadrature modulation techniques.
49. Coherent quadrature modulation techniques.
50. Coherent quadrature modulation techniques.
51. Non–coherent binary modulation techniques.
52. Non–coherent binary modulation technique

Course Articulation Matrix CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to		Programme Outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Define the random process, "stationarity", "ergodicity" & "white noise".(Unit – I)	L1	**H**	M			L						
02	Explain the quadrature sampling process of band pass signals.(Unit – II)	L2	**H**	**M**			L						
03	Formulate the quantization noise and SNR for different types of quantization.(Unit – III)	L5	**H**	**M**									
04	Explain the different discrete PAM signals. (Unit – IV)	L2	**H**	**M**									
05	Explain the eye pattern in data transmission system, correlation coding and adaptive equalizations.(Unit – IV)	L2	**H**	**M**									
06	Explain the coherent binary modulation techniques and non coherent binary modulation techniques.(Unit – V)	L2	**H**	**M**			L						

L-Low, M-Moderate, H-High

Course Assessment Matrix(CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to		Programme Outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Define the random process, "stationarity", "ergodicity" & "white noise".(Unit – I)	L1	3	2			1						
02	Explain the quadrature sampling process of band pass signals.(Unit – II)	L2	3	2			1						
03	Formulate the quantization noise and SNR for different types of quantization.(Unit – III)	L5	3	2									
04	Explain the different discrete PAM signals. (Unit – IV)	L2	3	2									
05	Explain the eye pattern in data transmission system, correlation coding and adaptive equalizations.(Unit – IV)	L2	3	2									
06	Explain the coherent binary modulation techniques and non coherent binary modulation techniques.(Unit – V)	L2	3	2			1						

1-Low, 2-Moderate, 3-High

Course Title : DIGITAL CMOS VLSI DESIGN			
Course Code: P13EC55	**Semester : V**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

This Course forms a prerequisite course for

Low Power VLSI Design– P13EC72

Course Learning Objectives (CLOs)

This Course aims to

1. Provide the basic knowledge of digital CMOS VLSI circuits and design.
2. Explain the basic electrical and physical properties of MOS transistor and dc characteristics of MOS inverter.
3. Describe the switching characteristics and delay of MOS inverter which determines the overall operating speed of digital systems.
4. Examine the static and dynamic characteristics of various combinational MOS logic circuits and sequential logic circuits.
5. Discuss the operation of dynamic logic circuits of reduced circuit delay and silicon area, compared to static logic circuits.
6. Discuss the static and dynamic behaviour of BICMOS circuits and some of its applications.
7. Provide the knowledge of I/O circuits, clock generation and distribution circuits which are essential in VLSI design chip.

Course Content

UNIT – I

MOS Transistor : The Metal Oxide Semiconductor(MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current – Voltage Characteristics, MOSFET Scaling and Small – Geometry Effects, MOSFET Capacitances

MOS Inverters, Static Characteristics: Introduction, Resistive – Load Inverter, Inverters with n– Type MOSFET Load, CMOS Inverter

Text: – 3.1 to 3.6, 5.1 to 5.4 **10 Hrs**

UNIT – II

MOS Inverters: Switching Characteristics and Interconnect Effects: Introduction, Delay – Time Definitions, Calculation of Delay Times, Inverter Design with Delay Times, Estimation of Interconnect Parasitic, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters

Text: – 6.1 to 6.7 **10 Hrs**

UNIT – III

Combinational MOS Logic Circuits : Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates(Pass Gates)

Sequential MOS Logic Circuits : Introduction, Behavior of Bistable Elements, SR Latch Circuit, Clocked Latch and Flip– Flop Circuits, CMOS D– Latch and Edge – Triggered Flip–Flop

Text: – 7.1 to 7.5, 8.1 to 8.5 **11 Hrs**

UNIT – IV

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High– Performance Dynamic CMOS Circuits

Text: – 9.1 to 9.6 **10 Hrs**

UNIT – V

BiCMOS Logic Circuits: Introduction, Bipolar Junction Transistor (BJT): Structure and Operation, Dynamic Behavior of BJTs, Basic BiCMOS Circuits: Static Behavior, Switching Delay in BiCMOS Logic Circuits, BiCMOS Applications

Chip Input and Output (I/O) Circuits: Introduction, ESD Protection, Input Circuits, Output Circuits and L (di/dt) Noise, On– Chip Clock Generation and Distribution, Latch – Up and Its Prevention

Text: – 12.1 to 12.6, 13.1 to 13.6 **11 Hrs**

TEXT BOOK:

"CMOS Digital Integrated Circuits Analysis and Design", Sung – Mo Kang, Yusuf Leblebici, Third Edition, Tata McGrawhill

REFERENCE BOOKS:

1. "Introduction to VLSI Circuits and systems", John .P. Uyemura, John Wiley, 3rd edition 2002
2. "Principles of CMOS VLSI Design", Neil. H. E. Weste, Kamran Eshraghian, 2nd edition 2002.
3. "Basic VLSI Design", Douglas A. Pucknell, Kamran Eshraghian, 3rd Edition 2006.

Course Outcome

After learning all the units of the course, the student is able to

01 Explain the structure, operation and characteristics of MOSFET, the scaling, small geometry effects and capacitance of MOSFET. – L2 (Unit – I)
02 Analyze the switching characteristics, delay time definitions, interconnect delay and parasitic of MOS inverter, the switching power dissipation with respect to MOS inverters. – L4 (Unit – II)
03 Analyze the combinational and sequential MOS and CMOS logic circuits, transmission gates, latches and flipflops. – L4 (Unit – III)
04 Discuss the principles of pass transistor circuits and the working of different dynamic logic circuit techniques, dynamic CMOS circuit techniques and high–performance dynamic CMOS circuits – L2 (Unit – IV)
05 Explain the structure and operation of dynamic and static behaviour of BJT's and BICMOS logic. – L2 (Unit – V)
06 Analyze the chip I/O circuit, noise effect, on chip clock generation and distribution circuits. – L4 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT– I, the student is able to

01 Explain the structure of MOS transistor and threshold voltage. – L2
02 Describe the operation, V– I characteristics, voltage current equation, gradual channel approximation, channel length modulation, Substrate bias effect of MOS transistor. – L2
03 Discuss the measurement of parameter of MOSFETS. – L2
04 Explain the MOSFETS scaling and small geometry effects. – L2
05 Discuss the effects of different MOSFET's capacitances. – L2
06 Describe the voltage transfer characteristics, noise immunity and noise margin, power and area consideration of NMOS inverter. – L2
07 Analyze the drain current, output low voltage, output high voltage, noise margin, power consumption and chip area of resistive load inverter. – L4
08 Discuss the inverter with N type MOS FETS load such as enhancement load NMOS inverter, depletion load NMOS inverter. – L2

09 Calculate the V_{OH}, VOL, $V_{IL,}$ and V_{IH} for depletion load NMOS inverter circuit. – L4
10 Explain the circuit operation, supply voltage scaling, power and area consideration of CMOS inverter. – L2
11 Calculate the V_{IL}, V_{IH}, V_{TH} of CMOS inverter. – L4

After learning all the topics of UNIT– II, the student is able to

01 Explain the delay time definition, calculation of delay times of CMOS inverter. – L2
02 Discuss the design of CMOS inverter with delay constants. – L2
03 Describe the effects of interconnect parasitic, interconnect capacitance estimation and resistance estimation. – L2
04 Analyze the interconnect delay with RC delay models, Elmore delay. – L4
05 Explain the switching power dissipation and power delay product of CMOS inverter. – L2
06 Solve the numerical problem on CMOS inverter design. – L3

After learning all the topics of UNIT– III, the student is able to

01 Describe the working of MOS logic circuits with depletion NMOS loads , calculation of V_{oh} , V_{ol}. – L2
02 Explain the structure of two inputs, multiple input NOR gate and NAND gate. – L2
03 Discuss the transient neither analyze of NOR gate and NAND gate. – L2
04 Analyze the CMOS nor to and CMOS NAND two gate. – L4
05 Calculate the switching threshold voltage neither for CMOS nor to and CMOS NAND two gates. – L4
06 Explain the circuit and layout of complex CMOS logic gates. – L2
07 Analyze the pseudo NMOS gate, CMOS full adder circuit. – L4
08 Describe the circuit and working of transmission gates, complementary pass transistor logic. – L2

After learning all the topics of UNIT– IV, the student is able to

01 Explain the basic principles of pass transistor circuits, charge storage and charge leakage. – L2
02 Describe the voltage bootstrapping methods. – L2
03 Discuss the synchronous dynamic circuit techniques with dynamic pass transistors circuits. – L2
04 Explain the dynamic MOS circuit techniques with CMOS transmission gate logic. – L2
05 Discuss the high performance dynamic CMOS such as dominos CMOS logic, NORA CMOS logic, Zipper CMOS circuit, true single phase clock dynamic CMOS. – L2

After learning all the topics of UNIT– V, the student is able to

01 Explain the structure, operation VI models of BJT. – L2
02 Describe the BJT inverter circuit, static characteristics and dynamic behaviour with charge control model. – L2
03 Discuss the basic BiCMOS circuits, static behaviour, switching delay and BiCMOS application - L2
04 Explain the ESD protection, input circuit, output circuit and L [di/dt] noise. – L2
05 Discuss the different on chip clock generation and distribution methods. – L2
06 Explain the latch up problems in CMOS chip and its prevention techniques. – L2

Review questions

1. With neat diagram explain the structure and working of MOS transistor.
2. Explain the MOS system under external bias and body bias effect.
3. Describe the operation and V– I characteristics of MOSFET
4. Derive the voltage current equation of MOSFET
5. Explain gradual channel approximation and channel length modulation of MOSFET
6. Explain the measurement of parameter of MOSFETS.
7. Explain the MOSFETS scaling and small geometry effects.
8. Discuss the short channel effect and narrow channel effect of MOSFET
9. Discuss the effects of different MOSFET's capacitances.
10. Draw the circuit of NMOS inverter and explain its voltage transfer characteristics
11. Describe the noise immunity and noise margin of NMOS inverter.
12. Discuss power and area consideration of NMOS inverter.
13. Analyze the drain current, output low voltage, output high voltage and noise margin of NMOS inverter.
14. Explain power consumption and chip area of resistive load inverter.
15. Discuss the inverter with N type MOSFETS enhancement load NMOS inverter
16. Discuss the inverter with N type MOSFETS depletion load NMOS inverter.
17. Calculate the V_{OH}, VOL, $V_{IL,}$ and V_{IH} for depletion load NMOS inverter circuit.
18. Explain the circuit operation, supply voltage scaling of cmos inverter.
19. Discuss power and area consideration of CMOS inverter.
20. Calculate the V_{IL}, V_{IH}, V_{TH} of CMOS inverter.
21. Explain the delay time definition of CMOS inverter.
22. Calculate the total delay times of CMOS inverter.
23. Analyse the design of CMOS inverter with delay constants.
24. Discuss the effects of interconnect parasitic capacitance and resistance
25. Explain the estimation of interconnect capacitance and resistance.
26. Analyze the interconnect delay with RC delay models, Elmore delay.
27. Explain the switching power dissipation and power delay product of CMOS inverter.
28. Describe the working of MOS logic circuits with depletion NMOS loads
29. Calculate V_{oh} and V_{ol} of logic circuits with depletion NMOS loads
30. Explain the structure of two inputs , multiple input NAND gate and NOR gate.
31. Discuss the transient analysis of NOR gate and NAND gate.
32. Analyze the CMOS NOR2 gate and CMOS NAND2 gate.
33. Calculate the switching threshold voltage for CMOS NOR2 gate.
34. Calculate the switching threshold voltage for CMOS NAND2 gates.
35. Explain the circuit and layout of complex CMOS logic gates.
36. Analyze the pseudo NMOS gate and CMOS full adder circuit.
37. Describe the circuit and working of transmission gates
38. Describe the circuit and working of complementary pass transistor logic.
39. Explain the basic principles of pass transistor circuits, charge storage and charge leakage.
40. Describe the voltage bootstrapping methods.
41. Discuss the synchronous dynamic circuit techniques with dynamic pass transistors circuits.
42. Explain the dynamic MOS circuit techniques with CMOS transmission gate logic.
43. Discuss the high performance dynamic dominos CMOS logic.
44. Explain NORA CMOS logic, Zipper CMOS circuit and true single phase clock dynamic CMOS.

45. Explain the structure, operation VI models of BJT.
46. Describe the BJT inverter circuit, static characteristics and dynamic behaviour with charge control model.
47. Discuss the basic BiCMOS circuits, static behaviour, switching delay and BiCMOS application.
48. Explain the ESD protection, input circuit, output circuit and L [di/dt] noise.
49. Discuss the different on chip clock generation and distribution methods.
50. Explain the latch up problems in CMOS chip and its prevention techniques.

Lesson plan

UNIT – I

Period No.	Topics
1.	MOS Transistor : introduction The Metal Oxide Semiconductor(MOS) Structure
2.	The MOS System under External Bias
3.	Structure and Operation of MOS Transistor (MOSFET)
4.	MOSFET Current – Voltage Characteristics
5.	MOSFET Scaling and Small – Geometry Effects,
6.	MOSFET Capacitances
7.	MOS Inverters, Static Characteristics**:** Introduction, Resistive – Load Inverter
8.	Inverters with n**–** Type MOSFET Load
9.	CMOS Inverter
10.	examples

UNIT – II

Period No.	Topics
1.	MOS Inverters: Switching Characteristics and Interconnect Effects: Introduction, Delay
2.	Time Definitions, Calculation of Delay Times
3.	Inverter Design with Delay Times
4.	Estimation of Interconnect Parasitic
5.	Calculation of Interconnect Delay
6.	Calculation of Interconnect Delay
7.	Switching Power Dissipation of CMOS Inverters
8.	Switching Power Dissipation of CMOS Inverters
9.	Examples
10.	Examples

UNIT – III

Period No.	Topics
1.	Combinational MOS Logic Circuits : Introduction, MOS Logic Circuits with Depletion nMOS Loads
2.	CMOS Logic Circuits
3.	Complex Logic Circuits
4.	CMOS Transmission Gates(Pass Gates)
5.	Sequential MOS Logic Circuits : Introduction
6.	Behavior of Bistable Elements, SR Latch Circuit
7.	Clocked Latch and Flip– Flop Circuits,
8.	CMOS D– Latch and Edge – Triggered Flip– Flop
9.	CMOS D– Latch and Edge – Triggered Flip– Flop
10.	Examples
11.	Examples

UNIT – IV

Period No.	Topics
1.	Dynamic Logic Circuits: Introduction
2.	Basic Principles of Pass Transistor Circuits
3.	Basic Principles of Pass Transistor Circuits
4.	Voltage Bootstrapping
5.	Synchronous Dynamic Circuit Techniques
6.	Dynamic CMOS Circuit Techniques
7.	Dynamic CMOS Circuit Techniques
8.	High– Performance Dynamic CMOS Circuits
9.	Examples
10.	Examples

UNIT – V

Period No.	Topics
1.	BiCMOS Logic Circuits: Introduction
2.	Bipolar Junction Transistor (BJT): Structure and Operation
3.	Dynamic Behavior of BJTs
4.	Basic BiCMOS Circuits: Static Behavior
5.	Switching Delay in BiCMOS Logic Circuits
6.	BiCMOS Applications
7.	Chip Input and Output (I/O) Circuits: Introduction
8.	ESD Protection, Input Circuits
9.	Output Circuits and L (di/dt) Noise
10.	On– Chip Clock Generation and Distribution
11.	Latch – Up and Its Prevention

Course Articulation Matrix(CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Explain the structure, operation and characteristics of MOSFET, the scaling, small geometry effects and capacitance of MOSFET. – L2 (Unit – I)	M	M	L								
02	Analyze the switching characteristics, delay time definitions, interconnect delay and parasitic of MOS inverter, the switching power dissipation with respect to MOS inverters. – L4 (Unit – II)	M										
03	Analyze the combinational and sequential MOS and CMOS logic circuits, transmission gates, latches and flipflops. – L4 (Unit – III)	M		L								
04	Discuss the principles of pass transistor circuits and the working of different dynamic logic circuit techniques, dynamic CMOS circuit techniques and high–performance dynamic CMOS circuits – L2 (Unit – IV)	M										
05	Explain the structure and operation of dynamic and static behaviour of BJT's and BICMOS logic. – L2 (Unit – V)	M	L	L								
06	Analyze the chip I/O circuit, noise effect, on chip clock generation and distribution circuits. – L4 (Unit – V)	M	L									

L-Low, M-Moderate, H-High

Course Assessment Matrix(CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Explain the structure, operation and characteristics of MOSFET, the scaling, small geometry effects and capacitance of MOSFET. – L2 (Unit – I)	**2**	**2**	**1**								
02	Analyze the switching characteristics, delay time definitions, interconnect delay and parasitic of MOS inverter, the switching power dissipation with respect to MOS inverters. – L4 (Unit – II)	**2**										
03	Analyze the combinational and sequential MOS and CMOS logic circuits, transmission gates, latches and flipflops. – L4 (Unit – III)	**2**		**1**								
04	Discuss the principles of pass transistor circuits and the working of different dynamic logic circuit techniques, dynamic CMOS circuit techniques and high–performance dynamic CMOS circuits – L2 (Unit – IV)	**2**										
05	Explain the structure and operation of dynamic and static behaviour of BJT's and BICMOS logic. – L2 (Unit – V)	**2**	**1**	**1**								
06	Analyze the chip I/O circuit, noise effect, on chip clock generation and distribution circuits. – L4 (Unit – V)	**2**	**1**									

1-Low, 2-Moderate, 3-High

Course Title : OPTICAL COMMUNICATION SYSTEMS			
Course Code: P13EC56	**Semester : V**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Discuss the types, characteristics, constitution and application of optical fibers.
2. Describe the propagation of light waves through the fibers.
3. State the causes for the absorption mechanisms in fibers.
4. Explain the bending losses in fibers.
5. Discuss the construction and operation of optical sources.
6. List the different lensing schemes for coupling improvement.
7. Outline the physical principles of photodiodes.
8. Explain the digital link and analog link.
9. Discuss the WDM concepts and components.
10. Describe the optical amplifiers and optical networks.

Course Content

UNIT – I

Optical Fibers: Structures, Wave guiding.
Basics optical laws and definitions, optical fiber modes and configurations, mode theory for circular waveguides, single–mode fibers, graded index fiber structure, fiber materials, photonic crystal fibers, fiber fabrication, Attenuation, signal distortion in fibers.
Text: 2.2 to 2.9, 3.1to 3.2 **10 Hrs**

UNIT – II

Optical Sources: Topics from semiconductor physics, Light–Emitting Diodes (LEDs), Laser Diodes.
Power Launching and coupling: Source to fiber power launching, lensing schemes for coupling improvement, fiber to fiber joints, LED coupling to single mode fibers, fiber splicing.
Text: 4.1 to 4.3, 5.1 to 5.5 **10 Hrs**

UNIT – III

Photo Detectors: Physical principles of photodiodes, photo detector noise, detector response time.
Optical Receiver Operation: Fundamental receiver operation, digital receiver performance, eye diagrams, burst mode receivers, analog receivers.
Text: 6.1 to 6.3, 7.1 to 7.5 **10 Hrs**

UNIT – IV

Digital Links: Point to point link.
Analog Links: Overview of analog links, carrier to noise ratio, multichannel transmission techniques, RF over fiber, radio over fiber links.
WDM Concepts and Components: Overview of WDM, passive optical couplers, isolators and circulators, fiber grating filters.
Text: 8.1, 9.1 to 9.5, 10.1 to 10.4 **11 Hrs**

UNIT – V

Optical Amplifiers: Basic applications and types of optical amplifiers, semiconductor optical amplifiers, erbium– doped fiber amplifiers.
Optical Networks: Network concepts, network topologies, SONET/SDH, High speed light wave links, optical add/drop multiplexing, optical switching, WDM network examples.

Text: 11.1 to 11.3, 13.1 to 13.7 **11 Hrs**

TEXT BOOK:

"Optical Fiber Communications", Gerd Keiser, McGraw Hill, 5th Edition–2013

REFERENCE BOOKS:

1. "Optical Fiber Communications", John M. Senior, Pearson Education 2nd Edition
2. "Fiber Optic Communication", Joseph Palais, Pearson Education, 4th Edition
3. "Optical Communication Systems", Satinder Bal Gupta, Ashish Goel, University Science Press, New Delhi.

Course Outcome

After learning all the units of the course, the student is able to

01 Develop the wave equations for step index fiber. – L5 (Unit – I)
02 Develop the expressions for quantum efficiency and emitted optical power in LED. – L5 (Unit – II)
03 Explain the operation of a pin photo diode circuit with an applied reverse bias. – L2 (Unit – III)
04 Calculate the optical link power budget in optical communication line. – L4 (Unit – IV)
05 Explain the basic constituents of a generic RF over fiber link. – L2 (Unit – IV)
06 Describe the wave guide coupler, erbium doped fiber amplifier and SONET/SDH networks. – L2 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT– I, the student is able to

01 Define the snell's law. – L1
02 Calculate the critical angle for the light travelling in the glass. – L4
03 Describe the polarization – sensitive materials with examples. – L1
04 Distinguish between the step index fiber and graded index fiber, as well as single mode fiber and multimode fiber. – L2
05 Develop the necessary condition that angle of incidence should satisfy, for the light way to propagate in the dielectric slab waveguide. – L5
06 Differentiate the meridional rays and skew rays. – L4
07 Explain the significance of cutoff wavelength and V– number for light propagation in the waveguide. – L2
08 Apply the Maxwell's equations to cylindrical system to obtain waveguide equations. – L2
09 Discuss the modes of propagation in step index fibers, with the sketches. – L2
10 Sketch the schematic of a fiber drawing operators. – L3
11 Calculate the ultra violet absorptions at different wavelengths. – L4
12 Discuss the micro bending and macro bending losses in optical fibers. – L2
13 List the causes of intra model dispersion. – L1

After learning all the topics of UNIT– II, the student is able to

01 Sketch the cross sectional drawing of a double hetero structure light emitter type of LED. – L3
02 Develop the expression for the optical power generated internally to the LED, the optical power emitted from the LED and quantum efficiency. – L5
03 Discuss the processes of absorption, spontaneous emission and stimulated emission in laser diodes. – L2

04 Develop the expression for the number of photons per unit volume emitted by the laser and for the external quantum efficiency of the laser. – L5
05 Sketch the radiance patterns for a lambertian source and the lateral output of a highly directional laser diode. – L3
06 Explain the different lensing schemes to improve optical source to fiber coupling efficiency. – L2
07 Calculate the insertion loss at the two fiber joints and the power coupling at the joints. – L4
08 Discuss the steps involved in fiber end face preparation. – L2
09 List the common end face defects during fiber end preparation. – L1
10 Explain the different splicing techniques. – L2

After learning all the topics of UNIT– III, the student is able to

01 Sketch the pin photodiode circuits with the reverse bias and the corresponding energy band diagram. – L3
02 Compare the responsivity and quantum efficiency for the pin diodes of three different materials. – L4
03 Show the construction of reach through avalanche photodiode along with the electric field variation in depletion and multiplication regions. – L3
04 Discuss the importance of noise sources and signal to noise ration in photo detector. – L2
05 Develop the relationship for the total current density through the reverse biased depletion layer of pin photodiode. – L5
06 Discuss the factors contributing towards the response time of a photodiode with output circuits. – L2
07 Show the signal path through an optical data link for digital signal transmission in a block diagram. – L3
08 List the noise sources and disturbances in an optical pulse detection mechanism. – L1
09 Discuss the operations of high impedance amplifier and trans– impedance amplifier. – L2
10 List the different information's which can be obtained from the eye pattern. – L1
11 Show the architecture of a typical passive optical network. – L3

After learning all the topics of UNIT– IV, the student is able to

01 Discuss the losses that occur at each element of the point– to– point digital link between a transmitter and a receiver. – L2
02 Develop the relationship for the total system rise time of an optical digital link in terms of transmitter rise time, the group velocity dispersion rise time, the modal dispersion rise time and the receiver rise time. . – L5
03 List the major noise contributors in an analog link. – L1
04 Explain how sub carrier multiplexing is adopted to transmit both analog and digital signals simultaneously. –L2
05 Describe the basic constituents of a generic R.F.–over–fiber link to transmit microwave analog signals. – L1
06 Discuss the Rader–over fiber, concept of a broad band wireless access network for interconnecting Antenna base station with the central controlling office. – L2
07 Show the implementation of a typical WDM network containing different optical amplifiers. – L3
08 Explain the fused – fiber coupler with a coupling region and two tapered regions. – L2
09 Calculate the coupling length of a symmetric waveguide coupler of a fixed coupling efficient for complete power transfer. – L4
10 Describe the design and operation of a polarization –independent isolator. – L1

11 Explain the operational concept of a three –port circulator. – L2
12 Outline the concept of de–multiplexing function using a fiber grating and an optical circulator. – L1

After learning all the topics of UNIT– V, the student is able to

01 Sketch the four possible applications of three classes of optical amplifiers, namely in line optical amplifier, Pre–amplifier, power amplifier. – L3
02 List the various amplifier structures and their operating regions. – L1
03 Calculate the photon density in semiconductor optical amplifier with the given specifications. – L4
04 Sketch the simplified energy – level diagrams and the transaction processes of Er ions in silica of erbium–doped fiber amplifier. – L3
05 Calculate the maximum input power and maximum output power for EDFA with given specification. – L4
06 Discuss the common topologies used for fiber optic networks. – L2
07 Explain the losses encountered in a passive linear bus coupler consisting of two directional couplers in cascade. – L2
08 Develop the power–balance equation for a particular link between two stations in a star network. – L5.
09 Sketch the basic formats of an STS–N SONET frame and an STM–N SDH frame. – L3
10 Explain the generic two–fiber unidirectional path– switched ring (UPSR) with a counter–rotating protection path. – L2
11 Sketch the ultra fast point–to–point transmission system using optical TDM. – L3
12 Explain the optical cross–connect architecture using optical space switches and no wavelength Converters. – L2.

Review Questions:

01 Explain the propagation of meridonal and skew rays along the fiber.
02 Compare step-index fiber with graded index fiber with respect to construction, performance and application.
03 With a neat schematic explain the structure of conventional fiber.
04 List out the types of fiber with respect to its refractive indices and modes.
05 What is numerical aperture? Derive an expression for numerical aperture and acceptance angle in case of step-index fiber.
06 List any four types of fiber fabrication process. Explain OVPO process with schematic.
07 What is attenuation? Mention the types of attenuation in fiber and give the relation for attenuation.
08 Write a short note on: (a) Refractive index, Reflection and refraction
(b) Polarisation sensitive materials
(c) fiber materials
09 Sketch and explain the structure of high impedance and trans impedance amplifiers.
10 Explain briefly the fundamental concepts of a coherent light wave system with necessary sketch.
11 Mention the necessary condition that an optical wave incident at angle θ should satisfy in dielectric wave guide propagation and derive it.
12 Discuss the power flow concepts in step-index fibers.
13 Explain the extrinsic and intrinsic absorption mechanism in optical fibers.
14 Write a note on fiber-drawing apparatus.

15 Explain the different lensing schemes used improve the coupling efficiency between optical source and the fiber.
16 Discuss the joint losses due to mismatch in core diagram, numerical aperture and core refractive index profile.
17 How are the fiber ends prepared under control fracture procedure?. Describe with the figure.
18 Mention the principle requirements of good connector design.
19 Starting from the fundamental concepts, derive the expression for the responsivity of pin photo diode.
20 Estimate the number of modes and V– number for a given fiber.
21 Develop the wave equations for step index fiber.
22 Sketch the transverse electric field vectors in step index fiber.
23 Sketch the cross section diagram of a double hetero structure light emitter.
24 Develop the expressions for quantum efficiency and emitted optical power in LED.
25 Explain the construction and operation on Fabry perot resonator cavity laser. Calculate the power coupled into step index or graded index fiber from LED.
26 Explain the operation of a pin photo diode circuit with an applied reverse bias. Calculate the quantum efficiency & responsibility of pin photo diode.
27 Discuss the factors contributing to the response time of photodiode.
28 List the sources of error in optical pulse detection mechanism.
29 Calculate the optical link power budget in optical communication line for given specification.
30 Define the relative refractive index difference for an optical fiber and show how it may be related to numerical aperture.
31 Outline the common LED structures for OFC discussing their relative merits and drawbacks.
32 Discuss lens coupling of LEDs to optical fibers and outline the various techniques employed.
33 What is meant by fusion splicing of OF. Discuss the advantages and drawbacks of this jointing techniques.
34 With aid of suitable diagrams describes three common techniques use for mechanical splicing of Optical Fibers.
35 Compare the relative advantages and disadvantages of LED and laser diode.
36 Discuss OF cable design with regards to fiber buffering.
37 Explain SONET-SDH with a neat diagram.
38 Explain the operational principles of WDM.
39 With the aid of simple sketches outline the major categories of multiport OF coupler.
40 Describe two common methods use in the fabrication of three and four fiber couplers.
41 Outline the three major categories of passive WDM coupler.
42 Illustrate the architecture of a typical passive optical network(PON).
43 With neat diagrams explain the fundamental measurement parameters of eye pattern.
44 Explain the construction and working of erbium– doped fiber amplifiers.
45 Discuss the homodyne detection and heterodyne detection.
46 Explain the simplex point to point link with a neat sketch.
47 Explain optical add/drop multiplexing.
48 Sketch the basic format of an STS-N SONET frame and an STM-N SDH frame.

Lesson Plan:

UNIT – I

Period No. Topics

1. Optical Fibers: Structures, Waveguiding.
2. Basics optical laws and definitions.
3. Optical fiber modes and configurations.
4. Mode theory for circular waveguides.
5. Single–mode fibers.
6. Graded index fiber structure.
7. Fiber materials.
8. Photonic crystal fibers.
9. Fiber fabrication, Attenuation.
10. Signal distortion in fibers.

UNIT – II

Period No. Topics

11. Optical Sources: Topics from semiconductor physics
12. Light–Emitting Diodes (LEDs).
13. Light–Emitting Diodes (LEDs).
14. Laser Diodes.
15. Power Launching and coupling: Source to fiber power launching.
16. Source to fiber power launching.
17. Lensing schemes for coupling improvement.
18. fiber to fiber joints.
19. LED coupling to single mode fibers.
20. fiber splicing.

UNIT – III

Period No. Topics

21. Photo Detectors: Physical principles of photodiodes.
22. Photo detector noise.
23. Photo detector noise.
24. Detector response time.
25. Optical Receiver Operation: Fundamental receiver operation.
26. Digital receiver performance.
27. Eye diagrams.
28. Eye diagrams.
29. Burst mode receivers.
30. Analog receivers.

UNIT – IV

Period No. Topics

31. Digital Links: Point to point link.
32. Point to point link.
33. Analog Links: Overview of analog links.
34. Carrier to noise ratio.
35. Multichannel transmission techniques.
36. RF over fiber.
37. Radio over fiber links.
38. WDM Concepts and Components: Overview of WDM.
39. Passive optical couplers.
40. Isolators and circulators.
41. Fiber grating filters.

UNIT – V

Period No. Topics

42. Optical Amplifiers: Basic applications and types of optical amplifiers.
43. Semiconductor optical amplifiers.
44. Erbium– doped fiber amplifiers.
45. Optical Networks: Network concepts.
46. Network topologies.
47. SONET/SDH.
48. SONET/SDH.
49. High speed light wave links.
50. Optical add/drop multiplexing.
51. Optical switching.
52. WDM network examples.

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Program outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Develop the wave equations for step index fiber. – L5 (Unit – I)	H	H	H								
02	Develop the expressions for quantum efficiency and emitted optical power in LED. – L5 (Unit – II)	M	M									
03	Explain the operation of a pin photo diode circuit with an applied reverse bias. – L2 (Unit – III)	L	M									
04	Calculate the optical link power budget in optical communication line. – L4 (Unit – IV)	M	L									
05	Explain the basic constituents of a generic RF over fiber link. – L2 (Unit – IV)	M	L									
06	Describe the wave guide coupler, erbium doped fiber amplifier and SONET/SDH networks. – L2 (Unit – V)	H	L									

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Program outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Develop the wave equations for step index fiber. – L5 (Unit – I)	3	3	3								
02	Develop the expressions for quantum efficiency and emitted optical power in LED. – L5 (Unit – II)	2	2									
03	Explain the operation of a pin photo diode circuit with an applied reverse bias. – L2 (Unit – III)	1	2									
04	Calculate the optical link power budget in optical communication line. – L4 (Unit – IV)	2	1									
05	Explain the basic constituents of a generic RF over fiber link. – L2 (Unit – IV)	2	1									
06	Describe the wave guide coupler, erbium doped fiber amplifier and SONET/SDH networks. – L2 (Unit – V)	3	1									

1-Low, 2-Moderate, 3-High

Course Title : DIGITAL SIGNAL PROCESSING LABORATORY			
Course Code: P13ECL57	**Semester : V**	**L-T-P-H:0 – 0 – 3-3**	**Credits:1.5**
Contact Period : Lecture :39 Hrs, Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic knowledge of how to use MATLAB for DSP concepts.
2. Illustrate the Verification of sampling theorem.
3. Identify the Impulse response of a given system.
4. Provide the Linear convolution of two given sequences.
5. Compute the Circular convolution of two given sequences.
6. Identify the Autocorrelation of a given sequence and verification of its properties.
7. Compute the Cross correlation of given sequences and verification of its properties.
8. Solve the given difference equation.
9. Compute the N point DFT of a given sequence and to plot magnitude and phase spectrum.
10. Demonstrate the Linear convolution of two sequences using DFT and IDFT.
11. Compute the Circular convolution of two given sequences using DFT and IDFT.
12. Design the FIR filter to meet the given specifications.
13. Design the IIR filter to meet the given specifications.
14. Predict the Linear convolution of two given sequences.
15. Produce the Circular convolution of two given sequences.
16. Compute the N Point DFT of a given sequence.
17. Realize the FIR filter to meet the given specifications for the input signal from function generator / speech signal.
18. Obtain the Impulse response of first order and second order system.

Course Content

A. EXPERIMENTS USING MATLAB / SCILAB / OCTAVE / WAB

01 Introduction to MATLAB and Verification of the sampling theorem.
02 Determination of Impulse response of the given system and solution of Difference equation for the same system.
03 Linear convolution of the two given sequences using shortcut methods, DFT and IDFT.
04 Circular convolution of the two given sequences using shortcut methods, DFT and IDFT.
05 Autocorrelation of the given sequence and verification of its properties.
06 Cross correlation of the given sequences and verification of its properties.
07 Computation of the N point DFT of a given sequence and to plot magnitude and phase spectrum.
08 Design and implementation of the FIR filter to meet the given specifications (Hamming, Hanning, Rectangular & Kaiser windows).
09 Design and implementation of the IIR filter to meet the given specifications (Butterworth and Chebyshev Type-I & Type-II).

B. EXPERIMENTS USING DIGITAL SIGNAL PROCESSOR (TMS320C54XX) AND CODE COMPOSER STUDIO (CCS)

(Note: Experiments no. 1, 2, 3 & 4 may be performed on CCS)

01 Determine the Linear and Circular convolution of the two given sequences.
02 Computation of the N Point DFT and IDFT of a given sequence.
03 Determination of Impulse response of first order and second order system.

04 Realizations of the FIR filter to meet given specifications. The input can be a signal from function generator / speech signal.

REFERENCE BOOKS:

1. "Digital signal processing using MATLAB", Sanjit K Mitra, TMH, 2001
2. "Digital signal processing using MATLAB", J.G. Proakis & Ingle, MGH, 2000
3. "Digital signal processors", B.Venkataramani and Bhaskar, TMH,2002

Course Outcome

After conducting all the experiments the student is able to

01 Demonstrate the Verification of sampling theorem. – L3
02 Generate the Impulse response of a given system. – L5
03 Calculate the Linear convolution of two given sequences. – L4
04 Compute the Circular convolution of two given sequences. – L3
05 Analyze the Autocorrelation of a given sequence & verification of its properties. – L4
06 Compute the Cross correlation of given sequences & verification of its properties. – L3
07 Solve the given difference equation. – L3
08 Compute the N point DFT of a given sequence & to plot magnitude and phase spectrum. – L3
09 Sketch the Linear convolution of two sequences using DFT and IDFT. – L3
10 Produce the Circular convolution of two given sequences using DFT and IDFT. – L3
11 Design the FIR filter to meet given specifications. – L5
12 Design the IIR filter to meet given specifications. – L5
13 Estimate the Linear convolution of two given sequences. – L2
14 Generate the Circular convolution of two given sequences. – L5
15 Compute the N Point DFT of a given sequence. – L3
16 Design the FIR filter (any type) to meet given specifications. The input can be a signal from function generator / speech signal. – L5
17 Generate the Impulse response of first order and second order system. – L5

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to	Program outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Demonstrate the Verification of sampling theorem. – L3	**L**	**L**									
02	Generate the Impulse response of a given system. –	**L**	**L**	**L**								
03	Calculate the Linear convolution of two given sequences. – L4	**L**	**L**									
04	Compute the Circular convolution of two given sequences. – L3	**L**	**L**									
05	Analyze the Autocorrelation of a given sequence & verification of its properties. – L4	**L**	**L**	**L**								
06	Compute the Cross correlation of given sequences & verification of its properties. – L3	**M**	**M**									
07	Solve the given difference equation. – L3	**M**	**M**									
08	Compute the N point DFT of a given sequence & to plot magnitude and phase spectrum. – L3	**M**	**M**									
09	Sketch the Linear convolution of two sequences using DFT and IDFT. – L3	**M**	**M**									
10	Produce the Circular convolution of two given sequences using DFT and IDFT. – L3	**M**	**M**									
11	Design the FIR filter to meet the given specifications. – L5	**M**	**M**									
12	Design the IIR filter to meet given specifications. – L5	**M**	**M**									
13	Estimate the Linear convolution of two given sequences. – L2	**H**	**H**	**H**								
14	Generate the Circular convolution of two given sequences. – L5	**H**	**H**	**H**								
15	Compute the N Point DFT of a given sequence. – L3	**H**	**H**	**H**								
16	Design the FIR filter to meet given specifications. The input can be a signal from function generator / speech signal. – L5	**H**	**H**									
17	Generate the Impulse response of first order and second order system. – L5	**H**	**H**	**H**								

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to	Program outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Demonstrate the Verification of sampling theorem. – L3	**1**	**1**									
02	Generate the Impulse response of a given system. – L5	**1**	**1**	**1**								
03	Calculate the Linear convolution of two given sequences. – L4	**1**	**1**									
04	Compute the Circular convolution of two given sequences. – L3	**1**	**1**									
05	Analyze the Autocorrelation of a given sequence & verification of its properties. – L4	**1**	**1**	**1**								
06	Compute the Cross correlation of given sequences & verification of its properties. – L3	**2**	**2**									
07	Solve the given difference equation. – L3	**2**	**2**									
08	Compute the N point DFT of a given sequence & to plot magnitude and phase spectrum. – L3	**2**	**2**									
09	Sketch the Linear convolution of two sequences using DFT and IDFT. – L3	**2**	**2**									
10	Produce the Circular convolution of two given sequences using DFT and IDFT. – L3	**2**	**2**									
11	Design the FIR filter to meet the given specifications. – L5	**2**	**2**									
12	Design the IIR filter to meet given specifications. – L5	**2**	**2**									
13	Estimate the Linear convolution of two given sequences. – L2	**3**	**3**	**3**								
14	Generate the Circular convolution of two given sequences. – L5	**3**	**3**	**3**								
15	Compute the N Point DFT of a given sequence. – L3	**3**	**3**	**3**								
16	Design the FIR filter to meet given specifications. The input can be a signal from function generator / speech signal. – L5	**3**	**3**									
17	Generate the Impulse response of first order and second order system. – L5	**3**	**3**	**3**								

1-Low, 2-Moderate, 3-High

Course Title : OPTICAL AND ANALOG COMMUNICATION LABORATORY			
Course Code: P13ECL58	**Semester : V**	**L-T-P-H:0 – 0 – 3-3**	**Credits:1.5**
Contact Period : Lecture :39 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Experiment the attenuation and dispersion in optical fiber.
2. Measure the bending loss and numerical aperture in optical fiber.
3. Experiment the characteristics of LASER and photo diode.
4. Demonstrate the working analog and digital optical link.
5. Experiment the working of TDM of digital signals.
6. Demonstrate the working of an Erbium Doped Fiber Amplifier.
7. Demonstrate the working of WDM, MUX and DEMUX.
8. Provide the basic practical knowledge of modulation, demodulation, filtering, application of 555 timers, fiber optic cable, characteristics of optical source and optical detector, TDM, MUX and DEMUX
9. Demonstrate the working of AM, PAM and its detection.
10. Demonstrate the working of PPM and FM.
11. Design the second order active LPF, HPF and BPF.
12. Design the Astable and Monostable multivibrators using 555 timer.

Course Content

A. EXPERIMENTS ON OPTICAL COMMUNICATION:

01 Analog and Digital Fiber optic links
02 Bending loss and Numerical aperture measurement of optical fiber.
03 Attenuation and Dispersion in optical fiber.
04 LASER diode and photo diode characterization.
05 Time Division Multiplexing of digital signals.
06 Characterization of an Erbium Doped Fiber Amplifier.
07 Characterization of WDM MUX and DEMUX.

B. EXPERIMENTS ON ANALOG COMMUNICATION:

08 Amplitude Modulation and Detection in time domain and its observation in frequency domain (Use Spectrum Analyzer).
09 Pulse Amplitude Modulation and detection, using 555 timer.
10 Pulse Position Modulation using 555 timer.
11 Pulse Width Modulation using 555 timer.
12 Frequency Modulation using 8038/2206 in time domain and in frequency domain.
13 Second order active filters using op-Amp: LPF, HPF and BPF.

Course Learning Outcome

After conducting all the experiments the student is able to

01 Experiment the attenuation and dispersion in optical fiber. – L4
02 Determine the bending loss and numerical aperture – L3
03 Experiment the characteristics of LASER and photo diode. – L4
04 Demonstrate the working analog and digital optic link. – L3
05 Experiment the working of TDM of digital signals. – L4
06 Demonstrate the working of an Erbium Doped Fiber Amplifier. – L3
07 Demonstrate the working WDM MUX and DMUX. – L3
08 Demonstrate the working of AM, PAM and its detection. – L3

09 Demonstrate the working of PPM and FM. – L3
10 Design the second order active LPF, HPF and BPF. – L5
11 Design the Astable and Monostable multivibrators using 555 timer. – L5

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to	Program outcome									
		a	b	c	d	e	f	g	h	i	j	k
01	Experiment the attenuation and dispersion in optical fiber. – L4	L	M									
02	Determine the bending loss and numerical aperture – L3	M	L									
03	Experiment the characteristics of LASER and photo diode. – L4	H	M									
04	Demonstrate the working analog and digital optic link.– L3	L	L									
05	Experiment the working of TDM of digital signals. – L4	L	M									
06	Demonstrate the working of an Erbium Doped Fiber Amplifier. – L3	L	M									
07	Demonstrate the working WDM MUX and DMUX. – L3	M	M									
08	Demonstrate the working of AM, PAM and its detection. – L3	H	H									
09	Demonstrate the working of PPM and FM. – L3	L	L									
10	Design the second order active LPF, HPF and BPF. – L5	L	M	M								
11	Design the Astable and Monostable multivibrators using 555 timer. – L5	L	M	M								

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to	Program outcome									
		a	b	c	d	e	f	g	h	i	j	k
01	Experiment the attenuation and dispersion in optical fiber.–L4	1	2									
02	Determine the bending loss and numerical aperture – L3	2	3									
03	Experiment the characteristics of LASER and photo diode.– L4	3	2									
04	Demonstrate the working analog and digital optic link. – L3	1	1									
05	Experiment the working of TDM of digital signals. – L4	1	2									
06	Demonstrate the working of an Erbium Doped Fiber Amplifier. – L3	1	2									
07	Demonstrate the working WDM MUX and DMUX. – L3	2	2									
08	Demonstrate the working of AM, PAM and its detection.–L3	3	3									
09	Demonstrate the working of PPM and FM. – L3	1	1									
10	Design the second order active LPF, HPF and BPF. – L5	1	2	2								
11	Design the Astable and Monostable multivibrators using 555 timer. – L5	1	2	2								

1-Low, 2-Moderate, 3-High

Course Title : ANALOG CMOS VLSI DESIGN			
Course Code: P13EC61	**Semester : VI**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Analyze the analog CMOS integrated circuits.
2. Describe the basic MOS device physics and more advanced properties and fabrication details.
3. Describe the small signal and large signal analysis of amplifiers.
4. Explain the working of various single stage MOS amplifiers.
5. Describe the operation of differential amplifier and different types of Current mirrors and their applications.
6. Provide the understanding of the concept of band gap references and discuss the speed and noise issues.
7. Discuss the elementary switched capacitor circuit and effect of non–linearity and miss–match.
8. Explain the condition for oscillation and design of different types of oscillators.
9. Design the Phase Locked Loops and its applications.

Course Content

UNIT – I

Basic MOS Device Physics: General Considerations, MOS I/V Characteristics, Second–Order Effects, MOS Device Models.

Single– Stage Amplifiers: Basic Concepts, Common–Source Stage, Source Follower, Common–Gate Stage, Cascode Stage, Choice of Device Models.

Text: 2.1 to 2.4 and 3.1 to 3.6 **11 Hrs**

UNIT – II

Differential Amplifiers: Single– Ended and Differential Operation, Basic Differential Pair, Common–Mode Response, Differential Pair with MOS Loads, Gilbert Cell.

Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors,

Text: 4.1 to 4.5 and 5.1 to 5.3 **11 Hrs**

UNIT – III

Bandgap References: General Considerations, Supply–Independent Biasing, Temperature–Independent References, PTAT Current Generation, Constant–*Gm* Biasing, Speed and Noise Issues, Case Study.

Introduction to Switched– Capacitor Circuits: General Considerations, Sampling Switches, Switched– Capacitor Amplifiers, Switched–Capacitor Integrator, Switched–Capacitor Common–Mode Feedback.

Text: 11.1 to 11.7 and 12.1 to 12.5 **10 Hrs**

UNIT – IV

Oscillators: General Considerations, Ring Oscillators, LC Oscillators, Voltage–Controlled Oscillators, Mathematical Model of VCOs.

Text: 14.1 to 14.5 **10 Hrs**

UNIT – V

Phase– Locked Loops: Simple PLL, Charge– Pump PLLs and Non–ideal Effects in PLLs, Delay–Locked Loops and Applications.

Text: 15.1 to 15.5 **10 Hrs**

TEXT BOOK:

"Design of Analog CMOS Integrated Circuits", Behzad Razavi, Tata Mcgraw Hill, 2001.

REFERENCE BOOKS:

1. "CMOS Analog Circuit Design", Phillip E. Allen, Douglas R. Holberg, Oxford University Press, 2003
2. "CMOS Circuit Design, Layout and Simulation", R. Jacob Baker, Harry W. Li, David E. Boyce, Prentice Hall of India, 2005

Course Outcome

After learning all the units of the course, the student is able to

01 Describe the physics of MOSFETs that is necessary for basic analog design & low frequency behaviour of single stage amplifiers and analysis of different parameters using small signal and large signal analysis. – L1 (Unit – I)
02 Explain the importance of current sources in single stage and differential amplifiers and design of current mirrors, differential amplifier design and analysis and Gilbert cell operation. – L2 (Unit – II)
03 Explain the common class of discrete time system called switched capacitor circuits. – L2 (Unit – III)
04 Design the CMOS oscillators such as VCOs. – L5 (Unit – IV)
05 Design the PLLs using CMOS technology. – L5 (Unit – V)
06 Classify the different types of PLLs. – L2 (Unit – V)

Topic Learning Outcome (TLO)

After learning all the topics of UNIT– I, the student is able to

Explain the General Considerations of MOS devices. – L2
01 Discuss the MOS I/V Characteristics. – L2
02 Explain the Second–Order Effects in MOS devices. – L2
03 Describe the different MOS Device Models. – L1
04 Explain the Basic Concepts Common– Source Stage Source Follower. – L2
05 Design the Common–Gate Stage amplifier. – L3
06 Explain the operation of Cascode Stage amplifier. – L2
07 Discuss the Choice of Device Models. – L2

After learning all the topics of UNIT– II, the student is able to

01 Explain the basic operation of Single–Ended amplifier. – L2
02 Describe the operation of Differential amplifier. – L1
03 Explain the operation of Basic Differential Pair. – L2
04 Discuss the Common–Mode Response of Differential amplifier. – L2
05 Design the Differential Pair amplifier with MOS Loads. – L3
06 Explain the operation of Gilbert Cell. – L2
07 Discuss the various Basic Current Mirrors. – L2
08 Explain the operation of Cascode Current Mirrors. – L2
09 Solve the problems on Current Mirrors. – L3
10 Explain the operation of active Current Mirrors. – L2

After learning all the topics of UNIT– III, the student is able to

01 List the General Considerations in bandgap reference. – L1
02 Explain the Supply–Independent Biasing of MOS Circuit. – L2
03 Describe the Temperature–Independent References of MOS circuit. – L1
04 Explain the PTAT Current Generation in MOS circuit. – L2
05 Discuss the Constant–*Gm* Biasing. – L2
06 Discuss the Speed and Noise Issues in MOS devices– L2
07 List the General Considerations in Switched–Capacitor of MOS devices. – L1

08 Explain the concept of Sampling Switches in MOS. – L2
09 Explain the circuit of Switched–Capacitor Integrator. – L2
10 Discuss the effect of Switched–Capacitor in MOS circuits. – L2
11 Explain the concept Common–Mode Feedback. – L2

After learning all the topics of UNIT– IV, the student is able to

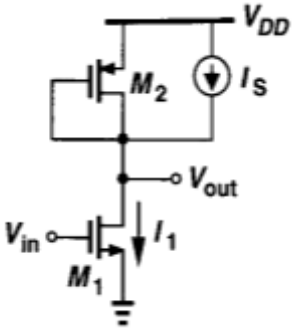
01 Explain the General Considerations for oscillators. – L2
02 Explain the operation of Ring Oscillators. – L2
03 Discuss the different LC Oscillators operation. – L2
04 Explain the operation of Voltage– Controlled Oscillators. – L2
05 Express the Mathematical Model of VCOs. – L2

After learning all the topics of UNIT– V, the student is able to

01 Explain the Simple PLL operation. – L2
02 Discuss the different Charge– Pump PLLs operation. – L2
03 Explain the Non–ideal Effects in PLLs. – L2
04 Explain the working of Delay–Locked Loops. – L2
05 Discuss the Applications of PLLs. – L2

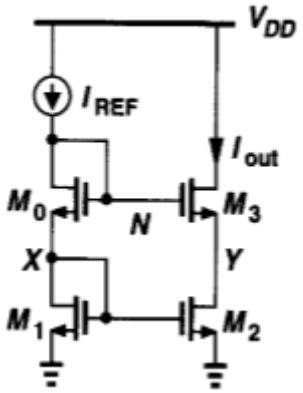
Review Questions

1. Explain VI characteristics of MOSFET.
2. Derive equation for drain current and transconductance at different region of operations.
3. Explain with diagram how MOSFET can be used as current source.
4. Differentiate between nmos and pmos and write spice model of nmos transistor.
5. Explain CS stage amplifier with resistive load and derive an equation for voltage gain.
6. Explain CS stage amplifier with diode connected load and derive an equation for voltage gain.
7. Derive an equation for voltage gain in source degeneration of CS amplifier.
8. In the circuit of figure M1 is biased in saturation with a drain current equal to I1.The current source Is=0.75I1 is added to circuit. Find gain of circuit.

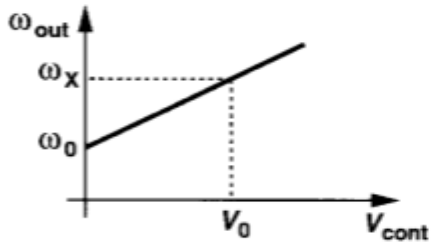


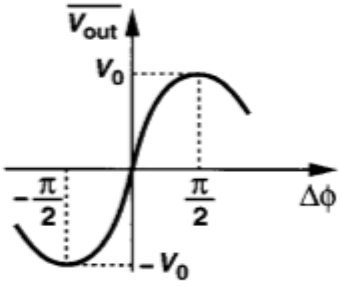
9. Explain CS stage with current source load.
10. Derive an equation for gain of CS stage with source degeneration.
11. Derive an equation for gain of Source follower amplifier.
12. Explain Basic Cascode stage amplifiers.
13. Explain Folded Cascode amplifier.
14. Explain why differential amplifiers are preferred over single ended amplifiers.
15. Explain basic differential pair amplifier.
16. Explain qualitative analysis of differential amplifier.
17. Explain quantitative analysis of differential amplifier.
18. Derive Common mode voltage gain of differential amplifier.

19. Explain Gilbert cell with neat circuit diagram.
20. Explain basic current mirror circuits.
21. Explain Cascaded current mirrors.
22. In the fig, sketch Vx and Vy as a function of Iref. If Iref requires 0.5v to operate as a current source, what is maximum value.



23. Explain active current mirror circuit with neat circuit diagrams.
24. Explain large signal analysis of active current mirror.
25. Explain small signal analysis of active current mirror.
26. Explain common mode properties of active current mirror circuits.
27. Explain supply independent biasing with equations and necessary circuit diagram.
28. Name types of temperature coefficients and explain temperature independent reference.
29. Derive an equation for bandgap refrences.
30. Write a brief note on supply dependency and start up problem.
31. Explain speed and noise issues of Bandgap refrences.
32. Explain how MOSFETS are used as sampling switches.
33. Explain channel charge injection and clock feedthrough.
34. Explain switched capacitor amplifiers.
35. Explain switched capacitor integrators.
36. Explain switched capacitor common mode feedback.
37. State and explain Barkhausen creiteria with oscillator block diagram.
38. Discuss ring oscillators and amplitude limiting of ring oscillators.
39. Explain LC oscillator topologies with neat circuit diagram.
40. 40. Explain cross coupled amplifier and colplits oscillator.
41. Explain one port oscillators.
42. Explain VCO and derive an equation for voltage gain of VCO.
43. Explain performance parameters of VCOs.
44. Explain mathematical modeling of VCO.
45. Explain simple PLL.
46. . Implement simple PLL in CMOS technology.
47. A PLL incorporates a VCO and a PD having characteristics shown in figure. Explain what happens as input frequency varies in locked condition.





48. . Explain dynamics of simple PLL and charge pump PLL.
49. Explain Charge pump PLL with neat circuit diagram.
50. .Explain non ideal effects in PLL.
51. .Explain PLL applications.

Lesson Plan

UNIT I

Period No. **Topics**

Basic Mos device physics

1. Mosfet structure
2. MOSFET VI characteristics
3. Second order effects
4. MOS device models

Single stage amplifier

5. Common source stage amplifier
6. Source follower
7. Common gate amplifier
8. Cascode amplifier
9. Folded cascode amplifier
10. Choice of device models

UNIT II

Period No. **Topics**

Differential amplifier

11. Single ended and differential amplifier
12. Qualitative analysis
13. Quantitative analysis
14. Common mode response
15. Differential pair with mos loads
16. Gilbert cell

Passive and active current mirrors

17. Basic current mirrors
18. Cascode current mirrors
19. Active current mirrors
20. Common mode properties

UNIT III

Period No. Topics

Bandgap refrences

21. Supply independent biasing
22. Temperature independent biasing
23. Constant gm biasing
24. Speed and noise issues

Introduction to switched capacitors

25. General considerations
26. Sampling switches
27. Switched capacitor amplifiers
28. Switched capacitor integrator
29. Switched capacitor common mode feedback

UNIT IV

Period No. Topics

30. Oscillators General considerations
31. Ring oscillators
32. LC oscillators
33. Colplitts oscillator
34. Voltage controlled oscillators
35. Mathematical modelling of VCO.

UNIT V

Period No. Topics

PLL

36. Simple PLL
37. Charge pump PLL.
38. Non ideal effects in PLL.
39. Delay locked loops

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to		Programme outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Describe the physics of MOSFETs that is necessary for basic analog design & low frequency behaviour of single stage amplifiers and analysis of different parameters using small signal and large signal analysis. – L1 (Unit – I)	L1	L	M									
02	Explain the importance of current sources in single stage and differential amplifiers and design of current mirrors, differential amplifier design and analysis and Gilbert cell operation. – L2 (Unit – II)	L2	L	M	H								
03	Explain the common class of discrete time system called switched capacitor circuits. – L2 (Unit – III)	L2	L	M	H								
04	Design the CMOS oscillators such as VCOs. – L5 (Unit – IV)	L5	L	M	H								
05	Design the PLLs using CMOS technology. – L5 (Unit – V)	L5	L	M	H								
06	Classify the different types of PLLs. – L2 (Unit – V)	L2	L	M									

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to		Programme outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Describe the physics of MOSFETs that is necessary for basic analog design & low frequency behaviour of single stage amplifiers and analysis of different parameters using small signal and large signal analysis. – L1 (Unit – I)	L1	1	2									
02	Explain the importance of current sources in single stage and differential amplifiers and design of current mirrors, differential amplifier design and analysis and Gilbert cell operation. – L2 (Unit – II)	L2	1	2	3								
03	Explain the common class of discrete time system called switched capacitor circuits. – L2 (Unit – III)	L2	1	2	3								
04	Design the CMOS oscillators such as VCOs. – L5 (Unit – IV)	L5	1	2	3								
05	Design the PLLs using CMOS technology. – L5 (Unit – V)	L5	1	2	3								
06	Classify the different types of PLLs. – L2 (Unit – V)	L2	1	2									

1-Low, 2-Moderate, 3-High

Course Title : COMPUTER COMMUNICATION NETWORKS			
Course Code: P13EC62	**Semester : VI**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Prerequisite course for:

1. GSM Communication and Networks – P13EC74

Course Learning Objectives (CLOs)

This course aims to

1. Provide the understanding of layering in computer networks.
2. Provide the understanding of different protocol stacks (TCP/IP); understand functions and protocols within a layer.
3. Provide the understanding of how the layers fit together and finally understand how the Internet works.
4. Discuss the different application architectures and Processes communicating.
5. Provide the understanding of the basic principles behind transport layer services and protocols (UDP, TCP).
6. Provide the understanding of network layer's host–to–host communication service.
7. Discussing between the forwarding and routing functions of the network layer.
8. Provide the understanding of link layer services, the principles underlying its operation, and a number of important specific protocols that use these principles in implementing link layer services.

Course Content

UNIT – I

Computer Networks and the Internet: What Is the Internet?, The Network Edge, The Network Core, Delay, Loss, and throughput in Packet–Switched Networks, Protocol Layers and their Service Models, History of computer networking and Internet.

Text: 1.1 to 1.7 **10 Hrs**

UNIT – II

Application Layer: Principles of Network Applications, The Web and HTTP, File **Transfer:** FTP, Electronic Mail in the Internet, DNS–The Internet's Directory Service, P2P File Applications.

Text: Chapter 2.1 to 2.6 **10 Hrs**

UNIT – III

Transport Layer: Introduction and Transport– Layer Services, Multiplexing and De–multiplexing.

Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection–**Oriented Transport:** TCP.

Text: 3.1 to 3.5 **11 Hrs**

UNIT – IV

The Network Layer: Introduction, Virtual Circuit and Datagram Networks, What's Inside a Router?

The Internet Protocol (IP): Forwarding and Addressing in the Internet, Routing Algorithms, Broadcast and Multicast Routing

Text: 4.1 to 4.5 And 4.7 **10 Hrs**

UNIT – V

The Link Layer and Local Area Networks: Link Layer: Introduction and Services, Error–Detection and Correction Techniques Multiple Access Protocols Link–Layer Addressing, **Ethernet Interconnections:** Hubs and Switches

PPP: The Point–to–Point Protocol Link Virtualization: A Network as a Link Layer
Text: 5.1 to 5.8 **11 Hrs**

TEXT BOOK:
"Computer Networks", James F. Kurose and Keith W. Ross Pearson education, 5th Edition, 2013

REFERENCE BOOKS:
1. "Data Communication and Networking", Behrouz Forouzan, TMH, 4th Edition
2. "Computer Networks", A Top down Approach by Behrouz Forouzan, Firouz Mosharraf, McGraw–Hill.
3. "Data and Computer Communication", William Stallings, PHI, 6th Edition

Course Outcomes

After learning all the units of the course, the student is able to
01 Explain the concept of internet infrastructure and services offered. – L1 (Unit – I)
02 Calculate the Delay & loss in packet– switched networks. – L4 (Unit – I)
03 Describe the Web, HTTP, FTP, Electronic Mail, SMTP, POP3, IMAP and DNS. – L1 (Unit – II)
04 Explain TCP and UDP transport layer protocol principles. – L3 (Unit – III)
05 Discuss the VCN,DGN's and network layer protocols with IPV4 and IPV6 formats.- L3(Unit-IV)
06 Discuss network layer services, Access protocols, Ethernet hubs, switches and PPP virtualization.-L2(Unit-V)

Topic Learning Outcomes

After learning all the topics of UNIT– I, the student is able to
01 Define the Internet and Explain Network edge and Network core. – L1
02 Describe the Internet's connection–oriented service provides reliable transport. – L1
03 Describe the Network access, physical media and ISPs. – L1
04 Calculate the Delay & loss in packet–switched networks. – L4
05 Draw the five layers in the Internet protocol stack. – L4
06 State the principle responsibilities for each of the five layers in the Internet protocol stack. – L1

After learning all the topics of UNIT– II, the student is able to
01 List the various network–application user agents that you use on a daily basis. – L1
02 Explain the application architectures and Processes communicating. – L2
03 Describe the Web, HTTP, FTP, Electronic Mail, SMTP, POP3, IMAP and DNS. – L1
04 Discuss the P2P file sharing. – L2

After learning all the topics of UNIT– III, the student is able to
01 Explain the transport layer protocol provides for logical communication between application processes running on different hosts. – L2
02 Discuss the Transport–layer services. – L2
03 Explain the Multiplexing and de–multiplexing. – L2
04 Write the UDP segment structure and explain its components. – L3
05 Describe the principles of reliable data transfer with service model and service implementation. – L2
06 Write the TCP segment structure and explain its components. – L3

After learning all the topics of UNIT– IV, the student is able to

01 Describe the principles behind network layer services. – L1
02 Compare the Virtual circuit and datagram networks. – L4
03 Explain the components of IPv4 and IPv6 datagram format. – L3
04 Explain the ICMP protocol. – L2
05 Compare the link state and distance–vector algorithms. – L4
06 Explain the broadcast and multicast routing algorithms. – L2

After learning all the topics of UNIT– V, the student is able to

01 List the possible services of link layer. – L1
02 Discuss the error detection and correction techniques in link layer. – L2
03 Explain the random access protocols (ALOHA, SLOTTED ALOHA, CSMA, CSMA/CD). – L2
04 Explain the taking–turn and ARP protocols. – L2
05 Define the MAC address. – L1
06 Differentiate the switches versus routers. – L4
07 Describe the MPLS and PPP with data format. – L1

Review Questions

1 Define the Internet and Explain Network edge and Network core.
2 Describe the Internet's connection–oriented service provides reliable transport.
3 Describe the Network access, physical media and ISPs.
4 Calculate the Delay & loss in packet–switched networks.
5 Explain queuing delay and its dependency on traffic intensity.
6 Compare Circuit switched network with packet switched network.
7 Draw the five layers in the Internet protocol stack.
8 State the principle responsibilities for each of the five layers in the Internet protocol stack.
9 List the various network–application user agents that you use on a daily basis.
10 Explain the application architectures and Processes communicating.
11 Describe the Web, HTTP, FTP, Electronic Mail, SMTP, POP3, IMAP and DNS.
12 What are cookies?
13 Describe message/commands format of HTTP, FTP and SMTP.
14 Compare HTTP and FTP.
15 What is MIME where and why it is used?
16 Discuss the P2P file sharing.
17 Explain the transport layer protocol provides for logical communication between application processes running on different hosts.
18 Discuss the Transport–layer services.
19 Explain the Multiplexing and de–multiplexing.
20 Why most internet application prefers UDP?
21 Write the UDP segment structure and explain its components.
22 Describe the principles of reliable data transfer with service model and service implementation.
23 With requires FSM/diagrams explain Goback-N protocol
24 Write the TCP segment structure and explain its components.
25 Discuss the Round-Trip Time estimation and Timeout.
26 Explain congestion control.
27 Describe the principles behind network layer services.
28 Compare the Virtual circuit and datagram networks.
29 Difference between routing and forwarding.

30 Describe packet loss at input and output ports.
31 Explain IGMP protocol.
32 Describe network address translation.
33 Explain the components of IPv4 and IPv6 datagram format.
34 Calculate binary equivalent of the given IP address.
35 Explain the ICMP protocol.
36 Compare the link state and distance–vector algorithms.
37 Explain Hierarchical Routing.
38 Explain the broadcast and multicast routing algorithms.
39 List the possible services of link layer.
40 Discuss the error detection and correction techniques in link layer.
41 Explain the random access protocols (ALOHA, SLOTTED ALOHA, CSMA, CSMA/CD).
42 Compare CSMA and CSMA/CD.
43 Describe Taking-Turns Protocol.
44 Explain in brief DHCP.
45 Explain the taking–turn and ARP protocols.
46 Define the MAC address.
47 With an illustration explain switch forwarding and filtering.
48 Differentiate the switches versus routers.
49 List out the IETF requirements of PPP.
50 Describe the MPLS and PPP with data format.

Lesson Plan

UNIT-I

Period No.	Topics
1.	Internet, Network Edge
2.	Network Core
3.	Network Core
4.	Delay, Loss in Packet Switched Networks
5.	Delay, Loss in Packet Switched Networks
6.	Delay, Loss in Packet Switched Networks
7.	Protocol Layers and Service Models
8.	Protocol Layers and Service Models
9.	Protocol Layers and Service Models
10.	History of computer networking and Internet

UNIT-II

Period No.	Topics
1.	Principles of Network Applications
2.	Principles of Network Applications
3.	The Web and HTTP
4.	HTTP Messages
5.	HTTP Messages
6.	File Transfer**:** FTP
7.	Electronic Mail in the Internet
8.	DNS–The Internet's Directory Service
9.	P2P File Applications
10.	P2P File Applications

UNIT-III

Period No. Topics

1. Transport Layer: Introduction
2. Transport– Layer Services
3. Transport– Layer Services
4. Multiplexing and De–multiplexing
5. Multiplexing and De–multiplexing.
6. Connectionless Transport: UDP
7. Connectionless Transport**:** UDP
8. Principles of Reliable Data Transfer
9. Principles of Reliable Data Transfer
10. Connection–Oriented Transport**:** TCP
11. Connection–Oriented Transport**:** TCP

UNIT-IV

Period No. Topics

1. The Network Layer: Introduction
2. Virtual Circuit and Datagram Networks
3. Virtual Circuit and Datagram Networks
4. What's Inside a Router?
5. The Internet Protocol (IP): Forwarding and Addressing in the Internet
6. Routing Algorithms
7. Routing Algorithms
8. Routing Algorithms
9. Broadcast and Multicast Routing
10. Broadcast and Multicast Routing

UNIT-V

Period No. Topics

1. The Link Layer and Local Area Networks: Link Layer: Introduction
2. The Link Layer and Local Area Networks: Link Layer: Introduction
3. Link Layer: Services
4. Link Layer: Services
5. Error–Detection and Correction Techniques
6. Multiple Access Protocols
7. Multiple Access Protocols
8. Link–Layer Addressing
9. Ethernet Interconnections: Hubs and Switches
10. PPP: The Point–to–Point Protocol Link Virtualization
11. PPP: The Point–to–Point Protocol Link Virtualization: A Network as a Link Layer

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Program Outcome (ABET/NBA-(3a-k))										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the concept of internet infrastructure and services offered. (Unit – I)	**L1**	**L**	**L**								
02	Calculate the Delay & loss in packet– switched networks. (Unit – I)	**L4**	**L**	**L**								
03	Describe the Web, HTTP, FTP, Electronic Mail, SMTP, POP3, IMAP and DNS. (Unit – II)	**L1**	**L**	**L**	**L**							
04	Explain TCP and UDP transport layer protocol principles. (Unit – III)	**L3**	**L**	**L**	**L**							
05	Discuss the VCN,DGN's and network layer protocols with IPV4 and IPV6 formats.(Unit-IV)	**L3**	**L**	**L**								
06	Discuss network layer services, Access protocols, Ethernet hubs, switched and PPP virtualization.(Unit-V)	**L2**	**L**	**L**	**L**							

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Program Outcome (ABET/NBA-(3a-k))										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the concept of internet infrastructure and services offered. (Unit – I)	**L1**	**1**	**1**								
02	Calculate the Delay & loss in packet– switched networks. (Unit – I)	**L4**	**1**	**1**								
03	Describe the Web, HTTP, FTP, Electronic Mail, SMTP, POP3, IMAP and DNS. (Unit – II)	**L1**	**1**	**1**	**1**							
04	Explain TCP and UDP transport layer protocol principles. (Unit – III)	**L3**	**1**	**1**	**1**							
05	Discuss the VCN,DGN's and network layer protocols with IPV4 and IPV6 formats.(Unit-IV)	**L3**	**1**	**1**								
06	Discuss network layer services, Access protocols, Ethernet hubs, switched and PPP virtualization.(Unit-V)	**L2**	**1**	**1**	**1**							

1-Low, 2-Moderate, 3-High

Course Title : MICROWAVE DEVICES AND INTEGRATED CIRCUITS			
Course Code: P13EC63	Semester : VI	L-T-P-H: 4 – 0 – 0-4	Credits: 4
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		Weightage :CIE:50% SEE:50%	

Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic knowledge of Microwave transmission lines.
2. Discuss the importance of Microwave Waveguides and components.
3. Provide the understanding of working principles of Microwave linear beam tubes like Klystrons, Helix TWT.
4. Describe the Microwave Network theories and Passive Devices.
5. Provide the understanding of concepts of Transfer Electron Devices, Avalanche transit time Devices and Parametric Amplifiers.
6. Explain the various planar Transmission Lines and Design of Microwave Integrated circuits.
7. Solve the numerical Problems on Smith chart, Impedance matching, Microwave Network Theory.

Course Content

UNIT – I

Microwave transmission lines: Introduction, transmission lines equations and solutions, reflection and transmission coefficients, standing waves and SWR, line impedance and line admittance. Smith chart, impedance matching using single stubs.

Text 1: 3.0 – 3.6.1 **10 Hrs**

UNIT – II

Microwave waveguides and components: Introduction, TE, TM and TEM waves in rectangular and circular wave guide, microwave cavities, directional couplers, circulators and isolators.

Microwave Linear beam Tubes (O Type): Klystron, Multi cavity Klystron Amplifier, reflex Klystron, Helix – TWT.

Text 1: 4.0, 4.1.2, 4.1.3, 4.2.2, 4.2.3, 4.2.4, 4.3, 4.5, 4.6 and 9.2 to 9.5 **11 Hrs**

UNIT – III

Microwave network theory and passive devices: Symmetrical Z and Y parameters, for reciprocal Networks, S matrix representation of multi port – networks, coaxial connectors and adapters, Phase shifters, Attenuators, Power dividers, Waveguide Tees, Magic tees.

Text 2: 6.1, 6.2, 6.3, 6.4.1, 6.4.2, 6.4.14, 6.4.15, 6.4.16 **11 Hrs**

UNIT – IV

Microwave diodes, Transfer electron devices: Introduction, GUNN Effect diodes – GaAs diode, RWH theory, Modes of operation, Avalanche transit time devices: READ diode, IMPATT diode, TRAPATT diode, BARITT diode, Parametric amplifiers Other diodes: PIN diodes, Tunnel diode, Varactor diode, Schottky barrier diodes.

Text 1: 7.0 to 7.3, 8.1 to 8.4 Text 2: 10.5 to 10.7 **10 Hrs**

UNIT – V

Planar Transmission Lines (Strip lines): Introduction, Micro strip lines, Parallel strip lines, Coplanar strip lines, Shielded strip Lines.

Microwave integrated circuit Design: Introduction, types of MIC's and their technology, hybrid technology, Monolithic Technology, MIC lumped and distributed elements.

Text 1: 11.0, 11.1, 11.2, 11.3, 11.4 Text 2: 4.1, 4.2, 4.3, 4.4, 4.5 **10 Hrs**

TEXT BOOK:

1. "Microwave Devices and Circuits", Samuel Y Liao, 3rd Edition, Pearson Education.
2. "Microwave Engineering", Annapurna Das, Sisir K Das, 2nd Edition, TMH.

REFERENCE BOOKS:

1. "Microwave Engineering", David M Pozar, John Wiley, 2nd Edition, 2004
2. "Foundations For Microwave Engineering", Robert E Collin, John Wiley & Sons Inc (Sea) Pte Ltd, 2009.

Course Outcome

After learning all the units of the course, the student is able to

01 Explain the microwave Transmission line equations and solutions. – L2 (Unit – I)
02 Discuss the TE, TM, TEM modes in circular and rectangular waveguides. – L2 (Unit – II)
03 Discuss the symmetrical Z and Y parameters for reciprocal networks. – L2 (Unit – III)
04 Explain the working of various microwave diodes. – L2 (Unit – IV)
05 Develop the expressions for characteristic impedance and losses in microstrip lines, parallel striplines, coplanar and shielded striplines. – L5 (Unit – V)
06 Describe the fabrication process of MMIC and hybrid MIC. – L2 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT– I, the student is able to

1. Explain the microwave transmission line equations and solutions. – L2
2. Develop the expressions for reflection and transmission coefficients and Standing Wave Ratio. – L5
3. Explain the line impedance, line admittance and smith chart. – L2
4. Solve the numerical problems on impedance matching and smith chart. – L3

After learning all the topics of UNIT– II, the student is able to

1. Discuss the TE, TM, TEM modes in rectangular and circular waveguides. – L2
2. Analyze the circulators, directional couplers and isolators. – L4
3. Develop the S matrix for directional coupler, circulators and isolators. – L5
4. Explain the concepts of klystron and helix–TWT. – L2

After learning all the topics of UNIT– III, the student is able to

1. Discuss the symmetrical Z and Y parameters for reciprocal networks. – L2
2. Analyze the multiport network using S–matrix. – L4
3. Solve the numerical problems on network theory. – L3
4. Describe the various microwave passive devices. – L2

After learning all the topics of UNIT– IV, the student is able to

1. Describe the working of Gunn diodes and modes of operation. – L2
2. Explain the working of avalanche transit time devices such as READ, IMPATT, TRAPATT, BARITT diodes. – L2
3. Discuss the concepts of parametric amplifiers. – L2
4. Summarize the working of PIN, Tunnel, Varactor and Schottky barrier diodes. – L2

After learning all the topics of UNIT– V, the student is able to

1. Develop the expression for characteristic impedance and losses in microstrip lines, parallel striplines, coplanar striplines and shielded striplines. – L5
2. Distinguish between the thick film and thin film technology. – L4
3. Describe the fabrication process of MMIC and hybrid MICs. – L2

4. Explain why the lumped elements R, L and C cannot be used at high RF and microwave frequencies. – L2

Review Questions

01 Develop the expressions for Reflection and Transmission coefficients and standing wave Ratio.
02 Solve the numerical problems on smith chart and impedance matching.
03 Explain the concepts of directional couplers, circulators and isolators.
04 Analyze the microwave passive devices using S– matrix.
05 Solve the numerical problems on network theory.
06 Explain the working of various microwave diodes.
07 Distinguish between the thick film and thin film technology.
08 Drive the equation for line impedance.
09 Explain two-valley model theory.
10 Explain high field domain and its properties.
11 Briefly describe a micro strip line.
12 What is an S-matrix? State and prove symmetric property and unitary property of an 'S' matrix.
13 Compare ABCD parameter with Z and Y parameter.
14 What are standing waves? Drive the relation between SWR and reflection coefficient of transmission lines.
15 Derive the equation for the following at microwave frequency. i) Propagation constant ii) Attenuation constant iii) Phase constant iv) Characteristic impedance & v) Phase velocity
16 Give the comparison between waveguide and co-axial cable.
17 How to realize the four –port circulator with directional couplers and 08 phase shifter? Explain
18 Explain mechanism of oscillation in Reflex klystron oscillator with neat sketches?
19 Explain TWT amplifier with neat sketches?
20 Explain the relation between incident and reflected waves in terms of scattering parameters for a two port network. Also explain physical significance of s- parameters.
21 Which properties are common in S,Z and Y matrices?
22 Two transmission lines of characteristic impedances Z1 and Z2 are joined at plane PP' Express s- parameters in terms of impedances.
23 Explain with a neat sketch a precision rotary phase shifter.
24 Explain with relevant figures the fundamental concept of RWH theory.
25 Explain the principle of operation of read diode with suitable diagrams.
26 Draw the equivalent circuit for parametric amplifier and explain.
27 Obtain attenuation losses in parallel strip lines for both conductor and dielectric.
28 Distinguish between thick film and thin film technology. Describe the 10 fabrication process of MMIC and hybrid MIC's.
29 Describe the basic fabrication process of MOSFET's?
30 Compare the performance characteristics of TWTA and a klystron amplifier.
31 Express the relationship between incident and reflected waves in terms 'S'-parameters, 'Sij' and describe the physical significance of S-parameters for two port reciprocal structures.
32 State and prove unitary property for a lossless junction in S-parameters.
33 With neat sketch explain precision type variable attenuator.
34 List out different types of co-axial connectors and their impedance.
35 With neat diagram explain the construction and operation of TRAPATT diode.

36 State the three criterias of RWH theory. For band structures of semiconductor to exhibit negative resistance.
37 Write the advantages and disadvantages of Microstrip lines.
38 Drive the characteristics impedance of for Microstrip lines.
39 What are the two basic methods are adopted for manufacturing of 'thick-film' MIC's and explain its fabrication steps.
40 Explain with sketchs plate-through technique and Etch back technique.
41 Why conventional open –wire lines are not suitable for microwave transmission.
42 Drive the set of field equations for TEmn modes in rectangular wave guide.
43 Drive the expression for power flow through a co-axial line starting from field equations.
44 Describe the operating principles of the microwave tube that can be used as a low power microwave oscillator. With neat illustration.
45 With a neat diagram, explain the working of precision type variable attenuator, write its s-matrix and get the expression for attenuation in dB.
46 Explain the ports of Hybrid magic-T and obtain the S matrix of the magic-T.
47 What is "Transferred Electron effect"? Explain how this is used in a solid state device in generating microwave oscillations.
48 What are the advantages and limitations of parametric amplifier.
49 Describe the hybrid IC techniques.
50 Obtain attenuation losses in parallel strip lines for both conductor and dielectric.

Lesson Plan

UNIT – I

Period No.	Topics
1.	Microwave transmission lines: Introduction.
2.	Transmission lines equations and solutions.
3.	Reflection and transmission coefficients.
4.	Reflection and transmission coefficients.
5.	Standing waves and SWR.
6.	Line impedance and line admittance.
7.	Smith chart.
8.	Smith chart.
9.	Impedance matching using single stubs.
10.	Impedance matching using single stubs.

UNIT – II

Period No.	Topics
11.	Microwave waveguides and components:
12.	Introduction.
13.	TE, TM and TEM waves in rectangular and circular wave guide.
14.	TE, TM and TEM waves in rectangular and circular wave guide.
15.	Microwave cavities.
16.	Directional couplers.
17.	Circulators and isolators.
18.	Microwave Linear beam Tubes (O Type): Klystron.
19.	Multi cavity Klystron Amplifier.
20.	Reflex Klystron.
21.	Helix – TWT.

UNIT – III

Period No.	Topics
22.	Microwave network theory and passive devices:
23.	Symmetrical Z and Y parameters, for reciprocal Networks.
24.	Symmetrical Z and Y parameters, for reciprocal Networks.
25.	S matrix representation of multi port – networks.
26.	S matrix representation of multi port – networks.
27.	Coaxial connectors and adapters.
28.	Phase shifters.
29.	Attenuators.
30.	Power dividers.
31.	Waveguide Tees.
32.	Magic tees.

UNIT – IV

Period No.	Topics
33.	Microwave diodes, Transfer electron devices: Introduction.
34.	GUNN Effect diodes – GaAs diode.
35.	RWH theory, Modes of operation.
36.	Avalanche transit time devices: READ diode.
37.	IMPATT diode, TRAPATT diode.
38.	BARITT diode.
39.	Parametric amplifiers Other diodes: PIN diodes.
40.	Tunnel diode.
41.	Varactor diode.
42.	Schottky barrier diodes.

UNIT – V

Period No.	Topics
43.	Planar Transmission Lines (Strip lines): Introduction
44.	Micro strip lines.
45.	Parallel strip lines.
46.	Coplanar strip lines.
47.	Shielded strip Lines.
48.	Microwave integrated circuit Design: Introduction.
49.	Types of MIC’s and their technology.
50.	Hybrid technology.
51.	Monolithic Technology.
52.	MIC lumped and distributed elements.

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Explain the microwave Transmission line equations and solutions. – L2 (Unit – I)	**H**	**M**			**L**						
02	Discuss the TE, TM, TEM modes in circular and rectangular waveguides. – L2 (Unit – II)	**H**	**L**	**L**								
03	Discuss the symmetrical Z and Y parameters for reciprocal networks. – L2 (Unit – III)	**H**	**M**			**L**						
04	Explain the working of various microwave diodes. – L2 (Unit – IV)	**H**	**L**									
05	Develop the expressions for characteristic impedance and losses in microstrip lines, parallel striplines, coplanar and shielded striplines. – L5 (Unit – V)	**H**	**L**			**M**						
06	Describe the fabrication process of MMIC and hybrid MIC. – L2 (Unit – V)	**H**	**L**									

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Explain the microwave Transmission line equations and solutions. – L2 (Unit – I)	**3**	**2**			**1**						
02	Discuss the TE, TM, TEM modes in circular and rectangular waveguides. – L2 (Unit – II)	**3**	**1**	**1**								
03	Discuss the symmetrical Z and Y parameters for reciprocal networks. – L2 (Unit – III)	**3**	**2**			**1**						
04	Explain the working of various microwave diodes. – L2 (Unit – IV)	**3**	**1**									
05	Develop the expressions for characteristic impedance and losses in microstrip lines, parallel striplines, coplanar and shielded striplines. – L5 (Unit – V)	**3**	**1**			**2**						
06	Describe the fabrication process of MMIC and hybrid MIC. – L2 (Unit – V)	**3**	**1**									

1-Low, 2-Moderate, 3-High

Course Title : DIGITAL IMAGE PROCESSING			
Course Code: P13EC64	**Semester : VI**	**L-T-P-H: 4 – 0 – 0-4**	**Credits: 4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Provide the knowledge about basic concepts of human eye and visualization.
2. Describe the block schematic of a digital image processing system
3. Outline the areas of applications of image processing.
4. Gain the knowledge of image enhancement.
5. Study the basic FFT and their applications for image processing.
6. Apply the knowledge for image segmentation and analysis.
7. Gain the knowledge of noise models and image restoration.
8. Design the filters for colour image processing.
9. Gain the exposure to image compression concepts and algorithms.

Course Content

UNIT – I

Architectures for Programmable DSP Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.

Text: 4.1 to 4.10 **10 Hrs**

UNIT – II

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal–processing Devices, Data Addressing Modes of TMS32OC54xx DSPs, Data Addressing Modes of TMS32OC54xx Processors, Memory Space of TMS32OC54xx Processors, Program Control, TMS32OC54xx Instructions and programming, On–chip Peripherals, Interrupts of TMS32OC54xx Processors, Pipeline Operation of TMS32OC54xx Processors.

Text: 5.1 to 5.10 **10 Hrs**

UNIT – III

Implementation of Basic DSP Algorithms: Introduction, the Q– notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID controller, Adaptive Filters, 2–D Signal Processing.

Implementation of FFT Algorithms: Introduction, an FFT Algorithm for DFT Computation, Overflow and Scaling, Bit–Reversed Index Generation, an 8 Point FFT Implementation on the TMS32OC54xx, Computation of Signal Spectrum.

Text: 7.1 to 7.10 and 8.1 to 8.7 **11 Hrs**

UNIT – IV

Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA).

Interfacing and Applications of DSP Processor: Introduction, Synchronous Serial Interface, A Multichannel Buffered Serial Port (McBSP), McBSP Programming, A CODEC Interface Circuit, CODEC Programming, A CODEC–DSP Interface example.

Text: 9.1 to 9.8 and 10.1 to10.7 **11 Hrs**

UNIT – V

Applications of Programmable DSP Devices: Introduction, A DSP system, DSP Based Bio– telemetry Receiver, A Speech Processing System, An Image Processing System, A Position control system for a hard disk drive, DSP based Power meter.

Text: 11.1 to 11.7 **10 Hrs**

TEXT BOOK:

"Digital Signal Processing", Avatar Singh and S. Srinivasan, Thomson Learning, 2004.

REFERENCE BOOKS:

1. "Digital Signal Processing", A practical approach, Ifeachor E. C.,Jervis B. W Pearson– Education, PHI/ 2002
2. "Digital Signal Processors", B Venkataramani and M Bhaskar TMH, 2002
3. "Architectures for Digital Signal Processing", Peter Pirsch John Weily, 2007

Course Learning Outcome

After learning all the units of the course, the student is able to

01 Describe the various steps in image processing. – L1 (Unit – I)
02 Explain the use of filters for preprocessing. – L2 (Unit – II)
03 Develop the suitable filters for image enhancement. – L5 (Unit – II)
04 Discuss the models for feature extraction and analysis. – L2 (Unit – III)
05 Analyze the algorithms for image restoration. – L4 (Unit – III)
06 Develop the algorithms for image segmentation. – L5 (Unit – IV)
07 Apply the Morphological image processing techniques for segmentation. – L3 (Unit – V)
08 Analyze the algorithms for color image processing. – L4 (Unit – V)
09 Explain the basic concept of Image compression. – L2 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT – I, the student is able to

01 Explain the Visual perception and image formation. – L2
02 List the various types of sensors used in image acquisition. – L1
03 Explain the basic block diagrams /methods of digital image formation. – L2
04 Differentiate the image sampling and quantization. – L4
05 Explain the basic relation between pixels, linear and nonlinear operations. – L2

After learning all the topics of UNIT – II, the student is able to

01 Explain the image enhancement in spatial domain. – L2
02 List the various types of algorithms for enhancement and compare them. – L1
03 Explain the basic block diagrams /methods of digital image filters. – L2
04 Differentiate the sharpening and smoothing filters. – L4
05 Explain the concept of homo– morphing filters. – L2

After learning all the topics of UNIT – III, the student is able to

01 Explain the basic block diagrams /methods of digital image restoration. – L2
02 Explain the problems under image degradation and restoration. – L2
03 List the various noise models and compare them. – L1
04 Differentiate the Wiener filter, Constrained Least squares filters. – L4
05 Explain the concept of Inverse filters ,Geometric Mean filters etc. – L2

After learning all the topics of UNIT – IV, the student is able to

01 Explain the need for image segmentation. – L2
02 Explain the problems under image segmentation and analysis. – L2
03 List the various methods for image segmentation. – L1
04 Explain the morphological operations. – L4
05 Explain the algorithms for region based segmentation. – L2

After learning all the topics of UNIT – V, the student is able to

01 Describe the color fundamentals and models. – L1
02 Explain the various color transformations. – L2
03 Explain the algorithms for color image processing. – L2
04 Explain the image compression, and methodologies. – L2
05 Analyze the various compression schemes and compare them. – L3

Review questions

1. Define image processing? Discuss the various steps in image processing?
2. Discus the role of brightness adaptation curve in human vision system?
3. How inter pixel distance are measured? Explain their importance?
4. Differentiate between sampling and quantization?
5. What is an image histogram? Explain the methods of histogram analysis classification?
6. Mention any four areas of applications of digital image processing and describe any two applications with examples.
7. Discuss with suitable examples linear and non-linear gray level transformations.
8. Explain the spatial domain filters used in image enhancement?
9 With a neat block diagram, explain the functional blocks of Digital Image Processing.
10 Discuss briefly various applications of Image processing.
11 Define Image enhancement and discuss its areas of applications.
12 What do you mean by connectivity and neighborhood?
13 Explain the importance of connectivity and neighborhood.
14 What is Gray level transformation? Explain how it is employed for image enhancement.
15 Define Image Histogram. Explain basic operations of histogram techniques used for image enhancement.
16 Explain Spatial filtering in Digital Image Processing.
17 Explain image enhancement in frequency domain?
18 Explain with example point detection.
19 State how Line detection and Edge detection are implemented under Image processing
20 What is texture?
21 Explain how co- occurrence matrix can be used in image analysis.
22 Explain various edge detection operations and compare them?
23 Discuss the following with reference to image segmentation a) Threshold b) Region merging
24 Briefly explain image negation and state its applications.
25 What are the fundamental colors and secondary colors, explain with reference to color image analysis the Conversion of RGB to HIS
26 Define pseudo color image processing?
27 What is watermarking? How it is used in data hiding?
28 Differentiate image enhancement and restoration.
29 Derive an expression for wiener filter for image restoration.
30 Define maximum entropy restoration?
31 What are the types of noise usually affect an image while transmission?
32 Mention the various mathematical models for noise in an image?
33 Discuss the applications of Fourier transforms for image enhancement.
34 Discuss the role of Matlab for image analysis.
35 Discuss the various image file formats.
36 Analyze the algorithms for color image processing.
37 Explain the basic concept of Image compression.

38 Analyze the algorithms for image restoration.
39 Explain the role of FFT in Image processing.
40 Write a note on CMY color model.
41 Explain DCT as applied to Image processing?
42 Explain the basic steps for filtering in Frequency domain.
43 What are adaptive filters?
44 Explain Laplacian operation in frequency domain.
45 What is aliasing?
46 Explain how aliasing can be reduced?
47 Obtained an expression for number of bits required to store a digitized image.
48 Explain the degradation function estimation using image observation?
49 Explain the degradation function estimation using experimentation?
50 Explain the degradation function estimation using mathematical modeling?

Lesson plan

UNIT – I

Period No. Topics

1. Digital Image Fundamentals: What is Digital Image Processing
2. Fundamental Steps in Digital Image Processing,
3. Fundamental Steps in Digital Image Processing,
4. Components of an Image processing system,
5. Components of an Image processing system,
6. Elements of Visual Perception,
7. Image Sensing and Acquisition,
8. Image Sampling and Quantization,
9. Some Basic Relationships between Pixels, Linear and Nonlinear Operations
10. Some Basic Relationships between Pixels, Linear and Nonlinear Operations

UNIT – II

Period No. Topics

11. Intensity Transformation and special filtering: Background,
12. Some Basic Gray Level Trans– formations,
13. Histogram Processing, fundamentals of special filtering,
14. Smoothing special filters.
15. Filtering In The Frequency Domain: preliminary concepts,
16. Sampling and Fourier transforms,
17. DFT,
18. Image smoothing using frequency domain filters,
19. Image smoothing using frequency domain filters,
20. Image sharpening using frequency domain filters.
21. Image sharpening using frequency domain filters.

UNIT – III

Period No. Topics

22. Image Restoration and reconstruction: A Model of image degradation/restoration process,
23. Noise models,
24. Restoration in the Presence of Noise Only– Spatial Filtering,
25. Periodic Noise Reduction by Frequency Domain Filtering,
26. Linear Position– Invariant Degradations,
27. Inverse filtering,
28. Minimum mean square error (Weiner) Filtering,
29. Minimum mean square error (Weiner) Filtering,
30. Geometric mean filters.
31. Geometric mean filters.
32. Problems solving.

UNIT – IV

Period No. Topics

33. Morphological image processing: Preliminaries,
34. Erosion and dilation,
35. Erosion and dilation,
36. Opening and closing,
37. The hit or miss transformation,
38. Some basic morphological algorithms.
39. Image Segmentation,Fundaments,
40. Point, line, and edge Detection,
41. Thresholding.
42. Thresholding.

UNIT – V

Period No. Topics

43. Colour Image Processing: Colour fundamentals,
44. Colour models,
45. Pseudo colour Image processing,
46. Basics of full colour image processing,
47. Colour transformations.
48. Image Compression: Fundamentals,
49. Some basic Compression Methods,
50. Some basic Compression Methods,
51. Digital image water marking.
52. Problems solving.

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Describe the various steps in image processing. – L1 (Unit – I)	**L**										
02	Explain the use of filters for preprocessing. – L2 (Unit – II)	**H**	**M**	L								
03	Develop the suitable filters for image enhancement. – L5 (Unit – II)	**H**	**M**	**L**								
04	Discuss the methods for feature extraction and analysis. – L2 (Unit – III)	**H**	**L**									
05	Develop the algorithms for image segmentation and Morphological image processing. – L5 (Unit – IV)	**H**	**M**	L								
06	Apply the color image processing techniques. – L3 (Unit – V)	**H**	**L**	M								

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Describe the various steps in image processing. – L1 (Unit – I)	**1**										
02	Explain the use of filters for preprocessing. – L2 (Unit – II)	**3**	**2**	1								
03	Develop the suitable filters for image enhancement. – L5 (Unit – II)	**3**	**2**	**1**								
04	Discuss the methods for feature extraction and analysis. – L2 (Unit – III)	**3**	**1**									
05	Develop the algorithms for image segmentation and Morphological image processing. – L5 (Unit – IV)	**3**	**2**	**1**								
06	Apply the color image processing techniques. – L3 (Unit – V)	**3**	**1**	**3**								

1-Low, 2-Moderate, 3-High

Course Title : Digital design using Verilog HDL			
Course Code: P13EC65	**Semester : VI**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Explain the working knowledge of a broad variety of verilog based topic for global understating of verilog HDL based design.
2. Describe the practical design prospective of verilog HDL.
3. Explain the logical progression of verilog HDL based topics.
4. Explain the basics and some advanced topics such as PLI and logic synthesis.
5. Explain the small models and run simulation.
6. Discuss the advance concepts such as UDP, timing simulation PLI and logic synthesis.
7. Explain the concepts applicable to the design of FPGA, PAL buses, boards and system, as well as ASIC design.

Course Content

UNIT – I

Basic Concepts: Lexical Conventions, Data Types, System Tasks and Compiler Directives.
Modules and Ports: Module, Ports, Hierarchical Names.
Gate– Level Modeling: Gate Type, Gate Delays.
Dataflow Modeling: Continuous Assignments, Delays, Expressions, Operators and Operands, Operator Types, Examples.
Text: Chapters 3, 4, 5 and 6 **11 Hrs**

UNIT – II

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, Multi–way Branching, Loops, Sequential and Parallel Blocks, Generate Blocks, Examples.
Tasks and Functions: Difference between Tasks and Functions, Tasks, Functions.
Useful Modeling Techniques: Procedural Continuous Assignments, Overriding Parameters, Conditional Compilation and Execution, Time Scales, Useful System Tasks.
Text: Chapters 7, 8 and 9 **11 Hrs**

UNIT – III

Timing and Delays: Types of Delay Models, Path Delay Modeling, Timing Checks, Delay Back–Annotation.
Switch Level Modeling: Switching– Modeling Elements, Examples.
User– Defined Primitives: UDP basics, Combinational UDPs, Sequential UDPs, UDP Table Shorthand Symbols, Guidelines for UDP Design.
Text: Chapters 10, 11 and 12 **10 Hrs**

UNIT – IV

Programming Language Interface: Uses of PLI, Linking and Invocation of PLI Tasks, Internal Data Representation, PLI Library Routines.
Logic Synthesis with Verilog HDL: What Is Logic Synthesis? Impact of Logic Synthesis, Verilog HDL Synthesis, Synthesis Design Flow, Verification of the Gate– Level Netlist, Modeling Tips for Logic Synthesis.
Text: Chapters 13 and 14 (14.1 to 14.6) **10 Hrs**

UNIT – V

Contd: Example of Sequential Circuit Synthesis.
Advanced Verification Techniques: Traditional Verification Flow Assertion Checking Formal Verification.
Text: Chapters 14 (14.7 only) and 15 **10 Hrs**

TEXT BOOK:

"Verilog® HDL, A Guide to Digital Design and Synthesis", Samir Palnitkar Pearson Education, Second Edition.

REFERENCE BOOKS:

1. "Advanced digital design with the verilog HDL", Michael d ciletti, PHI
2. "A Verilog HDL Primer", J. Bhaskar, BS Publications
3. "Fundamentals of digital logic with verilog design", Stephen brown and Zvonko vranesic, TMH

Course Outcome

After learning all the units of the course, the student is able to

01 Explain the Lexical conventions for operator, Comments, Whitespace number strings and identifiers. – L1 (Unit – I)
02 Explain the behavioral modeling for sequential and combinational blocks. – L2 (Unit – II)
03 Explain the switch level modeling using MOS. – L2 (Unit – III)
04 Describe the UDP. – L1 (Unit – III)
05 Explain the typical design flow using logic synthesis. – L5 (Unit – IV)
06 Outline architectural modeling with high level verification. – L1 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT– I, the student is able to

01 Explain the Lexical Conventions used in Verilog. – L2
02 List the different Data Types used in verilog. – L1
03 Explain the System Tasks. – L2
04 List the different Compiler Directives used in verilog. – L1
05 Define the Modules Ports used in verilog. – L2
06 List the Hierarchical Names used in verilog. – L1
07 Discuss the Gate Types used in verilog. – L2
08 Discuss the Gate Delays used in verilog. – L2
09 Discuss the Operators and Operands used in verilog. – L2
10 Write the Operator Types Examples used in verilog. – L3

After learning all the topics of UNIT– II, the student is able to

01 Explain the Structured Procedures used in verilog. – L2
02 Describe the Procedural Assignments of verilog. – L2
03 Discuss the Timing Controls of verilog. – L2
04 List the Conditional Statements used in verilog. – L1
05 Explain the concept of Multi–way Branching Loops. – L2
06 Explain the Sequential and Parallel Blocks used in verilog. – L2
07 Explain the Generate Blocks used in verilog. – L2
08 List the Difference between Tasks and Functions. – L1
09 Write the Tasks Functions used in verilog. – L3
10 Explain the concept of Procedural Continuous Assignments. – L2
11 Discuss the Overriding Parameters used in verilog. – L2
12 Explain the Conditional Compilation and Execution Time Scales. – L2
13 Describe the Useful System Tasks. – L1

After learning all the topics of UNIT– III, the student is able to

01 List the different types of Delay Models. – L1
02 Write the Path Delay Modeling. – L3
03 Explain the concept of Timing Checks. – L2
04 Write the Delay Back–Annotation Switching– Modeling. – L3
05 Explain the UDP basics Combinational circuits. – L2
06 Explain the Sequential UDPs used in verilog. – L2
07 Write the UDP Table Shorthand Symbols. – L3
08 List the Guidelines for UDP Design. – L1
09 Write the switch level Verilog description of NAND gate. -L3
10 List the user defined primitive(UDP) rules.-L1

After learning all the topics of UNIT– IV, the student is able to

01 Explain the Uses of PLI Linking and Invocation of PLI Tasks Internal. – L2
02 Explain the Data Representation. PLI Library Routines. – L2
03 Discuss the Impact of Logic Synthesis. – L2
04 Write the Verilog HDL Synthesis program. – L3.
05 Explain the logic Synthesis Design Flow. – L2
06 Explain the Verification of the Gate– Level Netlist. – L2
07 Discuss the Modeling Tips for Logic Synthesis. – L2
08 List the uses of Programming Language Interface(PLI)-L1
09 Explain the basic computer aided logic synthesis process with flowchart. –L2
10 Explain the design partitioning with neat block diagram –L2

After learning all the topics of UNIT– V, the student is able to

01 Write the Example of Sequential Circuit Synthesis. – L3
02 Discuss the different Advanced Verification Techniques used in verilog. – L2
03 Explain the Traditional Verification Flow. – L2
04 Explain the Assertion Checking Formal Verification. – L2
05 Discuss the different ways to stimulate a design with neat diagram –L2
06 Explain the formal verification and sequential checking –L2
07 Discuss the hardware acceleration with flowchart –L2
08 Explain the equivalence checking with flowchart –L2

Review questions

01 Explain the Lexical Conventions used in Verilog. – L2
02 List the different Data Types used in verilog. – L1
03 Explain the System Tasks. – L2
04 List the different Compiler Directives used in verilog. – L1
05 Define the Modules Ports used in verilog. – L2
06 List the Hierarchical Names used in verilog. – L1
07 Discuss the Gate Types used in verilog. – L2
08 Discuss the Gate Delays used in verilog. – L2
09 Discuss the Operators and Operands used in verilog. – L2
10 Write the Operator Types Examples used in verilog. – L3
11 Explain the Structured Procedures used in verilog. – L2
12 Describe the Procedural Assignments of verilog. – L2
13 Discuss the Timing Controls of verilog. – L2
14 List the Conditional Statements used in verilog. – L1
15 Explain the concept of Multi–way Branching Loops. – L2

16 Explain the Sequential and Parallel Blocks used in verilog. – L2
17 Explain the Generate Blocks used in verilog. – L2
18 List the Difference between Tasks and Functions. – L1
19 Write the Tasks Functions used in verilog. – L3
20 Explain the concept of Procedural Continuous Assignments. – L2
21 Discuss the Overriding Parameters used in verilog. – L2
22 Explain the Conditional Compilation and Execution Time Scales. – L2
23 Describe the Useful System Tasks. – L1
24 List the different types of Delay Models. – L1
25 Write the Path Delay Modeling. – L3
26 Explain the concept of Timing Checks. – L2
27 Write the Delay Back–Annotation Switching– Modeling. – L3
28 Explain the UDP basics Combinational circuits. – L2
29 Explain the Sequential UDPs used in verilog. – L2
30 Write the UDP Table Shorthand Symbols. – L3
31 List the Guidelines for UDP Design. – L1
32 Explain the Uses of PLI Linking and Invocation of PLI Tasks Internal. – L2
33 Explain the Data Representation. PLI Library Routines. – L2
34 Discuss the Impact of Logic Synthesis. – L2
35 Write the Verilog HDL Synthesis program. – L3.
36 Explain the logic Synthesis Design Flow. – L2
37 Explain the Verification of the Gate– Level Netlist. – L2
38 Discuss the Modeling Tips for Logic Synthesis. – L2
39 Write the Example of Sequential Circuit Synthesis. – L3
40 Discuss the different Advanced Verification Techniques used in verilog. – L2
41 Explain the Traditional Verification Flow. – L2
42 Explain the Assertion Checking Formal Verification. – L2
43 Write the switch level Verilog description of NAND gate.
44 List the user defined primitive(UDP) rules.
45 List the uses of Programming Language Interface(PLI)-L1
46 Explain the basic computer aided logic synthesis process with flowchart. –L2
47 Explain the design partitioning with neat block diagram –L2
48 Discuss the hardware acceleration with flowchart –L2
49 Explain the equivalence checking with flowchart –L2
50 Explain the formal verification and sequential checking –L2

Lesson Plan

UNIT I

Period No.	**Topics**
1.	Basic Concepts : Lexical Conventions..
2.	Data Types
3.	System Tasks and Compiler Directives
4.	Modules and Ports :Modules, ports
5.	Hierarchical Names.
6.	Gate-Level Modeling. Gate Types. Operator Types. Examples.
7.	Gate Delays
8.	Dataflow Modeling. Continuous Assignments
9.	Expressions, Operators
10.	Expressions, Operators
11.	Examples

UNIT II

Period No.	Topics
1.	Behavioral Modeling: Structured Procedures.
2.	Procedural Assignments
3.	Timing Controls
4.	Conditional Statements
5.	Multiway Branching, Loops
6.	Sequential and Parallel Blocks
7.	Generate Blocks. Examples
8.	Tasks and Functions: Difference between Tasks and Functions. Tasks Functions
9.	Useful Modeling Techniques. Procedural Continuous Assignments
10.	Overriding Parameters, Conditional Compilation and Execution
11.	Time Scales, Useful System Tasks

UNIT III

Period No.	Topics
1.	Timing and Delays.: Types of Delay Models
2.	Path Delay Modeling
3.	Timing Checks, Delay Back-Annotation
4.	Switch Level Modeling
5.	Switching-Modeling Elements
6.	Examples.
7.	Examples.
8.	User-Defined Primitives: UDP basics. Combinational UDPs.
9.	Sequential UDPs. UDP Table Shorthand Symbols
10.	Guidelines for UDP Design

UNIT IV

Period No.	Topics
1.	Programming Language Interface.Uses of PLI
2.	Linking and Invocation of PLI Tasks,
3.	PLI Library Routines.
4.	Logic Synthesis with Verilog HD: What Is Logic Synthesis?
5.	Impact of Logic Synthesis
6.	Verilog HDL Synthesis
7.	Synthesis Design Flow
8.	Verification of the Gate-Level Netlist
9.	Modeling Tips for Logic Synthesis.
10.	Examples.

UNIT V

Period No.	Topics
1.	Advanced Verification Techniques: Example of Sequential Circuit Synthesis.
2.	Traditional Verification Flow
3.	Architectural Modeling
4.	Functional Verification Environment
5.	Simulation
6.	Analysis
7.	Assertion Checking
8.	Formal Verification
9.	Equivalence Checking
10.	Examples.

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to		Programme outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the Lexical conventions for operator, Comments, Whitespace number strings and identifiers. –(Unit – I)	L1	**L**	**M**									
02	Explain the behavioral modeling for sequential and combinational blocks. (Unit – II)	– L2	**M**	**H**									
03	Explain the switch level modeling using MOS. –(Unit – III)	L2	**M**		**H**								
04	Describe the UDP. – (Unit – III)	L1	**L**	**H**									
05	Explain the typical design flow using logic synthesis. –(Unit – IV)	L5	**M**	**H**									
06	Outline architectural modeling with high level verification. –(Unit – V)	L1	**L**	**M**	**H**								

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to		Programme outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Explain the Lexical conventions for operator, Comments, Whitespace number strings and identifiers. –(Unit – I)	L1	**1**	**2**									
02	Explain the behavioral modeling for sequential and combinational blocks. (Unit – II)	– L2	**2**	**3**									
03	Explain the switch level modeling using MOS. –(Unit – III)	L2	**2**		**3**								
04	Describe the UDP. – (Unit – III)	L1	**1**	**3**									
05	Explain the typical design flow using logic synthesis. –(Unit – IV)	L5	**2**	**3**									
06	Outline architectural modeling with high level verification. –(Unit – V)	L1	**1**	**2**	**3**								

1-Low, 2-Moderate, 3-High

Course Title : Programming in C++			
Course Code: P13EC661	**Semester : VI**	**L-T-P-H: 2 – 2 – 0-4**	**Credits: 3**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50% Marks**	

Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic knowledge of different data types used in C++.
2. Explain the various types of operators, conditional and control statements.
3. Explain different control statements.
4. Describe the Pre– processor Directives, Dynamic Memory Allocation, pointers, and functions.
5. Describe inline function and function overloading.
6. Discuss the class, objects, class constructor, class destructor, Class Object Arrays and Vectors.
7. Provide the understanding of the concepts like Base class, derived class, Inheritance, accesses specifier, and Class Scope under Inheritance.
8. Gain the knowledge Operator overloading, Operators new and delete.
9. Explain the concept of Exception Handling.
10. Describe the Virtual function, abstract class, friend function, friend class, static function, and the pointer.

Course Content

UNIT – I

The basic language: Literal Constant, Variables, Pointer Type, String Types, Const Qualifier, Reference Types, the bool type, Enumeration types, Array types, the vector container type.

Operators: Arithmetic Operators, Equality, Relational and Logical operators, Assignment operators, Increment and Decrement operator, the conditional Operator, the size of operator, bitwise operator, bitset operator.

Text 1: 3.1 to 3.10, 4.2 to 4.5, 4.7, 4.8, 4.11, 4.12 **11 Hrs**

UNIT – II

Statements: if, switch, for, while, do while, break, continue, go to statements, Pre–processor Directives, the Built–In Array Data Type, Dynamic Memory Allocation and Pointers.

Functions: Prototype, Argument passing, returning a value, Recursion.

Text 1:5.3 to 5.10, 1.3, 2.1, 2.2, 7.2 to 7.5 **10 Hrs**

UNIT – III

Inline function, function overloading, **Classes:** Definition, Class Objects, class member function, Class Initializations, Class constructor, the class destructor, Class Object Arrays and Vectors.

Text 1: 7.6, 9.1, 13.1 to 13.3; 14.1 to 14.4 **10 Hrs**

UNIT – IV

Base class and derived class, Multiple Inheritance, public, private & protected inheritance, Class scope Under Inheritance, Operator overloading, Operators ++ and – – , Operators new and delete.

Text 1: 18.2 to 18.4, 15.7, 15.8 **10 Hrs**

UNIT – V

Exception Handling: Throwing an Exception, the try block, catching an exception, Exception Specification. Virtual function, late binding, pure virtual function, abstract class, friend function, friend class, static function, the pointer.

Text 1: 11.1 to 11.4, Text 2: Ch 13 (According to above topics) **11 Hrs**

TEXT BOOKS:

1. "C++ Primer", S. B. Lippman & J. Lajoie, 3rd Edition, Pearson education.
2. "Object Oriented Programming in turbo C++", R. Lafore, Galgotia Publications Pvt. Ltd

REFERENCE BOOKS:

1. "Object oriented programming with C++", E Balagurusamy, and 4th Edition, Tata McGraw–Hill Publishing Company Limited.
2. "C++ Program Design", An Introduction to Programming and Object–Oriented Design. Cohoon and Davidson, 3rd Edition. TMH publication. 2004.

Course Outcome

After learning all the units of the course, the student is able to

01 Explain the primitive data type and variables– L2 (Unit – I)
02 Discuss the Array types and the vector container type with example. – L2 (Unit – I)
03 Explain the types of conditional and control statements, Pre–Processor Directives with example. – L2 (Unit – II)
04 Explain the inline function and function overloading with example & describe the class member function and Class Initializations. – L2 (Unit – III)
05 Differentiate the base class and derived class with example. – L2 (Unit – IV)
06 Explain how to throw an exception, exception specification, friend function, friend class, and static function – L2 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT – I, the student is able to

01 Explain the primitive data type and variables with example. – L2
02 Define pointer. Give examples.-L1
03 Describe the Constant Qualifier and Reference Types-L2,
04 Explain the bool type, and Enumeration types, with example. – L2
05 Explain the Array types and the vector container type, with example. – L2
06 Discuss the Arithmetic and Equality– L2
07 Explain Relational and Logical operators. – L2
08 Discuss the Assignment, Increment and Decrement operator. – L2
09 Discuss the conditional Operator and the size of operator. – L2
10 Explain Bitwise operator, and bit–set operator. – L2

After learning all the topics of UNIT – II, the student is able to

01 Explain the types of conditional with example. – L2
02 Explain the types of control statements, with example. – L2
03 Explain the Pre–processor Directives, with example. – L2
04 Describe Dynamic Memory Allocation. – L2
05 Discuss the Built–In Array Data Type,– L2
06 Discuss the Functions Prototype-L2
07 Identify types of Argument passing-L4

08 Explain how function returns a value – L2
09 Define recursive function. – L1
10 Distinguish functions and pre-processor directives-L2

After learning all the topics of UNIT – III, the student is able to
01 Explain the inline function and function overloading, with example. – L2
02 Define the Class and class object. – L1
03 Describe the Class member function and Class Initializations. – L2
04 Explain the Class constructor, and class destructor, with example. – L2
05 Explain the Class Object Arrays and Vectors, with example. – L2

After learning all the topics of UNIT – IV, the student is able to
01 Differentiate the base class and derived class, with example. – L2
02 Explain the concept of inheritance, its types and its accesses specifier, with example. – L2
03 Describe the Class scope Under Inheritance. – L2
04 Describe the operator ++ and – – overloading, with example. – L2
05 Describe the operator new and delete overloading, with example. – L2

After learning all the topics of UNIT – V, the student is able to
01 Define an exception. – L1
02 Explain how to throw an exception. – L2
03 Describe the try and catch block. – L2
04 Explain the exception specification. – L2
05 Compare the virtual function and pure virtual function. – L2
06 Describe the abstract class. – L2
07 Discuss the friend function. – L2
08 Explain friend class, and static function. – L2
09 Explain the late binding. – L2
10 Explain the pointer. – L2

Review Questions

1. Write a program to pass an array as an argument to a function that finds out the smallest of all the integer elements of that array
2. What is default argument? Give example.
3. What is function overloading? Give example.
4. Define class. With example example different access specifies used in C++
5. What are constructors and destructor? Give example. How are they differs with each other?
6. With example explain the following: i) default constructor ii) copy constructor.
7. Give example how to create an array of objects by using new and delete expression. With example explain array of class object and vectors
8. What is operator overloading? Explain.
9. Explain the primitive data type and variables with example
10. Define pointer. Give examples.
11. Describe the Constant Qualifier and Reference Types
12. Explain the bool type, and Enumeration types, with example.
13. Explain the Array types and the vector container type, with example.
14. Discuss the Arithmetic and Equality
15. Explain Relational and Logical operators.
16. Discuss the Assignment, Increment and Decrement operator.

17. Discuss the conditional Operator and the size of operator.
18. Explain Bitwise operator, and bit–set operator.
19. Explain the types of conditional with example.
20. Explain the types of control statements, with example.
21. Explain the Pre–processor Directives, with example.
22. Describe Dynamic Memory Allocation.
23. Discuss the Built–In Array Data Type,
24. Discuss the Functions Prototype
25. Identify types of Argument passing
26. Explain how function returns a value
27. Define recursive function.
28. Distinguish functions and pre-processor directives
29. Write a function to find the product of two integers.
30. Write a recursive function to find the factorial of a number.
31. Write a suitable program in C++ to overload operator ++ for both postfix and prefix.
32. Explain the inline function and function overloading, with example.
33. Define the Class and class object.
34. Describe the Class member function and Class Initializations.
35. Explain the Class constructor, and class destructor, with example.
36. Explain the Class Object Arrays and Vectors, with example.
37. Define an exception
38. Explain how to throw an exception.
39. Describe the try and catch block.
40. Explain the exception specification
41. Compare the virtual function and pure virtual function.
42. Describe the abstract class
43. Discuss the friend function.
44. Explain friend class, and static function.
45. Explain the late binding.
46. Explain the pointer.
47. Differentiate the base class and derived class, with example.
48. Explain the concept of inheritance, its types and its accesses specifier, with example
49. Describe the Class scope Under Inheritance.
50. Describe the operator ++ and – – overloading, with example.
51. Describe the operator new and delete overloading, with example.

Lesson Plan

UNIT 1

Period No.	**Topics**
1.	The basic language: Literal Constant
2.	Variables
3.	Pointer Type, String Types
4.	Const Qualifier
5.	Reference Types
6.	The bool type, Enumeration types, Array types, the vector container type.
7.	Operators: Arithmetic Operators, Equality
8.	Relational and Logical operators, Assignment operators
9.	Increment and Decrement operator
10.	The conditional Operator, the size of operator
11.	Bitwise operator, bitset operator

UNIT II

Period No.	Topics
1.	Statements: if, switch, for
2.	While, do while, break, continue
3.	Go to statements, Pre–processor Directives
4.	The Built–In Array Data Type
5.	Dynamic Memory Allocation
6.	Pointers.
7.	Functions: Prototype
8.	Argument passing
9.	Returning a value
10.	Recursion

UNIT III

Period No.	Topics
1.	Inline function
2.	Function overloading
3.	Function overloading
4.	Classes: Definition, Class Objects
5.	Class member function
6.	Class Initializations
7.	Class Initializations
8.	Class constructor
9.	The class destructor
10.	Class Object Arrays and Vectors.

UNIT IV

Period No.	Topics
1.	Base class and derived class
2.	Multiple Inheritance
3.	Multiple Inheritance
4.	Public, private & protected inheritance
5.	Public, private & protected inheritance
6.	Class scope Under Inheritance
7.	Class scope Under Inheritance
8.	Operator overloading
9.	Operators ++ and – –
10.	Operators new and delete.

UNIT V

Period No.	Topics
1.	Exception Handling: Throwing an Exception
2.	The try block
3.	Catching an exception
4.	Exception Specification.
5.	Virtual function
6.	Late binding
7.	Pure virtual function
8.	Abstract class
9.	Friend function
10.	Friend class
11.	Static function
12.	The pointer.

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Explain the primitive data type, variables and pointer. – L2 (Unit – I)	**L**	**L**	**M**								
02	Discuss the Array types and the vector container type with example. – L2 (Unit – I)	**L**	**M**	**L**								
03	Explain the types of conditional and control statements, Pre–Processor Directives with example. – L2 (Unit – II)	**M**	**L**									
04	Explain the inline function and function overloading with example. – L2 (Unit – III)	**L**	**L**	**M**								
05	Differentiate the base class and derived class with example. – L2 (Unit – IV)	**M**	**L**	**L**								
06	Explain how to throw an exception, exception specification, friend function, friend class, and static function – L2 (Unit – V)	**L**	**M**									

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Explain the primitive data type, variables and pointer. – L2 (Unit – I)	**1**	**1**	**2**								
02	Discuss the Array types and the vector container type with example. – L2 (Unit – I)	**1**	**2**	**1**								
03	Explain the types of conditional and control statements, Pre–Processor Directives with example. – L2 (Unit – II)	**2**	**1**									
04	Explain the inline function and function overloading with example. – L2 (Unit – III)	**1**	**1**	**2**								
05	Differentiate the base class and derived class with example. – L2 (Unit – IV)	**2**	**1**	**1**								
06	Explain how to throw an exception, exception specification, friend function, friend class, and static function – L2 (Unit – V)	**1**	**2**									

1-Low, 2-Moderate, 3-High

Course Title : Radar and Navigational Aids			
Course Code: P13EC662	**Semester : VI**	**L-T-P-H: 2 – 2 – 0-4**	**Credits:3**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

1. Understand the concepts of basics of radar and its applications
2. Derive the radar range equation
3. Discuss the introduction to MTI and pulsed Doppler radar
4. Discuss the digital MTI processing moving target detection and limitations to MTI
5. Explain the about pulsed Doppler radar
6. Understand the concepts of tracking with radar monopulse tracking, conical scan and sequential lobing
7. Explain the limitations to tracking accuracy, low angle tracking, tracking in range
8. Explain the matched filter receiver, detection criterion and detectors
9. Describe automatic detection, integrators constant and false alarm rate receiver
10. Understand the concepts of various Radar clutters
11. Discuss the reflector antennas, electronically steered phase array antennas
12. Describe the phase shifters and frequency scan arrays
13. Describe the architecture for phased arrays and mechanically steered planar array antennas
14. Explain the radiation pattern synthesis ,effect of errors on radiation patternsand low side lobe antennas
15. Understand the concept of radar noise figures, super heterodyne receiver, duplexer and receiver protectors, radar displays.

Course Content

UNIT – I

An Introduction to Radar: Basic Radar, Simple form of the Radar equation, Radar block diagram, Radar frequencies, Applications of radar. **The Radar equation:** Introduction, Detection of signals in noise, Receiver noise and signal to noise ratio, Probabilities of detection and false alarm, Radar cross section of targets, Radar cross section fluctuations. **MTI and Pulse Doppler Radar:** Introduction, Delay line cancellers, Staggered PRF's,

Text 1: 1.1 to 1.5, 2.1 to 2.3, 2.7, 2.8, 3.1, 3.2, 3.3, **10 Hours**

Unit-II

MTI and Pulse Doppler Radar: Doppler filter banks, Digital MTI processing, Moving target detection, Limitations to MTI performance MTI from a moving platform(AMTI),Pulse Doppler radar. **Tracking Radar:** Tracking with Radar, Monopulse tracking, Conical scan and sequential lobing, Limitations to tracking accuracy, Low angle tracking, Tracking in range

Text 1: 3.4 to 3.9,4.1 to 4.6 **11Hours**

Unit-III

Detection of Signals in Noise: Introduction, Matched filter receiver, Detection criteria, Detectors, Automatic detection, Integrators, Constant false alarm rate receivers. **Radar clutter:** Introduction to Radar clutter, surface clutter radar equation, land clutter, sea clutter, weather clutter, detection of targets in clutter

Text 1: 5.1 to 5.7, 7.1 to 7.4, 7.6, 7.7 **10 Hours**

Unit-IV

The Radar Antenna: Reflector antennas, Electronically steered phases array antennas, Phase shifters, frequency scan arrays, Architectures for phased arrays, Mechanically steered planar

array antennas, Radiation pattern synthesis, Effect of errors on radiation patterns, Low side lobe antennas. **Radar receiver:** Radar noise figures, Super-heterodyne receiver, Duplexers and receiver protectors, Radar displays.
Text 1: 9.4 to 9.7,9.9 to 9.13,11.1 to 11.5 **10Hours**

Unit-V

Radar transmitter: Introduction, linear beam power tubes, solid state RF power sources, cross field amplifiers. **Propogation of radar waves:** Introduction, Forward scattering from a flat earth,, Scattering from round earth's surface, Atmospheric refraction-standard propogation, non standard propagation,diffraction, attenuation by atmospheric gases, external or environmental noise
Text 1: 10.1 to 10.3, 10.5, 8.1 to 8.8 **11Hours**

Text Book:

1. Introduction to Radar Systems, Merill.I.Skolnik 3rdEdition. Tata McGRAW Hill,2001

Reference Book:

1. Elements of Electronic navigation, N.S.Nagaraj, 2nd Edition, Tata McGRAW Hill

RADAR Sytems and Radio aids to Navigations, Dr. A. K sen, A .B Bhattacharya

Lesson Plan

UNIT 1

Period No. Topics

1. An Introduction to Radar: Basic Radar
2. Simple form of the Radar equation, Radar block diagram
3. Radar Frequencies, Application of radar
4. The radar equation: Introduction
5. Detect of Signals in noise, Receiver noise and signal to noise ratio
6. Probabilities of detection and false alarm
7. Radar cross section of targets
8. Radar cross section fluctuations
9. MTI and Pulse Doppler Radar: Introduction
10. Delay line cancellers, Staggered PRF's

UNIT II

Period No. Topics

11. MTI and Pulse Doppler Radar: Doppler filter banks
12. Digital MTI processing
13. Moving target detection
14. Limitations to MTI performance MTI from a moving platform(AMTI)
15. Pulse Doppler radar.
16. Tracking Radar: Tracking with Radar
17. Monopulse tracking
18. Conical scan and sequential lobbing
19. Limitations to tracking accuracy
20. Low angle tracking
21. Tracking in range

UNIT III

Period No. Topics

22. Detection of Signals in Noise: Introduction
23. Matched filter receiver
24. Detection criteria
25. Detectors, Automatic detection
26. Integrators, Constant false alarm rate receivers.
27. Radar clutter: Introduction to Radar clutter
28. Surface clutter radar equation
29. Land clutter
30. Sea clutter, Weather clutter
31. Detection of targets in clutter

UNIT IV

Period No. Topics

32. The Radar Antenna: Reflector antennas
33. Electronically steered phases array antennas
34. Phase shifters, frequency scan arrays, Architectures for phased arrays
35. Mechanically steered planar array antennas
36. Radiation pattern synthesis
37. Effect of errors on radiation patterns
38. Low side lobe antennas.
39. Radar receiver: Radar noise figures
40. Super-heterodyne receiver
41. Duplexers and receiver protectors, Radar displays.

UNIT V

Period No. Topics

42. Radar transmitter: Introduction
43. Linear beam power tubes
44. Solid state RF power sources, cross field amplifiers.
45. Propagation of radar waves: Introduction
46. Forward scattering from a flat earth
47. Scattering from round earth's surface
48. Atmospheric refraction-standard propagation
49. Non standard propagation
50. Diffraction
51. Attenuation by atmospheric gases
52. External or environmental noise

Course Title : MULTICORE PROCESSING			
Course Code: P13EC663	**Semester : VI**	**L-T-P-H: 2– 2 – 0-4**	**Credits: 3**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives:

1. Discuss the types and significance of threads.
2. Explain the different concepts used in the implementation of parallel programming.
3. Highlight the features of threading API's for Microsoft Windows and WIN32/MFC.
4. Explain Intel Task queuing Execution model diagram.
5. Discuss the concepts involved in the solutions of Heavily Contended Locks.
6. Discuss the cache related issues with respect to parallel programming

Course Content

UNIT – I

Introduction to Multi– core Architecture: Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi–core Architectures from Hyper– Threading Technology, Multithreading on Single–Core versus Multi–Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law.

System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.

Text: Chapters 1 and 2 **11 Hrs**

UNIT – II

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, and Challenges You will Face, Parallel Programming Patterns.

A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm.

An Alternate Approach: Parallel Error Diffusion, Other Alternatives.

Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control–based Concepts, Fence, Barrier, Implementation dependent Threading Features.

Text: Chapters 3 and 4 **11 Hrs**

UNIT – III

Threading APIs: Threading APIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft Dot–NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.

Text: Chapter 5 **10 Hrs**

UNIT – IV

OpenMP: A Portable Solution for Threading Challenges in Threading a Loop, Loop–carried Dependence, Data– race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work–sharing Sections, Performance– oriented Programming, Using Barrier and No wait, Interleaving Single– thread and Multi– thread Execution, Data Copy–in and Copy–out,

Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance.
Text: Chapter 6 **10 Hrs**

UNIT – V

Solutions to Common Parallel Programming Problems: Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non–blocking Algorithms, ABA Problem, Cache Line Ping–ponging, Memory Reclamation Problem, Recommendations, Thread–safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache related Issues, False Sharing, Memory Consistency, Current IA– 32 Architecture, Itanium Architecture, High–level Languages, Avoiding Pipeline Stalls on IA–32, Data Organization for High Performance.
Text: Chapter 7 **10 Hrs**

TEXT BOOK:

"Multicore Programming", Increased Performance through Software Multi–threading by Shameem Akhter and Jason Roberts, Intel Press, 2006

REFERENCE BOOKS:

1. "Principles of Parallel Programming", Calvin Lin, Lawrence Snyder, Pearson Education, 2009. (Listed topics only from Chapters 1, 2, 3).
2. "Parallel Programming in C with MPI and OpenMP", Michael J. Quinn, Tata McGraw Hill, 2004. (Listed topics only from Chapters 3, 17).

Course Outcomes:

1. Discuss the types and their flow in execution environment of parallel processing.
2. Describe the types of decomposition and their implications.
3. Outline the steps of error diffusion algorithm.
4. Explain the creation, management and communication among the threads.
5. Differentiate between single thread and multi thread execution.
6. Distinguish between dead locks and live locks.

Course Title : CONTROL SYSTEMS			
Course Code: P13EC664	**Semester : VI**	**L-T-P-H: 2 – 2 – 0-4**	**Credits:3**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage : CIE:50% SEE:50%**	

Course Learning Objectives

This course aims to

1. Discuss the mathematical model of physical system, of physical system, mechanical system and analogous system.
2. Describe the transfer function, block diagram and signal flow graph of different system.
3. Explain the time response specifications, steady state error and error constants.
4. Provide the understanding of the concepts of stability and root locus.
5. Discuss the relative stability using nyquist criteria.
6. Gain the knowledge on the bode plots and its relative stability.
7. Discuss the concepts of state variables and state models for electrical system.

Course Content

UNIT – I

Modeling of Systems: The control system, Mathematical models of physical systems – Introduction, Differential equations of physical systems–Mechanical systems, Friction, Translational systems (Mechanical accelerometer, Levered systems excluded), Rotational systems, Gear trains, Electrical systems, Analogous systems

Text: 1.1, 2.1, 2.2, 2.7 **10 Hrs**

UNIT – II

Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra, Signal Flow graphs (State variable formulation excluded)

Time Response of feedback control systems: Standard test signals, Unit step response of First and second order systems, Time response specifications, and Time response specifications of second order systems, steady–state errors and error constants.

Text: 2.4, 2.5, 2.6, 2.7, 5.1, 5.2, 5.3, 5.4, 5.5 **10 Hrs**

UNIT – III

Stability analysis and Root–Locus Techniques: Concepts of stability, Necessary conditions for Stability, Routh–stability criterion, Relative stability analysis; more on the Routh stability criterion Introduction on route locus techniques, the root locus concepts Construction of root loci.

Text: 6.1, 6.2, 6.4, 6.5, 6.6, 7.1, 7.2, 7.3 **11 Hrs**

UNIT – IV

Stability in the frequency domain: Mathematical preliminaries, Nyquist Stability criterion, (Inverse polar plots excluded), Assessment of relative stability using Nyquist criterion, (Systems with transportation lag excluded).

Text: 9.1, 9.2, 9.3, 9.4 **10 Hrs**

UNIT – V

Introduction to State variable analysis and Frequency domain analysis: Concepts of state, state variable and state models for electrical systems, Solution of state equations. Introduction on frequency domain analysis, Correlation between time and frequency response, Bode plots, All pass and minimum phase systems, Experimental determination of transfer functions, Assessment of relative stability using Bode Plots.

Text: 8.1, 8.2, 8.4, 8.5, 8.6, 12.1, 12.2, 12.3, 12.6 **11 Hrs**

TEXT BOOK:

"Control Systems Engineering", I. J. Nagarath and M. Gopal, New Age International (P) Limited, Publishers, Fourth edition – 2005

REFERENCE BOOKS:

1. "Modern Control Engineering", K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002.
2. "Concepts of Control Systems", P. S. Satyanarayana, Dynaram publishers, Bangalore, 2001
3. "Control Systems, Principles and Design", M. Gopal, TMH, 1999
4. "Feedback control system analysis and synthesis", J. J. D'Azzo and C. H. Houpis; McGraw Hill, International student Edition.

Course Outcome

After learning all the units of the course, the student is able to

01 Describe the mathematical model of different systems. – L2 (Unit – I)
02 Solve the problems on mechanical system, electrical system & analogous system. – L3 (Unit – I)
03 Explain the block diagram algebra & signal flow graph. – L2 (Unit – II)
04 Discuss the standard test signals, step response and time response of second order system. – L2 (Unit – II)
05 Describe the steady state error& error constant. – L2 (Unit – II)
06 Explain the concepts of stability & Routh's criteria. – L2 (Unit – III)
07 Explain the concepts of root locus. – L2 (Unit – III)
08 Discuss the stability using Nyquist criteria. – L2 (Unit – IV)
09 Solve the problems on bode plots. – L3 (Unit – V)
10 Explain the concepts of state & state variables. – L2 (Unit – V)

Topic Learning Outcome

After learning all the topics of UNIT – I, the student is able to

01 Describe the mathematical model of physical systems. – L2
02 Describe the Differential equations for physical systems. – L2
03 Explain the concept of Rotational and Translational systems. – L2
04 Explain the concept of Gear trains.-L2
05 Compare Rotational, Translational and electrical systems.-L4

After learning all the topics of UNIT – II, the student is able to

01 Illustrate the transfer functions for different block diagrams. – L3
02 Analyze the concept of signal flow graphs. – L4
03 Describe the Block diagram algebra. – L2
04 Explain the unit step response of the signals. –L2
05 Explain the Time Response of feedback control systems for first and second order systems. – L2

After learning all the topics of UNIT – III, the student is able to

01 Explain the concept of Stability analysis. – **L2**
02 Analyze the Necessary conditions for Stability. – L4
03 Explain the Routh–stability criterion. – L2
04 Explain the concept of relative stability. –L2
05 Explain the concept on root locus techniques. – L2

After learning all the topics of UNIT – IV, the student is able to

01 Explain frequency domain approach.-L2
02 Illustrate the Stability in the frequency domain such as Nyquist criteria. – L3
03 Analyze the Nyquist Stability criterion. – L4
04 Define the Assessment of relative stability using Nyquist criterion. – L1
05 Discuss the steps to construct Nyquist plot.-L2

After learning all the topics of UNIT – V, the student is able to

01 Describe the Frequency domain analysis such as Bode plots and Correlation between time and frequency response. – L2
02 Analyze the concept of Bode plots. – L4
03 Analyze the relative stability using Bode Plots. – L4
04 Model the "on state variable analysis". – L4
05 Define the state variable and state models for electrical systems. – L1

Review Questions

01. Discuss Laplace transform and transfer function.
02. Solve problems on Transfer function.
03. Distinguish open loop systems and closed loop systems.
04. Describe the mathematical model of physical systems.
05. Describe the Differential equations for physical systems.
06. Explain the concept of Rotational and Translational systems.
07. Explain the concept of Gear trains.
08. Analyze the mechanical systems and electrical systems.
09. Analyze Force-voltage and Force current analogous networks.
10. Compare Rotational, Translational and electrical systems.
11. Illustrate the transfer functions for different block diagrams.
12. Analyze the concept of signal flow graphs.
13. Solve the problems on signal flow graphs.
14. Describe the Block diagram algebra.
15. Compare block diagram and signal flow graph methods.
16. Explain the Time Response of feedback control systems for first and second order systems.
17. Analyze the concept of Standard test signals.
18. Illustrate the Time response specifications.
19. Define the steady–state errors and error constants.
20. Compare standard test signals for type0, type1 & type2.
21. Explain the concept of Stability analysis.
22. Analyze the Necessary conditions for Stability.
23. Explain Hurwitz criterion.
24. Explain the Routh–stability criterion.
25. Analyze different cases of Routh-Hurwitz criterion.
26. Discuss the steps to construct root locus.
27. Explain the concept on root locus techniques.
28. Solve problems on root locus techniques.
29. Analyze Graphical method of determining 'K' in root locus.
30. Discuss addition of poles and zeroes in root locus method.
31. Explain frequency domain approach.
32. Explain concept of encirclement and mapping.

33. Illustrate the Stability in the frequency domain such as Nyquist criteria.
34. Analyze the Nyquist Stability criterion, (Inverse polar plots excluded).
35. Define the Assessment of relative stability using Nyquist criterion.
36. Discuss the steps to construct Nyquist plot.
37. Explain Co-relation between time domain and frequency domain for second order system.
38. Explain relation between Transfer function and Frequency Response.
39. Describe the Frequency domain analysis such as Bode plots and Correlation between time and frequency response.
40. Compare the time and frequency response.
41. Discuss the steps to sketch Bode plot.
42. Analyze the concept of Bode plots.
43. Analyze the relative stability using Bode Plots.
44. Model the "on state variable analysis".
45. Define the state variable and state models for electrical systems.
46. Solve the problems on state equations.
47. Calculate Transfer function from Magnitude plot.
48. Discuss minimum and non-minimum phase systems.
49. Analyze transfer function from state model.
50. Explain state diagram of standard state model.

Lesson Plan

UNIT – I

Period No.	Topics
01.	Modeling of Systems: The control system.
02.	Mathematical models of physical systems – Introduction.
03.	Differential equations of physical systems–Mechanical systems.
04.	Differential equations of physical systems–Mechanical systems.
05.	Friction.
06.	Translational systems (Mechanical accelerometer, Levered systems excluded).
07.	Rotational systems.
08.	Gear trains.
09.	Electrical systems.
10.	Analogous systems.

UNIT – II

Period No.	Topics
11.	Block diagrams and signal flow graphs: Transfer functions.
12.	Block diagram algebra.
13.	Signal Flow graphs (State variable formulation excluded).
14.	Signal Flow graphs.
15.	Time Response of feedback control systems**:** Standard test signals.
16.	Unit step response of First and second order systems.
17.	Unit step response of First and second order systems.
18.	Time response specifications.
19.	Time response specifications of second order systems.
20.	Steady–state errors and error constants.

UNIT – III

Period No. Topics

21. Stability analysis and Root–Locus Techniques: Concepts of stability.
22. Concepts of stability.
23. Necessary conditions for Stability.
24. Necessary conditions for Stability.
25. Routh–stability criterion.
26. Routh–stability criterion.
27. Relative stability analysis.
28. Relative stability analysis.
29. More on the Routh stability criterion Introduction on root locus techniques.
30. The root locus concepts Construction of root loci.
31. The root locus concepts Construction of root loci.

UNIT – IV

Period No. Topics

32. Stability in the frequency domain: Mathematical preliminaries.
33. Stability in the frequency domain: Mathematical preliminaries.
34. Mathematical preliminaries.
35. Nyquist Stability criterion, (Inverse polar plots excluded).
36. Nyquist Stability criterion, (Inverse polar plots excluded).
37. Nyquist Stability criterion, (Inverse polar plots excluded).
38. Assessment of relative stability using Nyquist criterion, (Systems with transportation lag excluded).
39. Assessment of relative stability using Nyquist criterion.
40. Assessment of relative stability using Nyquist criterion, (Systems with transportation lag excluded).
41. Assessment of relative stability using Nyquist criterion, (Systems with transportation lag excluded).

UNIT – V

Period No. Topics

42. Introduction to State variable analysis and Frequency domain analysis:
43. Concepts of state, state variable and state models for electrical systems.
44. Solution of state equations.
45. Introduction on frequency domain analysis.
46. Correlation between time and frequency response.
47. Correlation between time and frequency response.
48. Bode plots.
49. All pass and minimum phase systems.
50. Experimental determination of transfer functions.
51. Assessment of relative stability using Bode Plots.
52. Assessment of relative stability using Bode Plots.

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Describe the mathematical model of different systems. – L2 (Unit – I)	L	L	M								
02	Solve the problems on mechanical system, electrical system & analogous system. – L3 (Unit – I)	L	M	H								
03	Explain the block diagram algebra & signal flow graph. – L2 (Unit – II)	L	M	M								
04	Discuss the standard test signals, step response and time response of second order system. – L2 (Unit – II)	L	L	M								
05	Describe the steady state error& error constant. – L2 (Unit – II)	L	L	L								
06	Explain the concepts of stability & Routh'S criteria. – L2 (Unit – III)	L	M	H								
07	Explain the concepts of root locus. – L2 (Unit – III)	L	H	H								
08	Discuss the stability using Nyquist criteria. – L2 (Unit – IV)	L	M	M								
09	Solve the problems on bode plots. – L3 (Unit – V)	L	M	H								
10	Explain the concepts of state & state variables. – L2 (Unit – V)	L	L	M								

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After learning all the units of the course, the student is able to	Programme outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Describe the mathematical model of different systems. – L2 (Unit – I)	1	1	2								
02	Solve the problems on mechanical system, electrical system & analogous system. – L3 (Unit – I)	1	2	3								
03	Explain the block diagram algebra & signal flow graph. – L2 (Unit – II)	1	2	2								
04	Discuss the standard test signals, step response and time response of second order system. – L2 (Unit – II)	1	1	2								
05	Describe the steady state error& error constant. – L2 (Unit – II)	1	1	1								
06	Explain the concepts of stability & Routh'S criteria. – L2 (Unit – III)	1	2	3								
07	Explain the concepts of root locus. – L2 (Unit – III)	1	3	3								
08	Discuss the stability using Nyquist criteria. – L2 (Unit – IV)	1	2	2								
09	Solve the problems on bode plots. – L3 (Unit – V)	1	2	3								
10	Explain the concepts of state & state variables. – L2 (Unit – V)	1	1	2								

1-Low, 2-Moderate, 3-High

Course Title : VERILOG HDL LABORATORY			
Course Code: P13ECL67	**Semester : VI**	**L-T-P-H: 0 – 0 – 3-3**	**Credits:1.5**
Contact Period : Lecture :39 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic knowledge of how to use Xilinx tool and Model SIM.
2. Execute the Verilog code to realize all basic gates.
3. Execute the Verilog code for combinational logic circuit.
4. Execute the Verilog code to describe the functions of a Full Adder.
5. Develop the Verilog code model for 32 bit ALU using the schematic diagram.
6. Develop the Verilog code for the different flip–flops.
7. Design the different types of counter using Verilog Code.
8. Develop the Verilog code to interface seven segment display and LCD and accepting the hex key pad.
9. Develop the Verilog code to interface of DC and Stepper motor.
10. Develop the Verilog code to generate different waveforms using DAC.
11. Develop the Verilog code to simulate Elevator operations.
12. Develop the Verilog code to control external lights using relays.

Course Content

Note: Programming can be done using any compiler. Download the programs on a FPGA/CPLD boards such as Apex/ Acex/ Max/ Spartan/ Sinfi/ TK Base or equivalent and performance testing may be done using 32 channel pattern generator and logic analyzer apart from verification by simulation with tools such as Altera/ Modelsim or equivalent.

A. EXPERIMENTS: PROGRAMMING (Using Verilog only)

1. Demonstrate the Fundamental knowledge to use Xilinx tool and Model SIM.
2. Write VERILOG HDL code to realize all the logic gates.
3. Write a VERILOG HDL program for the following combinational designs

a. 2 to 4 decoder
b. 8 to 3 (encoder without priority & with priority)
c. 8 to 1 multiplexer
d. 4 bit binary to gray converter
e. Multiplexer, De –Multiplexer, comparator.

4. Write a VERILOG HDL code to describe the functions of a Full Adder Using three Modeling styles.
5. Write a model for 32 bit ALU using the schematic diagram shown below
   A (31:0), B (31:0), Out (31:0)
   ALU should use combinational logic to calculate an output based on the four bit op–code input.
   ALU should pass the result to the out bus when enable line in high, and tri–state the out bus when the enable line is low.
   ALU should decode the 4 bit op–code according to the given in example below.
   OPCODE ALU OPERATION
   A + B
   A – B
   A Complement

A * B
A AND B
A OR B
A NAND B
A XOR B

6. Develop the VERILOG HDL code for the following flip– flops, SR, D, JK and T.
7. Design 4 bit binary, BCD counters (Synchronous reset and Asynchronous reset) and "any sequence" counters.

B. EXPERIMENTS: INTERFACING

1. Write VERILOG HDL code to display messages on the given seven segment display and LCD and accepting Hex key pad input data.
2. Write VERILOG HDL code to control speed, direction of DC and Stepper motor.
3. Write VERILOG HDL code to accept 8 channel Analog signals, Temperature sensors and display the data on LCD panel or seven segment display.
4. Write VERILOG HDL code to generate different waveforms (Sine, Square, Triangle, Ramp etc.,) using DAC change the frequency and amplitude.
5. Write VERILOG HDL code to simulate Elevator operations.
6. Write VERILOG HDL code to control external lights using relays.

Course Outcome

After conducting all the experiments the student is able to

01 Demonstrate the Fundamental knowledge to use Xilinx tool and Model SIM –L3
02 Write the Verilog code for all basic gates. – L3
03 Write the Verilog code for combinational logic circuit. – L3
04 Write the Verilog code to describe the functions of a Full Adder Using three modeling styles. – L3
05 Design the model for 32 bit ALU using the schematic diagram to perform the arithmetic and logic operation using Verilog code. – L5
06 Analyze the waveforms of RS, JK, D, and T flip– flops. – L4
07 Design the synchronous and asynchronous counter using Verilog Code. – L5
08 Write the Verilog code to Interface seven segment display, LCD and Hex key pad to FPGA kit using Verilog code. – L3.
09 Write the Verilog code to Interface of DC and Stepper motor to FPGA kit using Verilog code to control its speed. – L3
10 Write the Verilog code to Interface DAC to FPGA kit using Verilog code to generate sine, square, triangle, and ramp waveforms. – L3
11 Write the Verilog code to simulate Elevator operations. – L3
12 Write the Verilog code to control external lights using relays. – L3

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to		Program outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Demonstrate the Fundamental knowledge to use Xilinx tool and Model SIM	L3	**M**	**M**									
02	Write the Verilog code for all basic gates. –	L3	**M**	**H**									
03	Write the Verilog code for combinational logic circuit.	L3	**M**	**H**									
04	Write the Verilog code to describe the functions of a Full Adder Using three modeling styles. –	L3	**M**	**H**									
05	Design the model for 32 bit ALU using the schematic diagram to perform the arithmetic and logic operation using Verilog code. –	L5	**L**	**M**	**H**								
06	Analyze the waveforms of RS, JK, D, and T flip– flops. –	L4	**L**	**M**	**H**								
07	Design the synchronous and asynchronous counter using Verilog Code. –	L5	**L**	**M**	**H**								
08	Write the Verilog code to Interface seven segment display, LCD and Hex key pad to FPGA kit using Verilog code. –	L3	**M**	**H**									
09	Write the Verilog code to Interface of DC and Stepper motor to FPGA kit using Verilog code to control its speed. –	L3	**M**	**H**									
10	Write the Verilog code to Interface DAC to FPGA kit using Verilog code to generate sine, square, triangle, and ramp waveforms. –	L3	**M**	**H**									
11	Write the Verilog code to simulate Elevator operations. –	L3	**M**	**H**									
12	Write the Verilog code to control external lights using relays. –	L3	**M**	**H**									

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to		Program outcome										
			a	b	c	d	e	f	g	h	i	j	k
01	Demonstrate the Fundamental knowledge to use Xilinx tool and Model SIM	L3	**2**	**2**									
02	Write the Verilog code for all basic gates.	L3	**2**	**3**									
03	Write the Verilog code for combinational logic circuit.	L3	**2**	**3**									
04	Write the Verilog code to describe the functions of a Full Adder Using three modeling styles. –	L3	**2**	**3**									
05	Design the model for 32 bit ALU using the schematic diagram to perform the arithmetic and logic operation using Verilog code. –	L5	**1**	**2**	**3**								
06	Analyze the waveforms of RS, JK, D, and T flip– flops. –	L4	**1**	**2**	**3**								
07	Design the synchronous and asynchronous counter using Verilog Code. –	L5	**1**	**2**	**3**								
08	Write the Verilog code to Interface seven segment display, LCD and Hex key pad to FPGA kit using Verilog code. –	L3	**2**	**3**									
09	Write the Verilog code to Interface of DC and Stepper motor to FPGA kit using Verilog code to control its speed. –	L3	**2**	**3**									
10	Write the Verilog code to Interface DAC to FPGA kit using Verilog code to generate sine, square, triangle, and ramp waveforms. –	L3	**2**	**3**									
11	Write the Verilog code to simulate Elevator operations. –	L3	**2**	**3**									
12	Write the Verilog code to control external lights using relays. –	L3	**2**	**3**									

1-Low, 2-Moderate, 3-High

Course Title : DIGITAL COMMUNICATION AND MICROWAVE LABORATORY			
Course Code: P13ECL68	**Semester : VI**	**L-T-P-H: 0 – 0 – 3-3**	**Credits:1.5**
Contact Period : Lecture :39 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic practical knowledge of digital modulation, demodulation, microwave, micro–strip–line applications.
2. Know the working of ASK, FSK, PSK, DPSK, QPSK Generation and its detection.
3. Analyze the working o TDM with pulse amplitude modulation and demodulation.
4. Demonstrate the Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench using klystron/ Gunn oscillator as source.
5. Analyze the coupling and isolation characteristics of a micro–strip–line directional coupler.

Course Content

1. ASK , FSK and PSK, and generation and detection of two band limited signals.
2. DPSK generation and detection
3. QPSK generation and detection
4. TDM with pulse amplitude modulation and demodulation (Exp. 1–3 using kit version).
5. Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench
6. Measurement of VSWR, Isolation and coupling factor of Magic Tee.
7. Measurement of directivity of micro–strip Yagi antenna (printed- E – Plane and H-Plane).
8. Measurement of gain of micro–strip Yagi antenna (printed- E – Plane and H-Plane).
9. Determination of coupling and isolation characteristics of a micro–strip directional coupler.
10. Measurement of resonance characteristics of a micro– strip ring resonator and determination of dielectric constant of the substrate.
11. Measurement of power division and isolation characteristics of a micro–strip 3 dB power divider.
12. To simulate QPSK transmitter and receiver taking into account the phase and the frequency offset. (Using WICOMM–T Kit).
13. To understand the basic aspects of DS–CDMA in single user case and two user case. (Using WICOMM–T Kit).

REFERENCE BOOK:

"Advanced Digital Communication Laboratory Manual", Preetha Sharan, R Bhargava Rama Gowd, CBS Publishers & Distributors Pvt.Ltd., First Edition, 2013.

Course Outcome

After conducting all the experiments the student is able to

1. Demonstrate the working of ASK, FSK, PSK, DPSK, QPSK Generation & its detection.-L3
2. Demonstrate the working o TDM with pulse amplitude modulation and de–modulation.- L3
3. Demonstrate the Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench using klystron/Gunn oscillator as source. – L3
4. Demonstrate the coupling and isolation characteristics of a micro–strip directional coupler. - L3
5. Test the QPSK transmitter and receiver taking into account the phase and the frequency offset. – L4
6. Test the basic aspects of DS–CDMA in single user case and two user case. – L4

Course Articulation Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to	Program outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Demonstrate the working of ASK, FSK, PSK, DPSK, QPSK Generation & its detection. – L3	H	L									
02	Demonstrate the working o TDM with pulse amplitude modulation and de–modulation. – L3	H	M									
03	Demonstrate the Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench using klystron/Gunn oscillator as source. – L3	H	M									
04	Demonstrate the coupling and isolation characteristics of a micro–strip directional coupler. – L3	H	M									
05	Test the QPSK transmitter and receiver taking into account the phase and the frequency offset. – L4	H	M	L								
06	Test the basic aspects of DS–CDMA in single user case and two user case. – L4	M	L									

L-Low, M-Moderate, H-High

Course Assessment Matrix (CAM)

Sl. No	Course Learning Outcome – CLO After conducting all the experiments, the student is able to	Program outcome										
		a	b	c	d	e	f	g	h	i	j	k
01	Demonstrate the working of ASK, FSK, PSK, DPSK, QPSK Generation & its detection. – L3	3	1									
02	Demonstrate the working o TDM with pulse amplitude modulation and de–modulation. – L3	3	2									
03	Demonstrate the Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench using klystron/Gunn oscillator as source. – L3	3	2									
04	Demonstrate the coupling and isolation characteristics of a micro–strip directional coupler. – L3	3	2									
05	Test the QPSK transmitter and receiver taking into account the phase and the frequency offset. – L4	3	2	1								
06	Test the basic aspects of DS–CDMA in single user case and two user case. – L4	2	1									

1-Low, 2-Moderate, 3-High

********** **THE END** **********