SYLLABUS

(With effect from 2017-18)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2017–18)

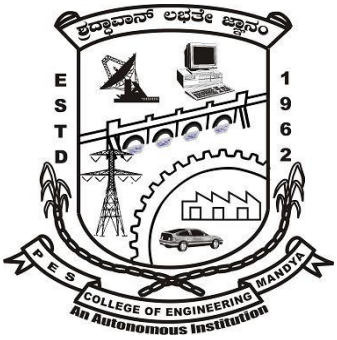
V & VI Semester

Bachelor Degree

in

Electronics and Communication Engineering

Out Come Based Education with Choice Based Credit System



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 CBCS based 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.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of the academic year 2015-16. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction are included in all undergraduate programs.

Dr. Umesh D R
Deputy Dean (Academic)
Associate Professor,
Dept. of CS &Engg

Dr. Nagarathna
Dean (Academic)
Professor
Dept. of CS & Engg

PES College of Engineering

VISION

PESCE shall be a leading institution imparting quality engineering and management education, developing creative and socially responsible professionals

MISSION

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching -learning practices
- Impart engineering and managerial skills through competent and committed faculty using Outcome Based Educational curriculum
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs
- Promote research, product development and industry-institution interaction.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

The department of Electronics and Communication Engineering was incepted in the year 1967 with an undergraduate program in Electronics and Communication Engineering. Initially program had an intake of 60 students and presently 150 students graduate every year. The long journey of 50 years has seen satisfactory contributions to the society, nation and world. The alumni of this department has strong global presence making their alma mater proud in every sector they represent.

Department has started its PG program in the year 2012 in the specialization of VLSI design and Embedded systems. Equipped with qualified and dedicated faculty department has focus on VLSI design, Embedded systems and Image processing. The quality of teaching and training has yielded high growth rate of placement at various organizations. Large number of candidates pursuing research programs (M.Sc/Ph D) is a true testimonial to the research potential of the department.

VISION

The department of E & C would Endeavour to create a pool of Engineers who would be extremely competent technically, ethically strong also fulfill their obligation in terms of social responsibility.

MISSION

- **M1:** Adopt the best pedagogical methods and provide the best facility, infrastructure and an ambience conducive to imbibe technical knowledge and practicing ethics.
- **M2:** Group and individual exercises to inculcate habit of analytical and strategic thinking to help the students to develop creative thinking and instil team skills

- **M3:** MoUs and Sponsored projects with industry and R & D organizations for collaborative learning
- **M4:** Enabling and encouraging students for continuing education and moulding them for life-long learning process

Programme Education Objectives (PEOs)

PEO1: Graduates to exhibit knowledge in mathematics, engineering fundamentals applied to Electronics and Communication Engineering for professional achievement in industry, research and academia

PEO2: Graduates to identify, analyse and apply engineering concepts for design of Electronics and Communication Engineering systems and demonstrate multidisciplinary expertise to handle societal needs and meet contemporary requirements

PEO3: Graduates to perform with leadership qualities, team spirit, management skills, attitude and ethics need for successful career, sustained learning and entrepreneurship.

Programme Specific Outcomes (PSOs)

Program Specific Outcomes of bachelor degree (B.E, E&C) program are defined as follows which are in line with the Program specific criteria (PSC) as defined by IEEE.

After the graduation, the student will have:

- An ability to **understand the basic concepts** in Electronics & Communication Engineering and to **apply them in the design and implementation** of Electronics and communication systems.
- An ability to **solve complex problems** in Electronics and Communication Engineering, using latest **hardware and software tools,** along with **analytical skills** to arrive at appropriate solutions.

SCHEME OF TEACHING AND EXAMINATION
V Semester B.E. (ECE)

Sl. No.	Course Code	Course Title	Teaching Dept.	Hrs/Week L:T:P:H	Total Credit	Examination Marks		
						CIE	SEE	Total
1.	P17EC51	Optical Communication Systems(CC-1)	ECE	4:0:0:4	4	50	50	100
2.	P17EC52	Digital CMOS VLSI Design (CC-2)	ECE	4:0:0:4	4	50	50	100
3.	P17EC53	Information Theory and Coding (CC-3)	ECE	4:0:0:4	4	50	50	100
4.	P17EC54	Fundamentals of Wireless Communication (FC-1)	ECE	4:0:0:4	4	50	50	100
5.	P17EC55X	Foundation Elective	ECE	4:0:0:4	3	50	50	100
6.	P17EC56X	Elective-I	ECE	4:0:0:4	3	50	50	100
7.	P17ECL57	Digital Signal Processing Laboratory	ECE	0:0:3:3	1.5	50	50	100
8.	P17ECL58	Optical and Analog Communication laboratory	ECE	0:0:3:3	1.5	50	50	100
9.	P17EC59	Industry Visit & Interaction	ECE	0:0:2:2	1	50	--	50
10.	P17HU510	Aptitude and Reasoning Development – Advanced. (ARDA)	HS&M	2:0:0:2	1	50	50	100
Total					27	500	450	950

List of Electives

Foundation Elective			Elective - 1		
Sl. No	Course Code	Course Title	Sl. No.	Course Code	Course Title
1.	P17EC551	Innovation , Entrepreneurship and Management	1.	P17EC561	DSP Processor and Applications
2.	P17EC552	E-waste Management	2.	P17EC562	Operating Systems
3.	P17EC553	Professional Ethics and Behavioural Skills	3.	P17EC563	ARM processor and Programming
4.	P17EC554	Green Computing	4.	P17EC564	Object Oriented Programming in C++

SCHEME OF TEACHING AND EXAMINATION
VI Semester B.E. (ECE)

Sl. No	Course Code	Course Title	Teaching Dept.	Hrs/Week L:T:P:H	Total Credit	Examination Marks		
						CIE	SEE	Total
1.	P17EC61	Embedded Systems (CC-1)	ECE	4:0:0:4	4	50	50	100
2.	P17EC62	Computer Communication Networks (CC-2)	ECE	4:0:0:4	4	50	50	100
3.	P17EC63	Microwaves and Antennas(CC-3)	ECE	4:0:0:4	4	50	50	100
4.	P17EC64	Control Systems (FC-2)	ECE	4:0:0:4	4	50	50	100
5.	P17EC65	Elective-II	ECE	4:0:0:4	3	50	50	100
6.	P17EC66	Elective-III	ECE	4:0:0:4	3	50	50	100
7.	P17ECL67	Circuit Simulation Laboratory	ECE	0:0:3:3	1.5	50	50	100
8.	P17EC68	Microwave and Digital Communication Laboratory	ECE	0:0:3:3	1.5	50	50	100
9.	P17EC69	Mini Project	ECE	0:0:2:2	1	50	--	50
10.	P17EC610	Aptitude and Reasoning Development – EXPERT (ARDE)	HS&M	2:0:0:2	1	50	50	100
Total					27	500	450	950

List of Electives

Elective-II			Elective - III		
Sl. No	Course Code	Course title	Sl. No.	Course Code	Course title
1.	P17EC651	Multimedia Communication	1.	P17EC661	Radar and Navigational Systems
2.	P17EC652	Cognitive Radio Networks	2.	P17EC662	Error Control Coding
3.	P17EC653	Adaptive Signal Processing	3.	P17EC663	Computer Organization
4.	P17EC654	Data Structures	4.	P17EC664	VLSI Testing and Verification

Course Title: Optical Communication Systems			
Course Code: P17EC51	**Semester : V**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. 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.

B. Course Content

UNIT – I

Optical Fibers: Structures, Wave guiding, and Fabrication, 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 1: 2.2 to 2.9, 3.1 to 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 1: 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 1: 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 1: 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 1 : 11.1 to 11.3, 13.1 to 13.7 **11 Hrs**

Self Learning Components:

- Study of practical Fiber optic cables, optical fiber connectors
- Comparison of photo detectors
- Study of Active optical components, Raman amplifiers.

TEXT BOOK:

1. "**Optical Fiber Communications**", Gerd Keiser, McGraw Hill, 5th Edition–2013,ISBN 13: 978-1-25-900687-6, ISBN 10: 1-25-900687-5

REFERENCE BOOKS:

1. "**Optical Fiber Communications**", John M. Senior, Pearson Education 3rd Edition-2013, ISBN- 978-81-317-3266-3
2. "**Fiber Optic Communication**", Joseph C. Palais, Pearson Education, 5th Edition-2005 ISBN-978-81-317-1791-2
3. "**Optical Communication Systems**", Satinder Bal Gupta, Ashish Goel, University Science Press, New Delhi 2nd Edition-2013
4. "**Fiber Optic Communication System**", Govind P Agarwal, Wiley, 3rd Edition-2013 ISBN-978-81-265-1386-4

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of physics to explain basic optical laws , various optoelectronic devices and its structures	PO1(L3)
CO2	**Analyze** the causes for different losses in an optical communication link	PO2(L4)
CO3	**Develop** a solution for optical communication systems for specified characteristics	PO2(L4), PO3(L4)
CO4	**Examine** the methods to improve coupling efficiency and signal to noise ratio of the communication system	PO1,PO2(L3)
CO5	**Inspect** optical devices and circuits for different applications	PO2(L 4)

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
#1	**3**												**3**	
#2		**2**												**2**
#3		**2**	**2**											**2**
#4	**2**	**3**											**2**	**3**
#5		**3**												**3**

Course Title : Digital CMOS VLSI Design			
Course Code: P17EC52	**Semester : V**	**L-T-P-H: 4 – 0 – 0-4**	**Credits:4**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. 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, BICMOS 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. Provide the knowledge of I/O circuits, clock generation and distribution circuits which are essential in VLSI design chip.
7. Able to understand IC fabrication process and familiarise the skills of modeling and simulation of MOS Transistor Logic.

B. 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 Capacitance

Text 1:– 3.1 to 3.6. **10 Hrs**

UNIT – II

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

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

Text 1:–5.1, 5.3, 5.4 and 6.1, 6.2,6.3,6.5,6.6, 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 1:– 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

Text1:– 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
Text1: – 12.1 to 12.6, 13.1 to 13.6 **11 Hrs**

Self Learning Component
Introduction to IC technology, IC Era, Metal Oxide Semiconductor (MOS) and Related VLSI Technology, Basic MOS Transistors, Enhancement Mode Transistor Action, Depletion Mode Transistor Action, nMOS Fabrication, CMOS Fabrication.
Text 2:- 1.1 to 1.8.
Modeling of MOS Transistor using SPICE
Knowing about MODEL statement in SPICE, Plotting O/P characteristics of N-MOS and P-MOS transistors and C-MOS inverter using, LEVEL-1 and LEVEL-2 model in SPICE and Scilab/Math lab.
Text1: – Chapter 4
TEXT BOOKS:
1. "**CMOS Digital Integrated Circuits Analysis and Design**", Sung – Mo Kang, Yusuf Leblebici, Third Edition, Tata McGraw-HillISBN: 9780070530775.
2. "**Basic VLSI Design**", Douglas A. Pucknell, Kamran Eshraghian, 3rd Edition 2006. ISBN-9788120309869

REFERENCE BOOKS:
1. "**Introduction to VLSI Circuits and systems**", John.P. Uyemura, John Wiley, 3rd edition 2002. ISBN-9788126509157
2. "**Principles of CMOS VLSI Design**", Neil. H. E. Weste, Kamran Eshraghian, 2nd edition. ISBN-8178082225

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To **apply** the basic knowledge of Physics and mathematics to understand the MOS and BJT characteristics and derive different current equations of MOS circuits and delays of CMOS inverter circuits	PO1(L3)
CO2	To **analyze** the MOS, BiCMOS inverters and combinational, sequential and dynamic designs based on these devices.	PO2 (L4)
CO3	To **design** combinational, sequential and Dynamic circuits based on CMOS& BiCMOS inverters for the given specifications.	PO3(L5)
CO4	To **Discuss** various issues related to clocking, I/O and protection in MOS and BiCMOS circuits	PO1(L4)
CO5	Work in groups to model transistors and its circuits learning new tools	PO5,PO9,PO12

D. Course Articulation Matrix

CO #	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
1	**3**												**3**	
2		**3**												**3**
3		**2**	**2**										**2**	**2**
4	**2**												**2**	
5					**2**				**1**			**1**		

Course Title : Information Theory Coding			
Course Code: P17EC53	**Semester : V**	**L-T-P: 4– 0 - 0**	**Credits: 04**
Contact Period : Lecture :52 Hrs, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Provide the knowledge of probability, 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 codes, cyclic codes and BCH codes.
5. Explain the encoding and decoding of convolution codes, concept of trellis coded modulation and concepts of cryptography.

B. Course Content

UNIT – I

Introduction to Probability Theory: Mathematical Models as Tools in Analysis and Design, Deterministic Models, Probability Models , a Detailed Example: A Packet Voice Transmission System, Other Examples. Basic Concepts of Probability Theory: Specifying Random Experiments, The Axioms of Probability, Computing Probabilities Using Counting Methods, Conditional Probability, Independence of Events, Sequential Experiments.

Text 1:1.1-1.6, 2.1-2.6 **11 Hrs**

UNIT – II

Source Coding and Channel Capacity:

Source Coding: Introduction to Information Theory, Uncertainty and information, Average Mutual Information and Entropy, Information Measures for Continuous Random Variables, Source Coding Theorem, Huffman Coding, Shannon-Fano-Elias Coding, Arithmetic Coding, The Lempel-Ziv Algorithm. Channel Capacity: Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, The Shannon Limit.

Text 2: 1.1-1.9 , 2.1-2.6 **10 Hrs**

UNIT – III

Error Control Coding:

Linear Block Codes: Introduction to Error Correcting Codes, Basic Definitions, Matrix Description of Linear Block Codes, Equivalent Codes, Parity Check Matrix, Decoding of a Linear Block Code, Syndrome Decoding, Error Probability after Coding (Probability of Error Correction), Perfect Codes, Hamming Codes, Low Density Parity Check (LDPC) Codes, Optimal Linear Codes, Maximum Distance Separable (MDS) Codes, Bounds on Minimum Distance

Cyclic Codes: Introduction to Cyclic Codes, Polynomials, The Division Algorithm for Polynomials, A Methods for Generating Cyclic Codes, Matrix Description of Cyclic Codes, Burst Error Correction, Fire Codes, Golay Codes, Cyclic Redundancy Check (CRC) Codes.

Text 2:3.1-3.14,4.1-4.10 **10 Hrs**

UNIT – IV

BCH Codes and Convolution Codes:

Bose-Chaudhuri Hocquenghem (BCH) Codes : Introduction to BCH C odes, Primitive Elements, Minimal Polynomials, Generator Polynomials in Terms of Minimal Polynomials, Some Examples of BCH Codes, Decoding of BCH Codes, Reed-Solomon Codes, Implementation of Reed-Solomon Encoders and Decoders, Performance of RS C odes Over Real Channels, Nested Codes.

Convolutional Codes: Introduction to Convolutional 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, Distance Bounds for Convolutional Codes, Performance Bounds, And Known Good Convolutional Codes.

Text 2: 5.1-5.10, 6.1-6.10 **10 Hrs**

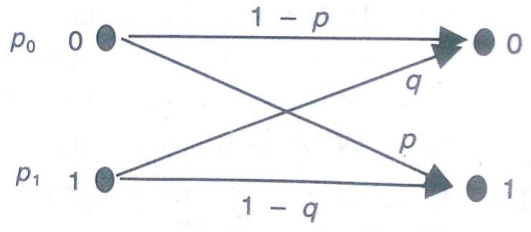
UNIT – V

TCM and Cryptography:
Introduction to TCM, The Concept of Coded Modulation, Mapping by Set Partitioning, Ungerboeck's TCM Design Rules, TCM Decoder, Performance Evaluation for AWGN Channel, Computation of d_{free}.
Introduction to Cryptography: An Overview of Encryption techniques, Operation Used by Encryption Algorithms, Symmetric (Secret Key) Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC Ciphers, Asymmetric (Public-Key) Algorithms, The RSA Algorithm.
Text 2: 7.1-7.7, 8.1-8.9 **11 Hrs**

Self Learning Components:

1. Discuss how to reduce the size of a repeating string of characters using RLE and PCX format.
2. Consider the binary channel shown in figure below. Let the a priori probabilities of sending the binary symbol be P_0 and P_1, where $P_0 + P_1 = 1$. Find the a posteriori probabilities.

P(X=0 | Y=0) and P(X=1 | Y=1)



3. Study the circuit implementation of Cyclic Codes.
4. Discuss Turbo coding and decoding techniques.
5. Consider a fully connected network consisting of n nodes. How many keys have to be generated for the entire network if all nodes are required to communicate with each other using i) Secret key encryption. ii) Public key encryption.

TEXT BOOK:
1. "**Probability, Statistics, Random processes for Electrical engineering**", Alberto Leon Garcia, 3rd edition, Pearson. ISBN : 978-0-13-147122-1
2. "**Information Theory, Coding and Cryptography**", Ranjan Bose, 2nd Edition. Tata McGraw.ISBN : 978-0-07-0669017

REFERENCE BOOKS:
1. "**Digital Communication systems**", Simon Haykin, John Wiley, 4th Ed.
2. "**Digital and analog communication systems**", K. Sam Shanmugam, John Wiley & Sons.
Hill– 2008
3. "**Error Control Coding**",Shu Lin, Daniel J. Costello, Jr., 2nd Edition, Pearson.
4. "**Probability, Random variables and random signal principles**",Peyton Z.Peebles,Jr., 2nd edition, McGraw hill.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply knowledge of mathematics to understand concepts of Probability, Information theory, communication channel, source codes and cryptography.	PO1[3]
CO2	Analyze different source codes for its efficiency used with communication channels.	PO2[L4]
CO3	Design coding schemes for a given specifications and evaluate for their error correcting capability.	PO3[L4]
CO4	Discuss different lossy / lossless data compression schemes and analyze various decoding schemes for reconstruction of transmitted data.	PO2 [L4]
CO5	Discuss various cryptography algorithms for secured communication.	PO2 [L4]

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO12	PSO1	PSO2
#1	**3**												**3**	
#2		**3**											**2**	**3**
#3			**2**										**2**	**2**
#4		**2**											**2**	**2**
#5		**2**											**2**	**2**

Foundation Course-I

Course Title : Fundamentals of Wireless Communication			
Course Code: P17EC54	**Semester : V**	**L-T-P: 4– 0 - 0**	**Credits: 04**
Contact Period : Lecture :52 Hrs, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Understand the evolution and various modern wireless communication systems.
2. Discuss the concept of cellular architecture.
3. Describe the system design fundamentals to improve channel capacity
4. Discuss and analyse different multiple access techniques.
5. Describe different wireless systems and standards.

B. Course Content

UNIT-I

Introduction to Wireless Communication Systems and Wireless Networks: Evolution of Mobile Radio Communications, Mobile Radiotelephony in the U.S, Mobile Radio Systems around the world, Examples of Wireless Communication Systems, Trends in cellular radio and Personal communications. Introduction to Wireless Networks, Differences Between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Fixed Network Transmission Hierarchy.

Text 1: 1.1-1.5 and 10.1-10.4 **10 Hrs**

UNIT-II

The Cellular Concept- System Design Fundamentals: Introduction, Frequency Reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trunking and Grade of service, Improving coverage and capacity in cellular systems.

Text 1: 3.1-3.7 **10 Hrs**

UNIT-III

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The 3 Basic Propagation Models, Reflection, Ground Reflection, **Mobile Radio Propagation: Small-Scale Fading and Multipath:** Small-Scale Multipath Propagation, Types of Small-Scale Fading.

Text 1: 4.1-4.6 and5.1,5.5 **11 Hrs**

UNIT-IV

Wireless Systems and Standards: Global System for Mobile (GSM), CDMA Digital Cellular Standard (IS-95),

Text 1: 11.3-11.11 **10 Hrs**

UNIT-V

Wireless Networking: Traffic Routing in Wireless Networks. Wireless Data Services, Common Channel Signaling (CCS), Integrated Services Digital Network (ISDN), Signaling System No. 7 (SS7), An Example of SS7 Ñ Global Cellular Network Interoperability, Personal Communication Services/Networks (PCS/PCNs), Protocols for Network Access, Network Databases, Universal Mobile Telecommunication System (UMTS).

Text 1:10.5-10.14 **11 Hrs**

TEXT BOOK:

1. Theodre. S. Rappaport **"Wireless Communications- Principles and Practice"**, Pearson, 2nd Edition, 2010. **ISBN-13:** 9788131731864.

REFERENCE BOOKS:

1. William. C. Y. Lee **"Wireless and Cellular Communications",** Mc-Graw Hill, 2005. **ISBN:**978-00-714-3686-1.
2. Gary. J. Mullet **"Introduction to Wireless Telecommunications Systems and Networks"**, Cengage Learning, 2010. ISBN-13: 978-81-315-0559-5.
3. Ozan. K. Tonguz, Giianluigi Ferrari **"Ad-HOC Wireless Networks: A Communication-Theoretic Perspective"**, Wiley India Edition, 2009, **ISBN:** 9788126523047.

Self Learning Components:

1. Study of modern wireless communications networks available to the user around the world, list out their services and type of technologies used
2. Discuss 4G and 5G mobile standards.
3. Discuss current capacity enhancement techniques.
4. Study of Smart Wireless Communication Technology.

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply signal processing for wireless communication system to understand basic principles of wireless communication.	PO1, L2
CO2	Analyze various methodologies to improve the cellular capacity.	PO2, L3
CO3	Apply communication system to interpret multiple access techniques and interference reduction techniques in wireless mobile communication	PO1, L2
CO4	Apply fundamentals of cellular communication system to understand handoff, roaming strategies and various wireless systems and standards	PO1, L3
CO5	Design a cellular system for various parameters like capacity, interference, handoff etc.	PO3, L4

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**												**3**	
#2		**3**												**3**
#3	**2**												**2**	
#4	**2**												**2**	
#5			**2**											

Foundation Electives

Course Title: Innovation, Entrepreneurship and Management			
Course Code: P17EC551	**Semester : V**	**L-T-P: 4– 0 – 0-4**	**Credits: 03**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives (CLO'S)

This course aims to

1. Understand the Classification of research, innovation and creativity.
2. Understand the role and importance of innovation in economic growth, skills of innovator, types of innovation and output forms of innovation.
3. Understand various ways to create and manage intellectual property and prepare innovation proposal.
4. Understand fundamental concepts and principles of management, including the basic roles, skill, and functions of management.
5. Understand the entrepreneurial process and recognize the core role of creativity and innovation in managing the entrepreneurial process effectively.
6. Understand comprehensive Entrepreneurship Development process.

B. Course Content

UNIT- I

Introduction to Innovation and Innovator: Introduction, understanding Innovation, Creativity and Research, Role of Innovation in economic growth of country, companies and community, phases of innovation journey, Roles of Innovator.

Text 1: Chapter 1 to 5 **10 Hrs**

UNIT -II

Innovator Skills and Innovation: Introduction to Innovative Skills, Types of Innovation, Introduction to patents and IP, preparing an innovation proposal Pitching an innovation proposal, Sustaining innovation.

Text 1: Chapter 6 to 13 **10 Hrs**

UNIT -III

Management Development : Management process : Achieving objectives through the functions of planning, organizing, co-coordinating, directing and controlling, Mintzberg Model: Interpersonal, informational and decisional roles; levels of management; Evolution of Management Thought : Scientific Management: work of F W Taylor, Administrative Management: Henry Fayol; ,Max Weber's Ideal Bureaucracy; The Hawthorne Studies; McGregor's Theory X and Y ; Recent Trends in Management**.**

Text 2: Chapter 2, 3,and 22 **11 Hrs**

UNIT -IV

Entrepreneur and Modern Small Business Enterprise:

Evolution of the concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an Entrepreneur & a Manager, Functions of an Entrepreneur, Types of Entrepreneur. Concept of Entrepreneurship, Growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development.

Text 3: Chapter 1 **10 Hrs**

UNIT - V

Financial and Institutional Support: Institutional Finance to Entrepreneurs: Need for Institutional Finance – Lease Financing & Hire Purchase – Advantage & disadvantage of Leasing – Concept of hire purchasing – Difference between leasing & hire Purchasing –Procedure of hire –purchasing, Institutional Support : Need of Institutional support ,Institutional support to small entrepreneurs, National Small

industries Corporation ltd (NSIC), Small industries Development Organization (SIDO) Small Scale Industries Board (SSIB), State Small Industries Development Corporation Small industries Centers (SISIs), District Industries Centers (DIC) Industrial Estates ,Technical Consultancy organization (TCOs)

Text 3: Chapter **11 Hrs**

Self Learning Components

1. List all the definitions of Innovation given by different Economists and Summarize the same for this generation
2. Describe Innovation and Innovator in your own terms
3. Study any three Patents Awarded to Indian Innovators and report
4. What are the Advantages and Disadvantages of Innovation in young engineers?
5. Analyze all different models of management
6. Considering an example for each, compare the Scientific Management and Bureaucracy
7. Write a report on One Young Small Scale Entrepreneur (of your choice), who established an industry in the past 5 years.
8. Write a note on Make in India. By proposing your opinions on, How this as effected the economical growth of our country.
9. What is Skill India? What are the different areas of Skill Development programs undertaken by Government of India
10. Report the path through which an entrepreneur established his/her business in and around the place you reside, (Visit and speak to an entrepreneur and report with simple interview and photos).

TEXT BOOKS:

1. "**A conversation with the innovator in you**", Sudeendra Koushik and Pragya Dixit, Pearson Kindle Direct Publishing, Amazon, 2017. ISBN-10: 1520512716**,** ISBN-13: 978-152051271.
2. "**Management – Concepts and Cases** "– V. S. P. Rao & V. Hari Krishna Excel Books, 2/e, 2008.ISBN 10: 8174466681 / ISBN 13: 9788174466686**.**
3. "**Entrepreneurial Development**" by Dr S S Khanka, S Chand & Company Ltd. ISBN-10: 8121918014; ISBN-13: 978-8121918015

REFERENCE BOOKS:

1. "**Debono, Edward: Six thinking Hats**", Penguin Books (2000). ISBN 10: 0140296662 / ISBN 13: 9780140296662.
2."**Kelley, Tom: The Art of Innovation**", Profile Books Limited (2011). ISBN-0:0385499841; ISBN-13: 978-0385499842.
3. "**Principles and practice of Management**" – L. M. Prasad. ISBN-13: 9789351610502.
4. "**Entrepreneurship"** by Robert D Hisrich, Micheal P Peters, Dean A Shepherd- 6/e, The Mc Graw – Hill Companies.ISBN-10: 0078029198.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Able to apply management knowledge to identify Business opportunity.	PO1[L3]
CO2	Demonstrate their conceptual skills, understanding an application of principles and functions of management	PO2 [L4]
CO3	Demonstrate the entrepreneurial process and recognize the core role of creativity and innovation in managing the entrepreneurial process effectively	PO2[L3]
CO4	Demonstrate the legal environment of business and describe how to prepare a business plan and implement it in reality.	PO2[L4]
CO5	Able to Analyse Causes for sickness in SSI and draw conclusions	PO6, PO7[L4]

D. Course Articulation Matrix

CO#	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	**3**												**3**	
2		**2**												**2**
3		**3**												**3**
4	**3**			**1**							1		**3**	
5						**2**	**2**							

Course Title : E-Waste Management			
Course Code: P17EC552	**Semester : V**	**L-T-P: 4– 0 – 0-4**	**Credits: 03**
Contact Period : Lecture :52 Hrs, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives

This course aims to

1. Understand importance of Electrical and Electronics waste management
2. Awareness about global rules and standards with respect to E-waster management
3. Acquire knowledge of materials used in E & E products and their disposition
4. Knowledge of Recycling and Recovery technologies.
5. Analysis of typical electronic devices their constituents and recyclability.
6. To understand OEM and allied vendor responsibility towards recyclable products and Manufacturing standards.

B. Course Content

UNIT-I

Introduction and Overview: Introduction, WEEE – The Scale of the Problem, Legislative Influences on Electronics, Recycling, Producer Responsibility Legislation, The WEEE Directive, The RoHS Directive, Other Examples of Legislation, Treatment Options for WEEE, Material Composition of WEEE, Socio-economic Factors, Logistics of WEEE, WEEE – the International Perspective, European Perspective, Barriers to Recycling of WEEE, the Recycling Hierarchy and Markets for Recyclate, WEEE Health and Safety Implications, Future Factors That May Influence Electronic waste Management.

Text 1: 1.1-1.12 (PageNo:1 to 35) **10 Hrs**

UNIT-II

Materials Used in Manufacturing Electrical and Electronic Products: Perspective, Impact of Legislation on Materials Used in Electronics, Overview, The RoHS Directive and Prescribed Materials, Where do RoHS Prescribed Materials Occur?, Lead, Brominated Flame Retardants, Cadmium, Mercury and Hexavalent Chromium, Soldering and the Move to Lead-free Assembly, Lead-free Solder Choices, Printed Circuit Board Materials, PCB Materials, Provision of Flame Retardancy in PCBs, Non-ferrous and Precious Metals, Encapsulants of Electronic Components, Indium Tin Oxide and LCD Screens, Polymeric Materials in Enclosures, Casings and Panels, Product-related Plastic Content, WEEE Engineering Thermoplastics, Polycarbonate (PC), ABS (Acrylonitrile-Butadiene-Styrene), High Impact Polystyrene (HIPS), Polyphenyleneoxide (PPO), PC/ABS Blends, Flame Retardants in Engineering Thermoplastics, Materials Composition of WEEE, Mobile Phones, Televisions, Washing Machines.

Text 1: 2.1-2.10 (Page 40 to 73) **10 Hrs**

UNIT- III

Part-I Recycling and Recovery: Introduction, Separation and Sorting, Treatment, Mixed WEEE, Refrigeration Equipment, Cathode Ray Tubes, Individual Processes, Outputs and Markets, Metals, Glass, Plastics, Emerging Technologies, Separation, Thermal Treatments, Hydrometallurgical Extraction, Sensing Technologies, Plastics to Liquid Fuel, Plastics Containing Brominated Flame Retardants.

Text 1: 4.1-4.5 (Page 91 to 107)

Part-II Integrated Approach to e-Waste Recycling: Introduction, Recycling and Recovery Technologies, Sorting/Disassembly, Crushing/Diminution, Separation, Emerging Recycling and Recovery Technologies, Automated Disassembly, Commintion, Separation, Thermal Treatments, Hydrometallurgical Extraction, Dry Capture Technologies, Biotechnological Capture, Sensing Technologies, Design for Recycling and Inverse, Manufacturing, Printed Circuit Boards, Overview,

Recycling, Current Disposal Hierarchy, Economics of Recycling, Future Developments, Characteristics of PCB Scrap, Emerging Technologies.

Text 1: 5.1-5.4 (Page 111 to 132) **11 Hrs**

UNIT –IV

Sector-based Eco-design, Disassembly, Fasteners, RFIDs (Radio Frequency Identification Tags), Active Disassembly, Design Methodology and Resource Efficiency, Recycling, Constraints on Materials Selection, Eco-design Guidelines for Manufacturing.(Ch5. Pg.N0.141-160), Liquid Crystal Displays: from Devices to Recycling: Overview of Liquid Crystals Definition and Classification of Liquid Crystals, Molecular and Chemical Architecture of Liquid Crystals, The **Mesophase:** Types of Intermediate State of Matter, Physical Properties of Liquid Crystals and Material Requirements, Overview of Liquid Crystal Displays Based on Nematic Mesophase, Basic LCD Operating Principles, Types of Electro-optic LCD Devices, LCD Manufacturing Process, Environmental Legislation and Lifecycle Analysis. The WEEE Directive and LCDs, RoHS and REACH, Far East Environmental Measures, Lifecycle Analysis, Potentially Hazardous Constituents: Toxicity of LCD Constituents, Toxicity of Mercury and Backlighting, Toxicity of Liquid-crystal Mixture, Demanufacture and Recycling, Future Outlook, LCD Panels 208, Smart Disassembly 209, Legislation.

Text 1: 7.1-7.7 (Page 180 to 209) **10 Hrs**

UNIT –V

The Role of Collective versus Individual Producer Responsibility in e-Waste Management: Key Learning's from Around the World: Brief Introduction to WEEE, The WEEE Directive, Producer Responsibility, Household and Non-household WEEE, E-waste and Its Environmental Impacts, Marking EEE Products, WEEE Collection Points, Product Categories and Waste Streams, Producer Compliance Schemes, Variations in National WEEE Laws, Introduction to European Recycling Platform (ERP), European Recycling Platform, Timeline, Founding Principles, Structure, Scope of services. Background to Producer Responsibility, Defining Individual and Collective Producer, Responsibility, The WEEE Directive in Europe, The WEEE Directive's Approach to Individual and Collective Producer Responsibility, Implementation of Individual and Collective Producer Responsibility in the EU, ICT Milieu, The Netherlands, E-waste Laws and Voluntary Agreements in Other Countries, Japanese Electronics Take-back Directive, Product Take-back in the USA, Product Stewardship in Australia.

Text 1: 6.1-6.2.7, 8.1-8.3 (Page 161 to 168 and 212 to 222) **11 Hrs**

Self Learning Component

1. Prepare a statistical survey report on Indian scenario of electronic sales and purchase.
2. Present a short summary on European Commission's 1991 Battery Directive (91/157/EEC) and its implications.
3. Present a report on e-waste management and recycling initiatives of companies like: SONY, Philips and Samsung etc.
4. Refer the websites: 1. https://www.epa.gov/, 2. https://sustainabilityguide.eu Understand the significance of design for sustainability.
5. Write a short note on "A model for optimal product recovery in the context of Extended Producer Responsibility".

TEXT BOOK:

1. "**Electronic Waste Management**" edited by Ronald E. Hester, Roy M. Harrison, RSC Publishing. ISBN: 9780854041121**.**

REFERENCE BOOKS:

1. **"E-Waste: Management, Types and Challenges (Computer Science, Technology and Applications: Environmental Remediation Technologies, Regulations and Safety)".** Yinchuan Li, BanciLian Wang, Nova Science Publishers, 2012, ISBN: 1619422174.

2. "**Electronic Waste: High-Impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors, Kevin Roebuck",** Emereo Publishing, 2011.ISBN: 9781743339084.

C. Course Outcomes

CO#	Course Outcome	Program Outcome with BTL
CO1	**Apply** the knowledge of basic sciences to understand the issues of Electrical and Electronic Equipment Wastes and societal responsibility**.**	PO1, PO7[L3]
CO2	**Analysis** of material used in current EEE and legislative directives.	PO2, [L3]
CO3	**Knowledge** of WEEE Directives, RoHS Directives, Health hazards, Recycling, Recovery technologies and future technologies.	PO1, [L4]
CO4	**Analyze t**ypical electronic devices and PCBs their constituent hazards, recyclability and treatment technologies.	PO2, [L3]
CO5	**Understand** need of waste management OEM and allied vendor responsibility towards recyclable products and Manufacturing Standards and nation wise initiatives.	PO2,PO7 [L2]

D. Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
#1	**3**						**1**							**2**
#2		**3**											**1**	
#3						**2**	**1**							
#4							**2**						**2**	
#5		**2**					**2**							

Course Title : Professional Ethics and Behavioral Skills			
Course Code: P17EC553	**Semester : V**	**L-T-P: 4– 0 – 0-4**	**Credits: 03**
Contact Period : Lecture :52 Hrs, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives (CLO'S)

This course aims to

1. To make students to understand the meaning of engineering ethics, doing things right and the obstacles to making good ethical decisions.
2. To enable students to identify and critically assess the principles and values they personally embrace and use in addressing the ethical issues which arise in their working lives.
3. To acquaint students with some of the major kinds of ethical problems encountered while performing work assignments and some possible ways of responding to them.
4. To make students to understand behaviour skills at the individual level and at the group level in an organization.

B. Course Content

UNIT -I

Engineering Ethics: Action Oriented, Ethical Vision, Indian Ethos, Ethics Defined, Approaches to Ethical Behavior, Various Connotations of Engineering Ethics, Why Study Engineering Ethics? Personal and Business Ethics, Ethics and the Law, Ethics and Design Problems, Duties and Rights, What is a Profession? Engineering as a Profession, Professional Societies, Core qualities of Professional Practitioners, Professional Institutions, Operating in a Pluralistic Society, Environments and Their Impact, Complexity of Environmental Forces, Social Attitudes, Beliefs, and Values, Code of Ethics, Solving Ethical Conflicts, Ethical judgment.

Text Book 1 (Page 01 – 28) **12 Hrs**

UNIT -II

Engineers Responsibility for Safety and Risk: Safety and Risk, Concept of Safety, Types of Risk, Safety and Engineer, Designing For Safety, Risk Benefit Analysis, Accidents.

Responsibilities and Rights : Collegiality, Two Senses of Loyalty, Professional Rights, Professional Responsibilities, Conflict of Interest, Self-interest, Customs and Religion, Collective Bargaining, Confidentiality, Acceptance of Bribes/Gifts, Occupational Crimes, Whistle Blowing.

Text Book1(Page 69 – 75,76 – 96) **10 Hrs**

UNIT- III

Global Issues : Globalization, Cross cultural issues, Environmental Ethics ,Computer Ethics, Weapons Development , Ethics and Research , Analyzing Ethical Problems in Research, Intellectual Property Rights. (IPRs).

Text Book 2 (Page 97 – 112) **10 Hrs**

UNIT- IV

Behavioral Skills: Individual Behavior: Personality, Different approaches to personality, Self-concept, Self-esteem, and Self-Monitoring, Perception, Attitudes.

Text Book 2 (Page 769- 781) **10 Hrs**

UNIT- V

Behavioral Skills: Group Behavior and Team building: Reasons for group formation, Types of groups, Formal groups – committees ,Stages of group development , Models of small group behavior, Informal organizations , Groups and teams, Team building, Team Development.

Text 2 (Page No 795- 841) **10 Hrs.**

Self learning components

1. Response with your opinions, How important is the professional ethics in the engineering fraternity
2. What are the roles and responsibilities of Professional Institution in building the professional ethics in young engineers.
3. Engineers are very important in managing a team of workers. So, Safety of each worker plays an important role, Justify this statement.
4. Engineers are Ethical and Responsible. How well they can be equipped in the field of Indian Politics?
5. Is Ethic, is something that is taught or it is in every human being? Justify your answer.
6. Summaries any three Researches made over Professional Ethics for the Global Development
7. Write a complete study of any one team building activity of your choice that can be performed in a classroom.
8. This young generation of student fraternity lack and has to taught with Ethical and Moral Values. What is your response to this statement?
9. Individual achievement and Team Achievement, which one is Good for Success? Why?

TEXT BOOKS:

1. "Engineering Ethics"—M. Govindarajan – PHI Learning Private Limited 2017. ISBN10: 1633692094 / ISBN 13: 9781633692091.
2. "**Management**" – VSP Rao ,V. Harikrishna –Excel Books 2010. ISBN 10: 8174463461 / ISBN 13: 9788174463463

REFERENCE BOOKS:

1. "**Perspectives on Business Ethics**" – HARMAN, LAURA. P. - Tata McGraw Hill. ISBN-10: 9780070620049.
2."**Ethics in Business Management, Concepts and Cases**" - Banerjee, R P. - Himalaya Publishing House. ISBN Number: 978-93-5142-257-0.
3. "**Ethics in the Workplace**", Dean Bredeson, Keith Goree, Cengage Learning, 2011. ISBN-10: 0538497777. ISBN-12 9780538497770.

C. Course Outcomes

CO#	Course Outcome	Program Outcome with BTL
CO1	Able to demonstrate the ethical issues inherent in the rapid changes in business	PO1,
CO2	Able to apply general ethical principles to any business	PO2,PO8[L3]
CO3	Able to analyze and manage any ethical problems in any business practices	PO1,PO8 [L3]
CO4	Able to manage behaviour skills at the individual level and at the group level in any business.	PO8, PO9 [L3]

D. Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
#1	**2**	**2**						**2**					**2**	**2**
#2	**3**												**3**	
#3		**3**				**2**		**3**						**3**
#4								**2**						
#5								**3**	**1**					

Course Title : Green Computing			
Course Code: P17EC554	**Semester : V**	**L-T-P: 4– 0 – 0-4**	**Credits: 03**
Contact Period : Lecture :52 Hrs, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives

This course aims to

1. To understand the need of Green Computing.
2. Evaluate the role of Cloud Computing in Green solutions.
3. Analyze Green Device Portfolio.
4. Analyze Green data centers and energy consumption.
5. To understand corporate socio economical responsibility of Green computing.

B. Course Content

UNIT -I

Green Computing and the Environment: Environmental Drivers for Green Computing, What Drives the Green Agenda? , Key Roots of Environmentalism, Environmentalism and IT, The New Imperative of Climate Change, A Brief History of the Climate, Al Gore and Climate Change, The 2°C Warming "Limit" , Climate Change and IT What's Next with Climate Change? , What It Means to "Go Green", Why IT Is a Climate Change Solution, Career Development and "Going Green".

Text 1: 3.1-3.13 (Page 35 to 58) **10 Hrs**

UNIT- II

A New Vision of Computing: Cloud Computing Emerges, The End of the PC Era, Some New-Model IT Challenges, A Few Examples from a Multinational, How a Company Adopted the iPhone, A Mental Model for IT Simplicity, Why Green Computing Fits the New Model, Is Cloud Computing the Whole Answer?, Disadvantages of Cloud Computing, Managing Disadvantages of Cloud Computing, What to Do Besides Cloud Computing, Efficiency and Cloud Computing, Greenability and Cloud Computing, Responsibility, Usability, and Cloud Computing, The Philosophical Implications of Green Computing, The Zen of Green Computing.

Text 1: 4.1-4.16 (Page 59 to 88) **10 Hrs**

UNIT- III

Part-I Building a Green Device Portfolio: Introduction, Why Green Works for Device, Purchases, Pushing Computing Down the Device Pyramid, Another Dimension of Device, Pyramid Greenness, Green Computing and Embodied Energy, Green Computing and Running Costs, Planned Obsolescence Isn't Green, Green Computing and Device Disposal, The Greenpeace Guide to Greener Electronics, Support Employees' Device Choices, Publicizing Your Process.

Part-II Finding Green Devices : What Makes a Device Green?, What Makes a Supplier Green?, Case Study: HP vs. Dell, Giving Suppliers and Vendors Feedback, Publicizing Your Selection Process and the Winner, A Sample Statement of Green Buying Principles Desktop Computers, Laptops, Sustainability and Failure to Supply, The Case of Windows 8 Tablets, "Less Computer" and "Computer-less" Solutions.

Text 1: 5.1 – 5.11, 6.1-6.12 (Page 89 to 132) **11 Hrs**

UNIT -IV

Part-I Green Servers and Data Centers: Choosing and Creating Green Data Centers, Green Data Centers as a Model, The Last Shall Be First, What Makes a Data Center Green?, Building and Power Supply Considerations, Servers, Storage, and Networking Data Center Suppliers.

Part-II Saving Energy: Saving Energy Serves Many Masters, Cost Savings through Energy Savings, Risk Reduction through Energy Savings, Carbon Footprint Reduction through Energy Savings, Improving Your Reputation and Brand, Why Energy Prices Will Stay High Embodied Energy, Analyzing Your Energy Usage, A Recipe for Energy Savings, Understanding the Unique Energy Needs of IT, Focusing on Solar Power, Saving Energy and the Supply Chain Energy-Saving Pilot Projects, Selling Energy Savings.

Text 1: 7.1 -7.7, 8.1-8.14 (Page 133 to 142,143 to 166) 11Hrs

UNIT- V

PART-I Green Computing by Industry Segment: Evaluating Greenness, The Newsweek Green 500 Approach, Looking at Industry Segments, Analyzing Your Own Initiatives, Company, and Sector.

PART-II The Future: Deep Green Computing: Green Computing and the Future Megatrends for Green Computing, An Increasing Need for Sustainability, The Continually Decreasing Cost of Core Computing Capabilities, The Ability of Computing to Do More and More, Telepresence Instead of Travel, Telecommuting Instead of Commuting, Toward Deep Green Computing, Platforms for Deep Green Computing, Selling Deep Green Computing.

Text 1: 11 -11.3, 12.1-12.7 (Page 197 to 212,213-232) 10 Hrs

Self Learning Components:

1. Watch TED talk by Al Gore at https://www.ted.com/talks/al_gore_on_averting_climate_crisis?language=en and write comments on individual role towards Green world.
2. Present a short survey report on setting and utilization of Cloud computing facility by e-commerce companies in view of green computing.
3. Refer Guide to Greener Electronics at https://www.greenpeace.org/usa/reports/enlist/document/record your views on the report.
4. Write an article on dirty data, data abuse and energy saving with reference to computer networks and data centers. (Reference: article by Bryan Walsh at https://time.com/46777/your-data-is-dirty-the-carbon-price-of-cloud-computing/)
5. Write an article on role of operating systems in Deep Green computing and energy saving.

TEXT BOOK:

1. "**Green Computing: Tools and Techniques for Saving Energy, Money, and Resources, Bud**", E. Smith, CRC Press. ISBN: 9781466503403.

REFERENCE BOOKS:

1. "**Sustainable ICTs and Management Systems for Green Computing**", Naima Kaabouch, Wen-Chen Hu, IGI Global Publishers. ISBN: 9781466618398.
2. "**Handbook of Green Information and Communication Systems**", edited by Mohammad S. Obadiah, Alagan Anpalagan, Isaac Woungang, Academic Press. ISBN: 0124158447.

C. Course Outcomes

CO#	Course Outcome	Program Outcome with BTL
CO1	**Understand** the need of Green Computing and IT aspects.	PO1, [L3]
CO2	**Evaluate** the role of Cloud Computing in Green solutions and data centers.	PO2, [L3]
CO3	**Knowledge** of IT & energy, Recycling, Recovery technologies, models and future technologies with case studies.	PO1, [L4]
CO4	**Analyze** Green Device Portfolio, Energy saving, cost saving and risk reduction w.r.t IT.	PO2, [L3]
CO5	**Understand** IT and corporate socio economical responsibility of Green computing and environmental issues.	PO1, [L2]

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
#1						**3**							**1**	
#2		**2**											**2**	**2**
#3							**3**							**3**
#4		**3**											**2**	**2**
#5											**3**		**2**	

Elective-I

Course Title : Digital Signal Processors and Applications			
Course Code: P17EC561	**Semester : V**	**L-T-P: 4– 0 – 0-4**	**Credits: 03**
Contact Period : Lecture :52 Hrs, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives

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.

B. 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 1: 4.1 to 4.10 **10 Hrs**

UNIT – II

Programmable Fixed Point 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 1:5.1 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 1: 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 1: 9.1 to 9.8 and 10.1 to10.7 **11 Hrs**

UNIT – V

Programmable Floating Point Digital Signal Processors: Introduction, Features of TMS320C6713, TMS320C6713 Architecture, Linear and Circular addressing modes, Instruction set, TMS 320C6713 DSK Boards, TMS 320C6713 Programming.

Applications of 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 2: 23.1 to 23.7.1, 23.8 **10 Hrs**

Self Learning Components

1. Design and implement 8-bit Barrel Shifter using 2:1 Multiplexer in Verilog.
2. With real life example explain pipelining and parallel processing, comment on time requirement in each process.
3. How DSP processor is different than conventional processor? Justify your answer with relevant example.
4. Study memory (internal and extended), peripherals and general purpose I/O pins characteristics of 54X processors.
5. Design and Implement 3-bit Flash analog to digital converter using CMOS technology.
6. Design and implement 4 tap FIR filter using Verilog.
7. Study of Multi-channel Buffered Serial Port.
8. A study of CODEC interface circuit and CODEC programming.
9. Discuss why floating point processor better than fixed point processor.
10. Implement speech processing system using MATLAB.

TEXT BOOK:

1. ”**Digital Signal Processing**”, Avatar Singh and S. Srinivasan, Thomson Learning, 2004. ISBN 10: 0534391230 / ISBN 13: 9780534391232.
2. “**Modern Digital Signal Processing**”, V. Udayashankara, Eastern Economy Edition, 2016. ISBN 10: 8120345673 / ISBN 13: 9788120345676.

REFERENCE BOOKS:

1. “**Digital Signal processors- Architectures, Implementations, and Applications**” Sen M Kuo, Woon-sengGan , Pearson Edition, 2005. ISBN-13: 978-0130352149, ISBN-10: 0130352144.
2. “ **Digital Signal Processors- Architecture, Programming and Applications**” B Venkataramani, MBhaskar, McGraw Hill Education, 2015. ISBN-10: 9780070702561.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Distinguish** between the DSP processor and general purpose processor.	PO1(L2)
CO2	**Analyze** the architectural features of Digital signal processor using basic digital circuit knowledge	PO2(L1)
CO3	**Develop** programs for digital filters using DSP processor for various situations and demonstrate utility DSP processor in various signal processing applications	PO4(L4)
CO4	**Apply** the logical and signal processing concepts to develop algorithms for DSP processor.	PO1(L3)
CO5	**Design** the interface to connect specified memory and signal converters.	PO3(L5)

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
#1	3												3	
#2		3											2	3
#3				2									2	2
#4	3													
#5			3										3	3

Course Title : Operating Systems			
Course Code: P17EC562	**Semester : V**	**L-T-P: 4– 0 - 0**	**Credits: 03**
Contact Period : Lecture :52 Hr, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives

This Course aims to

1. Provide an overview of the Operating Systems topics and present an analysis of processes, multithreading, symmetric multiprocessing (SMP), and microkernels.
2. Examine the key aspects of concurrency, issues of mutual exclusion and deadlock.
3. Provide techniques for memory management and provide the knowledge of virtual memory and its control structure.
4. Provides a comparative discussion of various approaches to process scheduling.
5. Examines the issues involved in Operating Systems control of the I/O function and provide an overview of file management
6. Provide a survey of threats and mechanisms for computer and network security.

B. Course Content

UNIT – I

Operating System Overview: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Virtual Machines, OS Design Considerations for Multiprocessor and Multicore.
Process Description and Control: What Is a Process?, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues.
Threads: Processes and Threads, Types of Threads, Multicore and Multithreading,
Text 1: 2.1-2.6, 3.1-3.6, 4.1-4.3 **11 Hrs**

UNIT – II

Concurrency: Mutual Exclusion and Synchronization - Principles of Concurrency, Mutual Exclusion: Hardware Support, Semaphores, Monitors, Message Passing, Readers/Writers Problem.
Concurrency: Deadlock and Starvation - Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategy, Dining Philosophers Problem.
Text 1: 5.1 - 5.6, 6.1 - 6.6 **10 Hrs**

UNIT – III

Memory Management: Memory Management Requirements, Memory Partitioning, Paging Segmentation, Security Issues.
Virtual Memory: Hardware and Control Structures, Operating System Software.
Text 1: 7.1 - 7.5, 8.1 - 8.2 **10 Hrs**

UNIT – IV

I/O Management and Disk Scheduling: I/O Devices, Organization of the I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling, RAID, Disk Cache.
File Management: Overview, File Organization and Access, B-Trees, File Directories, File Sharing, Record Blocking, Secondary Storage Management, File System Security.
Text 1: 11.1 - 11.7, 12.1 - 12.8 **10 Hrs**

UNIT – V

Computer Security Threats: Computer Security Concepts, Threats, Attacks, and Assets, Intruders, Malicious Software, Overview, Viruses, Worms, and Bots, Root kits.
Computer Security Techniques: Authentication, Access Control, Intrusion Detection, Malware Defense, Dealing with Buffer Overflow, Attacks.
Text 1: 14.1 – 14.6, 15.5 – 15.5 **11 Hrs**

Self Learning Components

1. Microsoft Windows, unix and Linux overview
2. Linux Process and Thread management
3. Unix Concurrency Mechanisms
4. Linux Concurrency Mechanisms
5. Linux Memory Management
6. Windows Memory Management
7. Linux File management
8. Windows 7 security

TEXT BOOK:

1. "**Operating Systems"** by William Stallings, 7e, Pearson India. ISBN-10: 9332518807

REFERENCE BOOK(S):

1. "**Operating systems**" by Silberschatz and Galvin, 9e, Wiley. ISBN-10: 8126554274.
2. "**Operating Systems**" by Godbole, 3e, McGraw Hill India. ISBN 10: 0070702039 / ISBN 13: 9780070702035.

C. Course outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Ability to **analyze** the characteristics of different structures of the Operating Systems and identify the core functions of the Operating Systems.	PO2(L4)
CO2	Ability to **identify** the problems related to process management, synchronization and deadlocks.	PO2(L3)
CO3	Ability to **analyze** the algorithms on which the core functions of the Operating Systems are built on.	PO3(L4)
CO4	Ability to **apply** the knowledge of system software and tools available in modern operating system (such as threads, system calls, semaphores, etc.).	PO1(L3)
CO5	Ability to **identify** potential threats to operating systems, security design features and the protection techniques.	PO2(L3)

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
#1		**3**												**3**
#2		**3**												**3**
#3			**2**											
#4	**3**												**3**	
#5		**2**												**2**

Course Title: ARM Processor and Programming			
Course Code: P17EC563	**Semester: V**	**L-T-P:4- 0- 0-4**	**Credits: 03**
Contact Period - Lecture:52Hrs.;Exam: 3Hrs.		**Weightage: CIE: 50%**	**SEE: 50%**

A. Course Learning Objectives

This Course aims to

1. Discuss the basic knowledge of programmer's model, program status registers, memory systems, exceptions, interrupts and system control blocks.
2. Discuss the instruction set, barrel sifter, accessing special instruction and special registers in programming.
3. Describe the memory system, memory access permissions, and access attributes in a microcontroller.
4. Explains the exception and interrupt control, vector table and vector table relocation, and procedures in setting up interrupts and software interrupts**.**
5. Discuss the exception handling optimization, low power designs, developing low power applications, configuration control register, auxiliary control register and co-processor access control register.
6. Explains the operating system support features, embedded operating systems and memory protection unit.
7. Describe the floating point operations, floating point exceptions and using embedded operating systems.

B. Course Content

UNIT-I

Architecture: Introduction to the architecture, Programmer's model, Behaviour of the application program status register (APSR), Memory system, Exceptions and interrupts, System control block (SCB).

Instruction set: Background to the instruction set in ARM Cortex-M processors, Comparison of the instruction set in ARM Cortex-M processors, Understanding the assembly language syntax, Use of a suffix in instructions, Unified assembly language (UAL), Instruction set, Cortex-M4-specific instructions, Barrel shifter, Accessing special instructions and special registers in programming.

Text 1: 4.1 to 4.6,5.1 to 5.9 **11 Hrs**

UNIT -II

Memory system: Memory map, Connecting the processor to memory and peripherals, Memory requirements, Memory endianness, Data alignment and unaligned data access support, Bit-band operations, Default memory access permissions, Memory access attributes, Exclusive accesses, Memory system in a microcontroller**.**

Exception and Interrupts: Overview of exceptions and interrupts, Exception types, Overview of interrupt management, Definitions of priority, Vector table and vector table relocation, Interrupt inputs and pending behaviours, Exception sequence overview, Details of NVIC registers for interrupt control, Details of SCB registers for exception and interrupt control, Details of special registers for exception or interrupt masking, Example procedures in setting up interrupts, Software interrupts**.**

Text 1: 6.2 to 6.10, 6.12,7.1 to 7.11 **10 Hrs**

UNIT- III

Exception Handling in Detail: Introduction, Exception sequences, Interrupt latency and exception handling optimization.

Low Power and System Control Features: Low power designs, Low power features, Using WFI and WFE instructions in programming, Developing low power applications, The SysTick timer,

Self-reset, CPU ID base register, Configuration control register, Auxiliary control register, Co-processor access control register.

Text 1: 9.1 to 9.10 **10 Hrs**

UNIT-IV

OS Support Features: Overview of OS support features, Shadowed stack pointer, SVC exception, PendSV exception, Context switching in action, Exclusive accesses and embedded OS. **Memory Protection Unit (MPU):** Overview of the MPU, MPU registers, Setting up the MPU, Memory barrier and MPU configuration, Using sub-region disable, Considerations when using MPU, Other usages of the MPU, Comparing with the MPU in the Cortex-M0D processor.

Text 1: 10.1 to 10.6,11.1 to 11.8 **11 Hrs**

UNIT-V

Floating Point Operations: About floating point data, Cortex-M4 floating point unit (FPU), Lazy stacking in detail, Using the floating point unit, Floating point exceptions.

Using Embedded Operating Systems: Introduction to embedded Oss, Keil RTX Real-Time Kernel, CMSIS-OS examples, OS-aware debugging

Text 1: 13.1 to 13.5, 19.1 to 19.4 **10 Hrs**

Self Learning Components

1. Programming exercises for the practical problems.
2. Preparation of write up on (i) Fault Exceptions and Fault Handling(ii) Debug and Trace Features
3. Working with Keil Microcontroller Development Kit for ARM, in the Lab.

TEXT BOOK:

1. "**The Definitive guide to ARM-CORTEX –M3 and CORTEX –M4 processors**" by Joseph Yiu, 3rd edition, Newnes (Elsevier), ISBNe13: 978-0-12-408082-9, 2014

REFERENCE BOOKS:

1. "**ARM Assembly Language Fundamentals and Techniques**", William Hohl and Christoper Hinds, 2nd Edition, ISBN 9781482229851, 2014, CRC (Taylor and Francis)
2. "**ARM System-on-chip architecture**" Steve Furber, 2nd Edition, Pearson, ISBN: 9788131708408, 8131708403, 2015.

C.Course Outcomes

CO#	Course Outcome	Program Outcome with BTL
CO1	Apply the knowledge of architecture and instruction set of ARM cortex-M3 and cortex-M4 to develop the program	PO1[L3]
CO2	Analyse the ARM processor based programs related to interrupts and exceptions	PO2[L4]
CO3	Design ARM cortex-M3 and cortex-M4 related system by incorporating memory, OS and others with an emphasis on lower power concepts	PO3[L5]
CO4	Conduct experiments related to floating point computations using Keil software	PO4[L4]
CO5	Build projects which are helpful to farmers, patients, drivers in their routines	PO6[L5]

D. Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3												3	
#2		2												2
#3			2										2	2
#4				1									1	1
#5						1							3	3

Course Title : Object-Oriented Programming With C++			
Course Code: P17EC564	**Semester : V**	**L-T-P: 4– 0 - 0**	**Credits: 03**
Contact Period : Lecture :52 Hrs, Exam: 3Hrs		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This Course aims to

1. Provide the basic knowledge of Object-Oriented programming.
2. Explain various data types, operators and control statements with C++.
3. Discuss Pre-Processor Directives, Dynamic Memory Allocation, pointers. Describe the concepts of Functions and discuss different versions of the same.
4. Illustrate the concept of class, objects and class member functions.
5. Explain the concept of constructors and destructors.
6. Understand the concepts Base class, derived class, Inheritance and Access Specifiers.
7. Describe Virtual function, abstract class, friend function, friend class, static function, and polymorphism.
8. Explain the concept of Exception Handling.

B. 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, bit set 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

Pre-processor Directives, the Built-In Array Data Type, Dynamic Memory Allocation and Pointers.
Statements: if, switch, for, while, do while, break, continue, go to statements.
Functions: Introduction, the main function, function prototyping, call by reference, return by reference, inline functions, default arguments, const arguments, recursion, function overloading, friend and virtual function.

Text 1:1.3, 2.1, 2.2, 5.3 to 5.10,Text 2:4.1 to 4.11 **10 Hrs**

UNIT-III

Classes and Objects: Introduction, C structures revised, specifying a class, defining member functions, A C++ program with class, making an outside function inline, nesting of member functions, private member functions, Arrays within a class, memory allocation for objects, static data members, static member functions, arrays of objects, objects as function arguments, friendly function, returning objects, const member function, pointers to members, local classes.
Constructors and Destructors: introduction, constructors, parameterized constructors, multiple constructors in a class, constructors with default arguments, dynamic initialization of objects, copy constructor, destructors.

Text 2:5.1 to 5.19, 6.1 to6.7, 6.11 **11 Hrs**

UNIT-IV

Operator Overloading: Operators ++ and --, Operators new and delete**.**
Inheritance: introduction, defining derived classes, single inheritance, making a private member Inheritable, multilevel inheritance, multiple inheritance, Hierarchical inheritance, hybrid Inheritance, virtual base classes, abstract classes, constructors in derived classes, member classes: Nesting of classes

Text 1:15.7, 15.8, 8.1 to 8.12 **10 Hrs**

UNIT-V

Pointers, Virtual Function and Polymorphism: introduction, pointers, pointers to objects, this pointer, pointers to derived classes, virtual function, pure virtual function, virtual constructors and destructors

Exception Handling: introduction, basics of exception handling, exception handling mechanism, throwing mechanism, catching mechanism, rethrowhing an exception, specifying exceptions, exceptions in constructors and destructors, exceptions in operator overloading functions.

Text 2:9.1 to 9.8, 13.1 to 13.9 **10 Hrs**

Self learning components:

1. Explain the following with proper example:
   (i) Complex number systems.
   (ii) Typedef Names.
   (iii) The Pair Type.
2. Explain Operator Overloading and Friends.
3. Discuss the following Operators with example:
   (i) =
   (ii) [ ]
   (iii) ( )
   (iv) -->
4. Develop C++ code for the following.
   (i) To add two complex numbers.
   (ii) To print prime numbers.
   (iii) To generate random numbers.
   (iv) To generate finonacci series.
   (v) To add two Matrices.
5. Discuss Class scope under Inheritance with importance of Virtual Inheritance

TEXT BOOKS:

1. "**C++ Primer**", S. B. Lippman & J. Lajoie, 3rd Edition, Pearson education. ISBN-13: 978-0201824704, ISBN-10: 0201824701.
2. "**Object Oriented Programming in with C++**", E balagurusamy,6e, McGraw Hill Education. ISBN-10: 9383286504; ISBN-13: 978-9383286508.

REFERENCE BOOKS:

1. "**Object Oriented Programming in with C++**", R. Lafore, Galgotia Publications PVT LTD. ISBN: 9788175152694, 8175152699.

C. Course outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply basic programming knowledge to understand different syntax of C++.	PO1(L3)
CO2	Formulate C++ programming as an object oriented problem.	PO2(L4)
CO3	Analyse a problem and to identify appropriate logical solutions.	PO2(L4)
CO4	Develop C++ program for a given Engineering problem.	PO3(L5)
CO5	Use modern tool “code blocks” to execute and debug C++ programs.	PO5(L3)

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12		PSO1	PSO2
#1	3													3	
#2		3													3
#3		3													3
#4			3												
#5					2										

Course Title : **Digital Signal Processing Laboratory**			
Course Code: P17ECL57	**Semester : V**	**L-T-P:0 – 0 – 3**	**Credits:1.5**
Contact Period - Lab: 39Hrs.; Exam: 3 Hrs.		**Weightage:CIE:50%SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic knowledge of how to use MATLAB, CCS studio and TMS32054xx for DSP concepts.
2. Illustrate and Verify fundamental DSP concepts using MATLAB.
3. Understand the usage of recorded real life signals in signal processing.
4. Understanding and dealing with various parameters of noise.
5. Programming of DSP processors.
6. Using of DSP processor for real time signal processing applications.

B. Course Content

A. EXPERIMENTS USING MATLAB/SCILAB/OCTAVE/WAB

01 Verification of the sampling theorem, Impulse response of the given system, Linear convolution and circular convolution of the two given sequences without using function and using DFT and IDFT.
02 Autocorrelation, Cross correlation of the given sequence and verification of its properties and Solving a given difference equation.
03 Computation of the N point DFT of a given sequence and to plot magnitude and phase spectrum.
04 Plot the spectrum of voice, ECG, EMG and Music.
05 Design and implementation of the FIR filter to meet the given specifications.
06 Design and implementation of the IIR filter to meet the given specifications.
07 Adding noise of specific means variance and distribution and add to voice signal and separate using a filter.

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

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

01 Linear and Circular convolution of the two given sequences.
02 Computation of the N Point DFT of a given sequence.
03 Realize the FIR filters to meet given specifications. The input can be a signal from function generator / speech signal.
04 Audio applications such as to plot time and frequency (Spectrum) display of Microphone output plus a cosine using DSP. Read a wav file and match with their respective spectrograms.
05 Noise: Add noise above 3 kHz and then remove; Interference suppression using 400 Hz tone.

Open ended Experiments

01. Interface ECG/EEG signal generator and analyze using DSP processor
02. Obtain speech spectrum using DSP Processor

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

C. Course Outcome (CO)

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Analyze and apply the fundamental DSP concepts using MATLAB	PO1, PO2, PO5
CO2	Analyze the recorded real life signals.	PO2
CO3	Analyse various parameters of noise.	PO2
CO4	Implement the filters by Interfacing external signal (Biomedical, speech etc) to DSP processor using CCS studio and conduct the experiment in group	PO3, PO5, PO9

D. Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	**2**	**2**			**2**								**2**	**2**
#2		**3**												**3**
#3		**3**												**3**
#4			**2**		**2**				**2**			**1**	**2**	**2**

Course Title : Optical and Analog Communication Laboratory			
Course Code: P17ECL58	**Semester : V**	**L-T-P:0 – 0 – 3**	**Credits:1.5**
Contact Period - Lab: 39Hrs.; Exam: 3 Hrs.		**Weightage:CIE:50%SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic practical knowledge of Analog and Digital Fiber Optic links, laser and diode characterization.
2. Demonstrate the measurement of various parameters of Optical fiber such as attenuation, losses and Numerical Aperture
3. Familiarize with the characterization and working of FBG, Optical circulator, and WDM MUX- DEMUX.
4. Demonstrate the generation and detection of analog signals using various modulation techniques such as AM, FM, PAM, PPM.
5. Design and analyze frequency response of Second order active filters using op-Amp: LPF, HPF and BPF.
6. Design of Astable and Monostable multivibrators for given values.

B.Course Content

1. Analog and Digital Fiber optic links. Attenuation, Bending loss and Numerical aperture measurement of optical fiber.
2. LASER diode and photo diode characterization.
3. Characterization of FBG and Optical Circulator.
4. Characterization of WDM MUX and DEMUX.
5. Time Division Multiplexing of signals.(Using PAM Kit).
6. Amplitude Modulation and Detection in time domain and its observation in frequency domain (Use Spectrum Analyzer).
7. Frequency Modulation using 8038/2206 in time domain and in frequency domain.
8. Design an Astable multivibrator for given frequency and Duty cycle using 555 timer.
9. Design a Monostable multivibrator for given pulse width.
10. Pulse Amplitude Modulation and detection, using 555 timer.
11. Pulse Position Modulation using 555 timer.
12. Second order active filters using op-Amp: LPF, HPF and BPF

OPEN ENDED EXPERIMENTS:

1. Demonstration of Hysteresis Curve using Schmitt Trigger Op-amp Circuit.
2. Generation of waveforms [Triangular, Square] using Op-amp circuits.
3. Determination of Bit Error Rate and Analysis of Eye Pattern in a Digital Transmission using Light Runner.
4. Analysis of Optical Amplification in a WDM link having EDFA and Measurement of the overall system gains for different wavelength combinations in the C-Band using Light Runner.

REFERENCES:

1. Introduction to Fiber Optic A.Ghatak and K. Thygarajan, Cambridge University Press, Cambridge, UK 1988.
2. Fiber optical Communication System, 3rd addition Govind P. Agrawal, John wiley Sons Inc. 2002.
3. Optical Fiber Communication Principles and Systems S. Kar, A. Selvarajan and T Sreenivas Tata McGraw Hill Publishing Company Ltd., New Delfi, 2002.
4. An Introduction to Analog and Digital Communication system, Simon Hykin and John Wiley 2004

Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Use Light Runner to set up an Analog link and digital link for data transmission. Also, determine attenuation, power, rise time, losses and Numerical Aperture of optical link and ability to develop experiments independently on light runner	PO1, PO4[L3,L4], PO12
CO2	Analyze the characterization and working of Laser diode, Photodiode, FBG, Optical circulator, TDM, OADM, WDM-MUX and WDM-DEMUX.	PO2,PO3,PO5, [L3,L4]
CO3	Analyze and verify Amplitude Modulation, Frequency Modulation, PPM, PWM using 555 timer /8038/2206 and spectrum analyser in a team	PO1, PO2, PO5,PO9 [L3]
CO4	Determine frequency response of Second Order Active filters using OpAmp	PO1, PO2 [L4]

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
#1	**3**			**2**								**1**	**3**	
#2		**3**	**3**		**2**									**3**
#3	**3**	**2**			**2**				**2**				**3**	**2**
#4	**2**	**2**											**2**	**2**

Title: Embedded Systems			
Course Code: P17EC61	**Semester: VI**	**L – T – P : 4 – 0 - 0**	**Credits: 4**
Contact Period-Lecture: 52Hrs.; Exam:3 Hrs.	**Weightage: CIE: 50%;**	**SEE: 50%**	

A. Course Learning Objective (CLO's)

This Course aims to:

1. Provide the knowledge about basic concepts of Embedded Systems.
2. Outline the concepts of typical embedded systems.
3. Describe the characteristics and quality attributes of embedded systems.
4. Provide the knowledge of software hardware co–design.
5. Describe the concepts of real time operating system based embedded systems.
6. Provide the knowledge of Task synchronization and communication.
7. Learn about the task states, task creation and management under Vxworks and MicroC/OS-II kernel.
8. Learn about different inter-task communication supported by Vxworks and MicroC/OS-II kernel.

B. Course Content

UNIT-I

Introduction to Embedded Systems: What is an embedded system? Embedded System vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, 'Smart' Running Shoes from Adidas-The Innovative Bonding of Life style with Embedded Technology.

The Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface Embedded Firmware, Other System Components.

Text 1: 1.1 to 1.7 and 2.1 to 2.7 **11 Hrs**

UNIT-II

Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, Quality attributes of embedded systems.

Embedded System- Application and Domain Specific: Consumer (Washing Machine), Automotive

Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language, Hardware Software Trade-offs.

Text 1: 3.1 to3.2, 4.1 to 4.2 and 7.1 to 7.4 **10 Hrs**

UNIT – III

Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether.(Including programs)

Text 1: 10.1 to 10.6 **10 Hrs**

UNIT – IV

Real-Time Operating System (RTOS) based Embedded System Design:

Task Communication – Task communication/Synchronization isuues, Dead lock, the dining Philodophers Problem, Producer-consumer/Bounded Buffer Problem, Reader Writer Problem, Priority inversion.

Task Synchronization – Mutual Exclusion through Busy Waiting/Spin Lock, Mutual Exclusion through sleep & wake up.
Device Drivers, How to Choose an RTOS- Functional Requirements, Non-functional requirements.(Including programs)
Text 1: 10.7 to 10.10 **11 Hrs**

UNIT – V

An Introduction to Embedded System Design with Vx works and Micro C/OS-II RTOs: Vx works – Task Creation and Management, Task Scheduling, kernel services, Inter-Task Communication, Task Synchronization and Mutual Exclusion, Interrupt Handling, Watchdog for Task Execution Monitoring , Timing and reference. (Including programs) Micro C/OS: Task Creation and Management, Task Scheduling, kernel function and initialization, Inter-Task Communication, Task Synchronization and Mutual Exclusion, Timing and reference Memory Management, Interrupt Handling. (Including programs)

Text 1: 11.1 to 11.2 **10 Hrs**

TEXT BOOK:

1. "Introduction to Embedded Systems", Shibu K V, Tata McGraw Hill Education Private Limited, ISBN-13:978-0-07-014589-4, 2009.

REFERENCE BOOKS:

1. **" Real Time Concepts for Embedded Systems"** , Qing Li, Elsevier, 2011. ***ISBN 1***-57820-124-***1***
1. **"Embedded/ Real Time Systems: Concept, Design and Programming"** Dr. K V K K Prasad, Dreamtech press Publisher. ***ISBN*** 13, 9788177224610
2. **"Embedded Systems –A contemporary Design Tool",** James K Peckol, John Weily, 2008.ISBN: 9788126524563, 8126524561
3. **"Embedded Systems Design: An Introduction to Processes, Tools, and Techniques",** by Arnold S. Berger ISBN: 1578200733 CMP Books © 2002

Self Learning Component:

Unit-I	1. Draw the interfacing diagram for connecting an LED to the port pin of a microcontroller. The LED is turned ON when the microcontroller port pin is at Logic '0'. Calculate the resistance required to connect in series with the LED for the following design parameters. a. LED voltage drop on conducting = 1.7 V b. LED current rating = 20mA c. Power supply voltage = 5V 2. Design an RC based reset circuit for producing an active low Power on Reset pulse of width 0.1 milli second.
Unit II	1. Draw the Data Flow Graph model for FIR filter implementation y[n] = a0 x [n] + a1 x [n-1]+ a2 x [n-2]+ …. a(n-1) x[1] 2. Draw the sequence diagram for the automatic coffee vending machine using UML.
Unit III	1. Create 'n' number of child threads. Each thread prints the message " I'm in thread number " and sleeps for 50 ms and then quits. The main thread waits for complete execution of all the child threads and then quits. 2. Write the multithread application satisfying the following : a. Two child threads are crated with normal priority. b. Thread 1 receives and prints its priority and sleeps for 50ms and then quits. c. Thread 2 prints the priority of the thread 1 and rises its priority to above normal and retrieves the new priority of thread 1, prints it and

	then quits. d. The main thread waits for the child thread to complete its job and quits.
Unit IV	1. Implement the usage of anonymous pipe with 512 bytes for data sharing between parent and child process. 2. Write a multithread application satisfying the following. a. The main thread creates a child thread with default stack size and name 'Child Thread'. b. The main thread sends user defined messages and the message 'WM_QUIT' randomly to the child thread. c. The child thread processes the message posted by the main thread and quits when it receives the 'WM_QUIT' message. d. The main thread checks the termination of the child thread and quits when the child thread complete its execution. e. The main thread continues sending the random messages to the child thread till the 'WM_QUIT' message is sent to child thread. f. The messaging mechanism between the main thread and child thread is synchronous.
Unit V	1. Write a Vx works multitasking application to create two tasks as per the following requirements a. The stack size for both the tasks are 2000 b. Priority for both the tasks are 100 c. Task 1 prints the message "hello from Task 1" continuously with delay of 500 timer ticks between successive printings. d. Task 2 prints the message "hello from Task 2" continuously with a delay of 500 timer ticks between successive printing. 2. Create a POSIX based message queue under Vx works for communicating between two tasks as per the requirements given below a. Use a named message queue with name "my queue" b. Create two tasks(task1 and task2) with stack size 4000 and priorities 99 and 100 respectively. c. Task 1 creates the specified message queue as Read Write and reads the message present, if any, from the message queue and prints it on the console. d. Task2 open the message queue and posts the message 'Hi from Task2'. Handle all possible error scenarios appropriately.

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of Microcontrollers to understand & explain the concepts of Embedded systems.	**PO1 (L1,L2)**
CO2	**Analyse** and understand the different issues involved in embedded system development using real time operating systems.	**PO2 (L2)**
CO3	**Design** and **Develop** domain specific Embedded system applications.	**PO3 (L5)**
CO4	**Design** and **Develop** a domain specific Real time Embedded system applications	**PO3 (L3)**

D.Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3												3	
#2		2												2
#3			2											2
#4			2											2

Course Title : Aptitude and Reasoning Development - Advanced (ARDA)			
Course Code : P17HU510	Semester : 5	L:T:P:H :0:0:2:2	Credits: 1
Contact Period: Lecture: 32 Hr, Exam: 3 Hr		Weightage: CIE:50;% SEE:50%	
Prerequisites: Vocabulary builder, Concept of Percentage.			

Course Learning Objectives (CLOS)

This course aims to,

1. Describe the importance of reading with comprehension.
2. Explain seven dimensions approach to better reading skills.
3. Explain the purpose, plan and the ways to identify specific details in a paragraph for better comprehension.
4. Formulate easier ways to solve problems of averages.
5. Explain the Application of the technique of alligation while solving weighted average and mixture problems.
6. Describe the concepts of profit, loss, discount, marked price.
7. Explain the application of percentage in our daily life.
8. Discover different ways to identify the progressions and to compare between AP< GP and HP.
9. Explain the basic concepts in calculating simple interest and compound interest.
10. Differentiate between simple interest and compound interest and describes the importance of compound interest and its behavior.

Course Content

UNIT – I

Reading Comprehension:

Introduction: Read more and more, the process of writing and its relevance to the process of writing, how reading skills are important for aspects other than the reading comprehension questions, the daily reading scheme.

Seven dimension approach to better reading skills:

Developing the ability of understanding vocabulary in context, Ability to identify and understand main ideas, Ability to predict and identify supporting details, Understanding the use of transition and idea organization patterns, Inferences, Identifying purpose and tone, Recognizing and evaluating arguments and their common structures.

Theory of reading comprehension:

Solving RC passages is an exact science, tackling RC on the basis of evaluation of support, All passages have a topic, purpose and a plan, Other things to pick up while reading the passage– The tonality and other software related the author's viewpoint in the passage, specific details and their use in the passage, Types of questions asked in reading comprehension passage.

10 Hrs

UNIT – II

Averages and Alligations mixtures:

Average: relevance of average, meaning of average, properties of average, deviation method, concept of weighted average. **Alligation method:** situation where allegation technique, general representation of alligations, the straight line approach, application of weighted average and alligation method in problems involving mixtures. Application of alligation on situation other than mixtures problems.

6 Hrs

UNIT – III

Profit and Loss: percentage change, original 100 concept effect of percentage increase or decrease in number, effect of successive percentage change, amount of change, comparison of two numbers through percentage and ratio, return to original concept, net percentage change to keep product fixed. Definition of basic terms— cost price, selling price, profit percentage, discount and marked price, solving problems using n/d method, techniques to tackle from standard set of problems, the concept of mark up. Concept of partnership and problems involving partnership

6 Hrs

UNIT IV

Progression:

Arithmetic Progression: sum of given number of terms in an A.P., arithmetic mean, to insert a given number of arithmetic means between two given quantities, nth term of an A.P., finding common difference of an A.P. given 2 terms of an A.P., types of A.P.s– increasing A.P.s and decreasing A.P. s

Geometric: to find, the geometric mean between two given quantities, to insert a given number of geometric means between two given quantities, sum of a number of terms in a G.P. Types of G.P.s— increasing G. P. s type one and two , decreasing G. P. s type one and two.

Harmonic Progression: to find the harmonic mean between two given quantities, theorems related with progressions, solved examples sample company questions

6 Hrs

UNIT- V

Simple Interest and Compound Interest

Concept of time value of money, Terminology pertaining to interest, Relation among Principal, Time, Rate percent per annum and total interest. Compound interest, Depreciation of value, Population, Application of interest in D.I.– The difference between simple annual growth rate and compound annual growth rate.

4 Hrs

Reference books:

1. **Trachtenberg speed system of basic mathematics**, published by Rupa publications.
2. AbhijithGuha **"CAT Mathematics"** published by PHI learning private limited.
3. Dr. R. S Agarwal "**Quantitative aptitude**" published by S.Chand private limited.
4. Dr. R. S Agarwal , " **Verbal reasoning**" published by S. Chand private limited.
5. Arun Sharma " **Quantitative aptitude**" for CAT by, published by McGraw Hill publication.

Course Outcomes (CO)

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

1. Apply the approach of seven dimensions to better reading skills. L2
2. Solve the questions under reading comprehension confidently with higher accuracy than random reading. L4
3. Apply the technique of alligation for effective problem solving. L2
4. Interpret the requirement of different methods of calculating average and apply the right method at right scenario. L4

5. Effectively solve problems of profit and loss and problems related to discount, simple interest and compound interest. L5
6. Formulate the equations for summation and other functions for all the kinds of progressions– AP, GP and HP. L1

Course Articulation Matrix (CAM)															
Course Outcome (CO)	Program Outcome (ABET/NBA-(3a-k))														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Apply the approach of seven dimensions to better reading skills.	L2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Solve the questions under reading comprehension confidently with higher accuracy than random reading.	L4	-	-	-	-	-	-	2	-	2	-	-	-	-	-
Apply the technique of alligation for effective problem solving.	L2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Interpret the requirement of different methods of calculating average and apply the right method at right scenario.	L4	2	-	-	-	-	-	-	-	2	-	-	-	-	-
Effectively solve problems of profit and loss and problems related to discount, simple interest and compound interest.	L5	3	-	-	-	-	-	-	-	2	-	-	-	-	-
1 – Low, 2 – Moderate and 3 – High															

Course Title: Computer Communication Networks			
Course Code: P17EC62	**Semester: VI**	**L-T-P:4-0-0**	**Credits: 04**
Contact Period - Lab: 39Hrs.; Exam: 3 Hrs.	**Weightage: CIE: 50 %;**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to

1) Describe/explain the computer network applications, network hierarchy, TCP/IP layers functioning, their dependency and interaction.
2) Compute and characterize different types of delays and error detection schemes in a computer network.
3) Analyze and optimize the network delay and path for the given specifications.
4) Identify and illustrate the roles, responsibilities, limitations and resource fairness in context of computer networks.
5) Understand and compare various channel access schemes/techniques and routing algorithms

B. Course Content

UNIT– I

Overview of The Internet: Networks , Switching, The Internet, Accessing the Internet, Hardware and Software, Protocol Layering, Scenarios, TCP/IP Protocol Suite, Standards And Administration, Internet Standards, Internet Administration, Introduction, Providing Services , Application-Layer Paradigms, Client-Server Paradigm, Application Programming Interface, Using Services of the Transport Layer.

Text 1:1.1.1-1.1.5, 1.2.1, 1.2.2, 1.4.1, 1.4.2, 2.1.1, 2.1.2, 2.2.1, 2.2.2. 11 Hrs

UNIT– II

Standard Client-Server Applications: World Wide Web and HTTP, FTP, Electronic Mail, TELNET, Domain Name System (DNS), PEER-TO-PEER PARADIGM,P2P Networks, Distributed Hash Table (DHT),A Popular P2P Network: Bit Torrent.

Text 1:2.3.1-2.3.4, 2.3.6, 2.4.1, 2.4.2, 2.4.6 10 Hrs

UNIT– III

Introduction: Transport-Layer Services, Transport-Layer Protocols, Simple Protocol, Stop and-Wait Protocol, Go-Back-N Protocol (GBN), Selective-Repeat Protocol, USER Datagram Protocol (UDP), User Datagram, UDP Services, UDP Applications, Transmission Control Protocol (TCP), TCP Services, TCP Features, Segment, A TCP Connection, TCP Congestion Control.

Text 1:3.1, 3.2.1 - 3.2.5, 3.3, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.9 11 Hrs

UNIT– IV

Introduction: Network-Layer Services, Packet Switching, Network-Layer Performance, Network-Layer Congestion, Structure of A Router, Network-Layer Protocols, IPv4 Datagram Format, IPv4 Addresses, Forwarding of IP Packets ,ICMPv4 ,Next Generation Ip, Packet Format, Transition from IPv4 to IPv6.

Text 1:4.1.1 – 4.1.4, 4.1.5, 4.2.1 – 4.2.4, 4.5.1, 4.5.3 10 Hrs

UNIT– V

Introduction: Nodes and Links, Two Types of Links, Two Sub layers, Data Link Control (Dlc), Framing, Flow and Error Control, Error Detection and Correction, Two DLC Protocols, Multiple Access Protocols (MAC), Random Access, Controlled Access, Channelization, Other Wired Networks, Point-to-Point Networks, Connecting Devices, Repeaters or Hubs, Link-Layer Switches.

Text 1:5.1, 5.2, 5.3, 5.6.1, 5.7.1, 5.7.2 10 Hrs

TEXT BOOK:

1. "**Computer Networks, A Top-Down Approach**" by Behrouz A. Forouzan and Firouz Mosharraf, Tata McGraw-Hill Education, 2012.ISBN 13: 9781259001567.

REFERENCE BOOKS:

1. "**Computer Networks**", James F. Kurose and Keith W. Ross, Pearson education, 7e.ISBN-13: 978-0-13-285620-1. ISBN-10: 0-13-285620-4
2. "**Computer Networks**", Andrew S. Tanenbaum, PHI, 5e.ISBN-13: 978-0-13-212695-3.
3. "**Computer and Communication Networks**", 2e, Nader F Mir, Prentice Hall, 2014.ISBN 10: 0133814742 ISBN 13: 9780133814743

Self Learning Components:

SLC-1: Real time interactive protocols
SLC-2: Quality of service
SLC-3: Confidentiality
SLC-4: Internet security
SLC-5: Firewalls

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply basic mathematics and fundamentals of digital communication to understand concepts of networks.	PO1[L3]
CO2	Analyse and compare the various algorithms and protocols	PO2[L4]
CO3	Analyse and characterise computer networks	PO2[L4]
CO4	Analyse and optimize the network delay and path for the given specifications.	PO2[L4]
CO5	Identify and illustrate the roles, responsibilities, limitations and resource fairness in context of computer networks	PO1[L3], PO8[L3]

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
#1	**2**												**2**	
#2		**3**												**3**
#3		**3**												**3**
#4		**3**												**3**
#5	**3**							**1**					**3**	

Course Title : Microwaves and Antennas			
Course Code: P17EC63	**Semester : VI**	**L-T-P: 4-0-0**	**Credits: 4**
Contact Period : 52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives

This course aims to

1. Provide the basic knowledge of Microwave transmission lines and planar transmission lines.
2. Discuss the working of Microwave Waveguides and components.
3. Describe the Microwave Network theories and working of passive Devices.
4. Provide the understanding of concepts of Transfer Electron Devices, Avalanche transit time Devices and Design of Microwave Integrated circuits.
5. Solve the numerical Problems on Microwave transmission lines, Microwave Network Theory.
6. Discuss the parameters of antenna, field due to dipole and linear antenna.
7. Describe the structure and working of different types of antennas.

B. Course Content

UNIT I

Microwave Transmission Lines: Introduction, transmission lines equations, characteristics and input impedances, reflection and transmission coefficients, standing waves, mismatch losses in transmission lines, rectangular waveguides, TE and TM wave solutions , dominant and degenerate modes.

Planar Transmission Lines: strip lines, microstrip lines, microwave integrated circuit design and manufacturing**:** Introduction, types of MICs and their technology, hybrid technology, monolithic technology, MIC lumped and distributed elements.

Text1: 3.1- 3.6, 3.10, 3.10.1, 3.10.2, 3.11.1-3.11.4, 4.1-4.5 **11 Hrs**

UNIT II

Microwave Network Theory and Passive Devices: introduction, symmetrical Z- and Y-matrices for reciprocal network, scattering or S- matrix representation of multiport network.

Microwave Passive Devices: Attenuators, phase shifters, waveguide tees, Directional couplers-coupled transmission line coupler, coupled coaxial lines, microstrip and strip line coupler, analysis of the transmission line coupler (excluding all other types of couplers), power divider and combiners.

Text1: 6.1-6.3, 6.4.14, 6.4.15, 6.4.16, 6.4.18, 6.4.19 **10 Hrs**

UNIT III

Microwave Solid State Devices: introduction, diodes, transferred electron devices (TED) - Gunn diodes, avalanche transit time devices (ATTD), tunnel diodes, varactor diodes.

Applications of Microwaves: Introduction, microwave radar systems, microwave communication systems, industrial application of microwaves, medical applications.

Text1: 10.1-10.6, 11.1-11.5 **10 Hrs**

UNIT IV

Antenna Basics: Basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, directivity and gain, antenna apertures, effective height, the radio communication links, antenna filed zones, Shape Impedance consideration.

Electric Dipoles and Thin Linear Antennas: introduction, Short electric dipole, fields of a short dipole, radiation resistance of short dipole, thin linear antenna.

Text2: 2.1 - 2.11, 2.13, 2.14, 5.1 – 5.5 **11 Hrs**

UNIT V

Antenna Types: Flat sheet reflectors, corner reflectors, parabolic general properties, lens antennas, sleeve antenna, turnstile antenna, antennas for terrestrial mobile communication system, base station antennas, mobile station antenna, antennas for ground penetrating radars, embedded antennas, ultra wide band antennas, plasma antenna, adaptive and smart antennas.

Horn, Yagi-Uda Array and log Periodic Antenna: Horn antenna, practical design consideration, Yagi-Uda array, slot antenna, Balinet's principle and complementary antennas, patch or micro-strip antennas.

Text 2: 8.2, 8.3, 8.5, 14.2, 17.6, 17.7, 17.25, 17.25a, 17.25b, 17.26-17.29, 6.19, 7.4, 7.7, 6.12, 6.14, 6.18, 5.21 **10 Hrs**

TEXT BOOK:

1. Annapurna Das, Sisir K Das, "**Microwave Engineering**", T.M.H, 2nd Edition-2009 ISBN:9780070667389.
2. John D Kraus, Ronald J Marheka, Ahmad s Khan, "**Antennas for all Applications**", T.M.H,2006, 3rd edition ISBN:9780070601857.

REFERENCE BOOKS:

1. David M Pozar, "**Microwave Engineering**", John Wiley,2004, 2nd Edition ISBN: 9780470631553
2. Robert E Collin, "**Foundations for Microwave Engineering**", John Wiley & Sons Inc (Sea) Pte Ltd, 2009.
3. Samuel Y Liao, "**Microwave Devices and Circuits**", 2004, 3rd Edition ISBN:9780135846810
4. C. A. Balanis, "**Antenna Theory Analysis and Design**", John Wiley, 1997,2nd Edition ISBN:9780471592686.

Self Learning Components:

1. Study of circular waveguides, TE and TM wave solutions, dominant and degenerate modes.
2. Study of Microwave radiation Hazards.
3. Visit nearby microwave station and submit the report.
4. Study of antenna point sources and Arrays.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of mathematics and EM fields to understand the parameters, field due to antennas, properties of microwave devices and transmission lines	PO1 [L3]
CO2	**Analyse** IC design techniques and microwave transmission lines for different losses.	PO1,PO2 [L4]
CO3	**Examine** the working and performance of microwave sources, microwave transmission line and different types of antennas.	PO2 [L4]
CO4	**Analyse** the working and performance of microwave devices, networks and antennas.	PO2 [L4]
CO5	**Analyse** the applications of microwaves, devices and antennas.	PO2 [L4]

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	3												3	
#2	2	3												3
#3		3												3
#4		3												3
#5		2												3

Foundation Course-II

Course Title : Control Systems			
Course Code: P17EC64	**Semester : VI**	**L-T-P-H: 4 – 0 – 0- 4**	**Credits:4**
Contact Period: Lecture: 52 Hrs. Exam: 3Hrs.		**Weightage : CIE:50%**	**SEE:50%**

A. Course learning objectives

This course aims to

1. Discuss the mathematical model of physical system, of physical system, mechanical stem 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 Bode plots and relative stability analysis.
7. Discuss the concepts of state variables and state models for electrical system.

B. 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: 1.1, 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 1:2.4, 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 1:6.1, 6.2, 6.4, 6.5, 6.6, 7.1, 7.2, 7.3 **10 Hrs**

UNIT – IV

Stability in the Frequency Domain: Introduction to frequency domain analysis, Correlation between time & frequency response, all pass and minimum phase systems, Experimental determination of transfer functions in bode plots. Assessment of relative stability using bode Plots.

Polar Plot: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion, Stability analysis using polar plot, Numerical problems.

Text 1: 8.1, 8.2, 8.4, 8.5, 8.6, 9.1, 9.2, 9.3, 9.4, **12 Hrs**

UNIT – V

Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Controllability and observability, Derivation of transfer functions from the state model, Solution of state equations.

Text 1:12.1, 12.2, 12.3, 12.6, 12.7 **10 Hrs**

Self Learning Componets:

Group activity for commenting on existing demos, modeling of systems, plotting of different plots and stability analysis of the systems using Scilab/ Mathlab/Mappe.

TEXT BOOK:

1."Control Systems Engineering", I. J. Nagarath and M. Gopal, New Age International (P) Limited, Publishers, Fourth edition – 2005. ISBN 10:8122420087; ISBN 13: 9788122420081.

REFERENCE BOOKS:

1. "**Modern Control Engineering**", K. Ogata, Pearson Education Asia/ PHI, 4th Edition,2002. ISBN 0-13-043245-8.

2. "**Concepts of Control Systems**", P. S. Satyanarayana, Dynaram publishers, Bangalore,2001. ISBN: 1234567152271.

3. "**Automatic Control Systems**", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8thEdition,2008. ISBN 978-81-203-4010-7

4. "**Feedback control system analysis and synthesis**", J. J. D'Azzo and C. H. Houpis McGraw Hill, International student Edition. ISBN 10: 0070161755 / ISBN 13: 9780070161757.

C.Course outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply mathematical knowledge** to determine the Transfer function of a system.	PO1(L3)
CO2	**Analyse** the stability of a system using different techniques.	PO2(L4)
CO3	**Analyse** response of the system in time and frequency Domain and state variable techniques.	PO2(L4)
CO4	**Develop the mathematical models** using different techniques of state variables.	PO2(L4)
CO5	**Commenting on existing demo, group activity based learning new tools and applying for design**	PO4, PO9(L5)

D.Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	**3**												**3**	
#2		**3**												**3**
#3		**3**												**3**
#4		**3**												**3**
#5				**1**	**2**				**1**					

Elective II

Course Title : Multimedia Communication			
Course Code: P17EC651	**Semester : VI**	**L-T-P-H: 4 – 0 – 0- 4**	**Credits:3**
Contact Period: Lecture: 52 Hrs. Exam: 3Hrs.		**Weightage : CIE:50%**	**SEE:50%**

A. Course Learning Objectives

This course aims to

1. Explain the types of multimedia network and its applications.
2. Describe the digitization principles of text and images.
3. Provide the understanding of digitization techniques of audio and video.
4. Discuss the compression techniques of different media.
5. Describe the standards related to multimedia communication.
6. Explain the various data security and encryption techniques.

B. Course Content

UNIT – I

Multimedia Communications: Introduction, Multimedia information representation, Multimedia networks, Multimedia applications, Application and networking terminology.
Text 1: 1.1 to 1.5 **10 Hrs**

UNIT – II

Multimedia Information Representation: Introduction, Digitization principles, Text, Images, Audio, Video.
Text 1: 2.1 to 2.6 **10 Hrs**

UNIT – III

Text and Image Compression: Introduction, Compression principles, Text compression, Image compression.
Audio and Video Compression: Introduction, Audio compression, Video compression.
Text 1: 3.1 to 3.4 and 4.1 to 4.3 **11 Hrs**

UNIT – IV

Standards for Multimedia Communications: Introduction, Reference model, Standards relating to interpersonal communications, Standards relating to interactive applications over the internet, Standards for entertainment applications.
Text 1: 5.1 to 5.5 **11 Hrs**

UNIT – V

Entertainment Networks and High–Speed Modems: Introduction, Cable TV networks, Satellite television networks.
Application Support Functions: Introduction, ASN.1, Security, Data encryption, Nonrepudiation, Authentication, Public key certification authorities.
Text 1: 11.1 to 11.3 , 13.1-13.7. **10 Hrs**

Self Learning Components

1. Multipoint Control Unit (MCU),
2. Multipoint Video Conferencing Blog
3. Huffman Coding,

4. PC Video representation
5. Dolby coders
6. Lossy and Lossless Compression techniques
7. MPEG-7
8. MPEG-21 multimedia framework.
9. High speed modems
10. RSA Algorithm

TEXT BOOK:

1. "**Multimedia Communications, applications, networks, protocols and standards**", Fred Halsall, Pearson, Fifth Impression, 2011.ISBN: 978-81-317-0994-8

REFERENCE BOOKS:

1. "**Fundamentals of Multimedia**", ZeNian li and Mark.S.Drew, Pearson education,2004. ISBN-13: 978-0130618726
2. "**Multimedia: Computing, Communications and Applications**", Ralf Steinmetz and Klara Nabrsted, Pearson Education, 2004.ISBN : 9788177584417
3. "**Multimedia Communication Systems**", K.R Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Pearson Education, 2004.ISBN: 013031398X
4. "**Multimedia: Making it Work**", Tay Vaughan, Tata McGraw Hill, 2004. ISBN : 978-0-07-063681-8
5. "**Multimedia Information Systems**", PallapaVenkataram, Pearson Education, 2005.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the basic knowledge of digital data processing and computer networking in understanding Multimedia systems and standards.	PO1 [L3]
CO2	**Analyze** various data representation types and compression algorithms for different media types	PO1,PO2 [L4]
CO3	**Inspect** the various standards used in multimedia applications.	PO2 [L2]
CO4	**Compare** various data networks in multimedia.	PO2 [L4]
CO5	**Analyze** the multimedia standards, data security and encryption techniques.	PO2 [L4]

D. Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3												3	
#2	3	2											3	3
#3		2											2	3
#4		3											2	3
#5		2											2	2

Course Title : Cognitive Radio Networks			
Course Code: P17EC652	**Semester : VI**	**L-T-P-H: 4 – 0 – 0- 4**	**Credits:03**
Contact Period: Lecture: 52 Hrs. Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives

This course aims to

1. Explain the hardware and software domains of software-defined radio (SDR)
2. Describe the technologies required for cognitive radio and spectrum aware radio.
3. Discuss the fully functional cognitive radio and the intelligent cross-layer optimization of physical (PHY) and link (or medium access control, MAC) layers.
4. Provide the understanding of position and network awareness in cognitive radio.
5. Explain the cognitive services for the radio.
6. Describe the radio environment map(REM) and different cognitive radio architectures.

B. Course Content

UNIT – I

The Software Defined Radio as a Platform for Cognitive Radio: Introduction, Hardware Architecture, Software Architecture, SDR Development and Design, Applications, Development, Cognitive Waveform Development.

Text 1: 3.1-3.7 **10 Hrs**

UNIT – II

Cognitive Radio- The Technologies Required: Introduction, Radio Flexibility and Capability, Aware, Adaptive, and CRs, Comparison of Radio Capabilities and Properties, Available Technologies for CRs.

Spectrum Awareness: Introduction, The Interference Avoidance Problem, Cognitive Radio Role, Spectral Footprint Minimization, Creating Spectrum Awareness, Channel Awareness and Multiple Signals in Space, Spectrally Aware Networking, Overlay and Underlay Techniques, Adaptive Spectrum Implications for Cognitive Radio Hardware.

Text 1: 4.1-4.5, 5.1-5.9 **10 Hrs**

UNIT – III

Cognitive Techniques- Physical and Link Layers: Introduction, Optimizing PHY and Link Layers for Multiple-Objectives under Current Channel Conditions, Defining the Cognitive Radio, Developing Radio Controls (Knobs) and Performance Measures (Meters), MODM Theory and Its Application to Cognitive Radio, The Multi-objective GA for Cognitive Radios, Advanced GA Techniques.

Cognitive Techniques-Position Awareness: Introduction, Radio Geolocation and Time Services, Network Localization, Additional Geolocation Approaches, Network-Based Approaches, Boundary Decisions.

Text 1: 7.1-7.7, 8.1-8.6 **11 Hrs**

UNIT – IV

Cognitive Techniques-Network Awareness: Introduction, Applications and their Requirements, Network Solutions to Requirements, Coping with the Complex Trade-Space, Cognition to the Rescue, The DARPA SAPIENT Program.

Cognitive Services for the User: Introduction, Speech and Language Processing, Concierge Services.

Text 1: 9.1-9.6, 10.1-10.3 **10 Hrs**

UNIT – V

Network Support The Radio Environment Map: Introduction, Internal and External Network Support, Introduction to the REM, REM Infrastructure Support to Cognitive Radios, Obtaining Awareness with the REM, Network Support Scenarios and Applications, Supporting Elements to the REM.

Cognitive Radio Architecture: Introduction, CRA I: Functions, Components, and Design Rules, CRA II: The Cognition Cycle, CRA III: The Inference Hierarchy.

Text 1: 11.1-11.7, 14.1-14.4 **11 Hrs**

Self Learning Components

1. Global Policy interest in Cognitive networks
2. Cognitive Geolocation applications
3. Cognitive Radio Authentication applications
4. Higher Layer Intelligence of Cognitive Radios
5. Interfaces to Other Cognitive technologies
6. PDF detection in Cognitive radio Networks
7. Building the CRA on SDR architectures

TEXT BOOK:

1."**Cognitive Radio Technology**" Bruce A. Fette (Editor), Elsevier(Newnes) 2006. ISBN:13:978-0-7506-7, 10:0-7506-7952-2.

REFERENCE BOOKS:

1. "**Software Defined Radio for 3G**", Paul Burns- Artech house, 2002. ISBN: 1-58053-347-7.

2. "**RF and DSP for SDR**", Tony J. Rouphael-Elsevier (Newnes) 2008. ISBN: 9780080941738,9780750682107.

3. "**Digital Synthesizers and Transmitters for Software Radio**", Joukovankka-Spinger 2005. ISBN:10 1-4020-3194-7.

4. "**RF and Baseband Techniques for Software Defined Radio**", P.Kenington-Artech house, 2005. ISBN: 1-58053-793-6.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the concepts of MODM theory and others to Cognitive radio.	PO1 [L3]
CO2	**Analyze** the functions of different components of Software defined radio in cognitive radio network	PO2 [L4]
CO3	**Design** the cognitive radio network using the concepts of physical and link layers as well as position and network awareness	PO3 [L5]
CO4	**Examine** the applicability of cognitive radio network to cognitive services such as speech and language processing, concierge services.	PO4 [L4]

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**												**3**	
#2		**3**												**3**
#3			**3**										**3**	**3**
#4				**2**									**2**	**2**

Course Title: Adaptive Signal Processing			
Course Code: P17EC653	**Semester: VI**	**L-T- P: 4- 0- 0**	**Credits: 03**
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		**Weightage: CIE: 50% SEE: 50%**	

A. Course Learning Objectives (CLOs)

This Course aims to:

1. Provide general understanding of adaptive systems
2. Provide mathematical understanding of gradient analysis used with adaptive systems
3. Understand the filter design (Adaptive filters) related to adaptive signal processing
4. Provide understanding of LMS algorithm
5. Introduce different algorithms to implement adaptive signal processing
6. Provide exposure to different applications of adaptive signal processing

B. Course Content

UNIT – I

Introduction: Adaptive systems - definitions and characteristics - applications - properties-Open and closed Loop Adaptation- Application of Closed Loop adaptation, examples - adaptive linear combiner input signal and weight vectors – Desired Response and error-performance function-gradient and minimum mean square error, Example of a Performance Surface-Alternate Expression of the gradient, Decorrelation of Error and Input Components.

Properties of Quadratic Performance Surface: Normal Form of Input correlation Matrix, Eigen values and Eigenvectors of the input, correlation matrix, an Example of two weights, Geometrical significance of Eigenvectors and Eigen values, second example

Text 1: chapter 1 , chapter 2 and chapter 3 **10 Hrs**

UNIT – II

Searching the Performance Surface: Methods for searching the performance surface, basic Ideas of gradient search Methods, a simple gradient search algorithm and its solution, stability and rate of convergence, Learning curve, gradient search by Newton's method, Newton's method in multidimensional space, Gradient search by steepest Descent, Comparison of learning Curves.

Gradient Estimation and Its Effect on Application: Gradient Component Estimation by derivative measurement, Performance penalty, Derivative Measurement and Performance Penalties with multiple weights, Variance of gradient Estimate, effects on the weight vector solution, excess mean square error and time constants Mis-adjustments, compaitive performance of Newton's and Steepest-Descent Methods

Text 1: Chapter 4 and chapter 5 **11 Hrs**

UNIT – III

Linear Adaptive Algorithm and Structures: LMS Algorithm-Derivation, Convergence of weight Vector, an example of Convergence, Learning Curve, Noise in Weight-Vector Solution, Misadjustments, Performance.

Z-Transform In Adaptive Signal Processing- z-Transform, right and left handed sequence, Transfer function, frequency response, impulse response and stability, inverse z-Transform, correlation functions and power spectra, performance Function, Example of Performance Surfaces.

Text 1: Chapter 6 and Chapter 7 **11 Hrs**

UNIT – IV

Other Adaptive Algorithms And Structures: LMS/Newton Algorithm, Properties of LMS/Newton Algorithm, The Sequential Regression Algorithm, Adaptive Recursive Filters, Random-Search Algorithms, Lattice structures, The Adaptive Lattice Predictor, Adaptive Filters with Orthogonal Signals.

Text 1: Chapter 8 **10 Hrs**

UNIT – V

Applications of Adaptive Signal Processing: Adaptive Modelling and System Identification: General Description, Adaptive Modelling of a Multipath Communication channel, Adaptive Modelling in Geophysical Exploration, Adaptive Modelling in FIR Digital Filter Synthesis

Adaptive Interference Cancelling: Adaptive Interference cancellor as a Notch Filter, Adaptive Interference cancellor as a High Pass Filter, Cancelling Of 60-Hz Interference in ECG, Cancelling Maternal ECG in Fetal ECG.

Text1: Chapter 9 , 12.5,12.6,12.9,2.11 **10 Hrs**

Self Learning Components

1. Explain the four main application of adaptive filter.
2. Describe the wiener-hopf equation.
3. Explain the concept of Stability of the steepest Descent Algorithm.
4. Design the concepts of least mean square algorithm and application.
5. Comparison of LMS algorithm with the steepest- descent algorithm.
6. Design suitable algorithm for specific application, (any algorithm with any application)
7. Analyze the concept of system identification -adaptive modeling.

TEXT BOOKS:

1. "**Adaptive Signal Processing**", Bernard Widrow and Samuel Stearns, Pearson Education, 2nd Ed., 1995, First Impression-2006, Second Impression-2009. ISBN: 978-81-317-0532-2.

REFERENCE BOOKS:

1. "**Adaptive Filter Theory**", Simon HaykinPrentice Hall International", 3rd Ed., 2002.ISBN: 013322760X
2. "**Adaptive Signal Processing in Wireless Communications**", Mohamed Ibnkahla(Edited),CRC Press, Taylor & Francis Group, 1st Ed., 2009. ISBN: 9781420046021.
3. "**Fundamentals of Adaptive Filtering**", Ali H. Sayed, Wiley, 1st Ed., 2003. ISBN: 0-471-46126-1.
4. "**Adaptive Filters Theory and Applications**", Farhang-Boroujeny B.,John Wiley & Sons, 1st Ed.,1998. ISBN: 978-1-119-97954-8.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the basic Knowledge of Mathematics and Signal Processing to understand Adaptive Systems, Algorithms for adaptive systems and applications.	PO1(L3)
CO2	**Analyze** Adaptive Systems for their operations and Performance	PO2 (L4)
CO3	**Analyze** and **Develop** algorithms for adaptive systems	PO2-PO3 (L4, L5)
CO4	**Apply** the concepts of Adaptive Signal Processing to **analyze and Develop** algorithms for adaptive filters	PO2, PO3, (L4, L5)
CO5	**Apply** the concepts of adaptive signal processing to real world applications	PO1 (L2)

D. Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	**3**												**3**	
#2	**3**												**3**	
#3	**3**	**3**	**2**										**3**	**2**
#4		**3**	**2**										**3**	**2**
#5	**3**												**3**	**3**

Course Title: Data Structures			
Course Code: P17EC654	**Semester: VI**	**L – T – P : 4 – 0 – 0**	**Credits: 03**
Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.		**Weightage: CIE: 50%; SEE: 50%**	

A. Course Learning Objectives

This Course aims to:

1. Introduce the fundamentals of Data Structures, abstract concepts and how these concepts are useful in problem solving.
2. Analyze the various data structures algorithms step by step.
3. Design and apply appropriate data structures for solving real world problems.
4. Implementing various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs.
5. Understanding various searching & sorting techniques

B. Course Content

Unit - I

Basic Concepts: Pseudocode, The Abstract Data Type, Model for an Abstract Data Type, ADT Implementations, Generic Code for ADTs, Algorithm Efficiency.
Recursion: Factorial—A Case Study, Designing Recursive Algorithms, Recursive Examples.
Text 1: Chapter 1 and 2 **11 Hrs**

Unit - II

Stacks: Basic Stack Operations, Stack Linked List, C Language Implementations, Stack ADT, Stack Applications, How Recursion Works.
Queues: Queue Operations, Queue Linked List Design, Queue ADT, Queuing Theory, Queue Applications.
Text 1: Chapter 3 and 4 **10 Hrs**

Unit - III

General Linear Lists: Basic Operations, Implementation, List ADT, Application.
Introduction to Trees: Basic Tree Concepts, Binary Trees, General Trees.
Binary Search Trees: Basic Concepts, BST Operations, BST Applications.
Text 1: Chapter 5, 6 and 7 **11 Hrs**

Unit - IV

Graphs: Basic Concepts, Operations, Graph Storage Structures, Graph Algorithms, Graph ADT, Networks.
Text 1: Chapter 11 **10 Hrs**

Unit - V

Sorting: Sort Concepts, Selection Sorts, Insertion Sorts, Exchange Sorts, External Sorts, Quick Sort Efficiency.
Searching: List Searches: Search Implementations, Hashed List Searches, Collision Resolution.
Text 1: Chapter 12 and 13 **10 Hrs**

Self Learning Components

1. Enumerated data types
2. Simulation of "Tower of Hanoi" problem
3. Binary search tree ADT
4. Kruskal's Algorithm,
5. Dijikstra's Algorithm

Minimum Spanning trees

Text Book:

1. "**Data Structures – A Pseudocode Approach with C**", Gilberg and Forouzan, 2e d, Cengage Learning.,2004. ISBN-13: 978-0-534-39080-8, 10:m0-534-39080-3.

Reference Book:

1. "**Data Structures using C and C++**", 2e, Langsam, Augenstein, Tenenbaum, PHI

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Ability to analyze algorithms and algorithm efficiency	PO-1,2(L4)
CO2	Ability to choose the types of Data Structures.	PO-2,4(L3)
CO3	Ability to develop proficiency in the specification, representation, and implementation of Data Types and Data Structures.	PO-2,5(L2)
CO4	Ability to select an appropriate data structure for solving typical computing problems.	PO-2,5(L3)
CO5	Ability to apply the concepts of knowledge of tree and graphs.	PO-1, 2(L3)

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
#1	**3**	**3**											**3**	**2**
#2		**3**		**3**									**3**	**2**
#3		**2**			**3**								**3**	**2**
#4		**2**			**3**								**3**	**2**
#5	**3**	**3**											**3**	**2**

Elective III

Course Title: Radar and Navigational Systems			
Course Code:P17EC661	**Semester: VI**	**L- T- P:4 - 0 - 0**	**Credits: 03**
Contact Period - Lecture:52Hrs.;Exam: 3Hrs.		**Weightage: CIE: 50% SEE: 50%**	

A.Course Learning Objectives (CLOs)

This course aims to

1. Describe the basic Radar operation and its applications.
2. Discuss different radar range equations and calculate the effect of various external /internal factors on radar accuracies.
3. Explain the idea behind MTI and tracking systems.
4. Examine the technology of Noise Detection and Radar Clutter.
5. Discuss the transmission and reception of Radar signals.
6. Explain different navigational aids.

B. 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.

Text 1: 1.1 to 1.5, 2.1 to 2.3, 2.5, 2.7. 11 Hrs

UNIT-II

MTI and Pulse Doppler Radar: Introduction, Delay line cancellers, Digital MTI processing, Moving target detection, Limitations to MTI performance. **Tracking Radar:** Tracking with Radar, Monopulse tracking, Conical scan and sequential lobing, Limitations to tracking accuracy.

Text 1: 3.1, 3.2, 3.5 to 3.7,4.1 to 4.4. 10Hrs

UNIT-III

Detection of Signals in Noise: Introduction, Matched filter receiver, Detection criteria, Detectors, Automatic detection. **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 5.5, 7.1 to 7.4, 7.8. 11Hrs

UNIT-IV

Radar transmitter: Introduction, linear beam power tubes, solid state RF power sources, cross field amplifiers. **Radar receiver:** Radar noise figures, Super-heterodyne receiver, Duplexers and receiver protectors, Radar displays.

Text 1: 10.1 to 10.3, 10.5, 11.1 to 11.5. 10 Hrs

UNIT-V

Navigation: Hyperbolic Navigation: Introduction, LORAN-A, LORAN-C, DECCA, OMEGA, DECTRA, DERLAC.

Satellite Navigation: Introduction, Doppler Navigation, GPS, Principle of operation of GPS, GPS Segments, GPS Navigation Message, GPS Data Subframe, Source of Errors in GPS.Modern Navigational Method.

Text 2: 14.1 to 14.10, 15.1, 17.3. **10 Hrs**

Self- Learning Components

1. Radar cross section Fluctuations
2. Pulse repetition frequency
3. Doppler filter Banks and ADT
4. Constant –False- alram rate receivers, and Weather Clutter
5. Magnetron and Other aspects of Radar Transmitters
6. Global positioning system
7. Celestial Navigation

TEXT BOOKS:

1. "**Introduction to Radar Systems**", Merill. I. Skolnik 3rdEdition. Tata McGraw Hill,2001.ISBN-13: 978-0-07-044533-8.
2. "**Radar Systems and Radio aids to Navigation**", Dr. A. K Sen, Dr. A .B Bhattacharya. Khanna Publishers. ISBN **:** 978-81-7409-08-9.

REFERENCE BOOK:

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

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the basics of electromagnetic field theory and mathematics concepts to understand the working of different radars, Tracking systems and Factors affecting radar system.	PO1[L3]
CO2	Analysis of Radar Equations, different types of Radar systems and Tracking systems.	PO1, PO2[L3]
CO3	Analyze the effect of various external / internal factors on Radar and its trans-reception.	PO1, PO2[L2]
CO4	Analysis of radar applications for different target detections.	PO1, PO2[L4]
CO5	Analyze the concept of Navigation and Positioning Aids.	PO1, PO2[L3]

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
#1	**3**												**3**	
#2	**2**	**3**											**2**	**3**
#3	**2**	**3**											**2**	**3**
#4	**1**	**3**											**1**	**3**
#5	**1**	**3**											**1**	**3**

Course Title : Error Control Coding			
Course Code: P17EC662	**Semester : VI**	**L-T-P-H: 4 – 0 – 0- 4**	**Credits:03**
Contact Period: Lecture: 52 Hrs. Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives

This course aims to:
1.Provide the knowledge of groups, fields and different types of codes for error controlling.
2. Analyze the performance of Turbo Codes in communication.
3. Discuss construction and decoding of LDPC Codes.
4. Explain the construction and performance analysis of TCM.
5. Discuss Burst Error Correcting Codes and Automatic Repeat Request strategies.

B. Course Content

UNIT – I

Introduction to error control coding: Coding for reliable digital transmission and storage: Introduction, types of codes, Modulation and coding, maximum likelihood decoding, types of error, error control strategies, performance measures, coded modulation.

Introduction to Algebra: Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2^m) , Basic properties of GF (2^m), Computations using GF (2^m) Arithmetic, Vector spaces, Matrices.

Text 1:1.1-1.8, 2.1-2.8 **11 Hrs**

UNIT – II

Turbo Codes: Introduction to Turbo Coding, Distance Properties of Turbo Codes, Performance Analysis of Turbo Codes, Design of Turbo Codes, Iterative Decoding of Turbo Codes.

Text 1: 16.1-16.5 **10Hrs**

UNIT III

Low-Density Parity-Check Codes: Introduction to LDPC Codes, Tanner Graphs for Linear Block Codes, A Geometric Construction of LDPC Codes, EG-LDPC Codes, PG-LDPC Codes, Decoding of LDPC Codes, Code Construction by Column and Row Splitting.

Text 1: 17.1-17.7 **10Hrs**

UNIT – IV

Trellis-Coded Modulation: Introduction to Trellis-Coded Modulation, TCM Code Construction, TCM Performance Analysis, Rotationally Invariant TCM, Multidimensional TCM.

Text 1: 18.1 to 18.5 **10Hrs**

UNIT – V

Burst Error Correction: Introduction, Decoding of Single-Burst Error-Correcting Cyclic Codes, Single-Burst-Error-Correcting Codes, Phased-Burst-Error-Correcting Codes, and Burst-and-Random-Error-Correcting Codes.

Automatic-Repeat-Request Strategies: Basic ARQ Schemes, Selective-Repeat ARQ System with Finite Receiver Buffer, ARQ Schemes with Mixed Modes of Retransmission, Hybrid ARQ Schemes.

Text1:20.1-20.5, 22.1-22.4 **11Hrs**

Self- Learning Components

1. Write a MATLAB Program to verify whether the given Polynomial is Primitive or not
2. Write a MATLAB Program to find the number of roots for. $f(X)=X^4+a^3X^3+X^2+aX+a^3$ over GF(2^3)
3. Write a MATLAB Program to encode given sequence of 8 bit messages to TURBO CODES
4. Write a MATLAB Program that helps in computing the values of $\alpha\ \beta\ and\ \gamma$ as well as LLR for the given specifications
5. Demonstrate the operation of Bit Flipping Algorithm using MATLAB/Simulink
6. Derive the Generator Matrix for (20,3,4) LDPC code for encoding use.
7. Write a MATLAB Program to demonstrate the operation of a TCM code
8. Describe the operation of TCM for Different types of channel
9. With the help of a MATLAB Program explain the operation of Selective Repeat ARQ
10. Simulate and Explain Go back N ARQ with the help of Cyclic Codes

TEXT BOOK:

1. "**Error Control Coding**", Shu Lin, Daniel J. Costello, Jr., Second Edition, ISBN:978-81-317-3440-7 .

REFERENCE BOOKS:

1. "**Information Theory, Coding and Cryptography**", Ranjan Bose, 2nd Edition. Tata McGraw, ISBN13:978-0-07-0669017.

2. "**Digital Communication systems**", Simon Haykin, John Wiley, 4th Ed. ISBN:0-471-17869-1.

3. "**Digital and analog communication systems**", K. Sam Shanmugam, John Wiley & Sons. Hill– 2008.978-81-265-4231-4.

4. "**Elements of information theory",** Thomas .M. Cover, Joy .a. Thomas, John Wiley-student edition-2006. ISBN: 9780471241959,0471241954.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply knowledge of mathematics to understand concepts of Information theory for communication and also groups, fields.	PO1[L3]
CO2	Develop different error correcting codes for its efficiency used with communication channels.	PO2[L4]
CO3	Design coding schemes for a given specifications and evaluate for their error correcting capability.	PO3[L4]
CO4	Analyze the performance of various Error control codes.	PO2 [L4]
CO5	Discuss different ARQ strategies for Error correction at receiver.	PO2 [L4]

D. Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	**3**												**3**	
#2		**3**												**3**
#3			**2**										**2**	**2**
#4		**2**												**2**
#5		**2**												**2**

Course Title: Computer Organization			
Course Code: P17EC663	**Semester: VI**	**L – T – P : 4 – 0 - 0**	**Credits: 03**
Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.		**Weightage: CIE: 50%; SEE: 50%**	

A.Course Learning Objectives

This Course aims to:

1. Understand the basics of computer organization: structure and operation of computers and their peripherals.
2. Understand the concepts of programs as sequences or machine instructions.
3. Expose different ways of communicating with I/O devices and standard I/O interfaces.
4. Describe hierarchical memory systems including cache memories and virtual memory.
5. Describe arithmetic and logical operations with integer and floating-point operands.
6. Understand basic processing unit and organization of simple processor, concept of pipelining and other large computing systems.

B.Course Content

UNIT - I

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.
Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions.
Text 1: Ch 1: 1.3, 1.4, 1.6.1, 1.6.2, 1.6.4, 1.6.7. Ch 2: 2.2 to 2.10, 2.12 **11 Hrs**

UNIT - II

Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, USB.
Text 1: Ch 4: 4.1, 4.2: 4.2.1 to 4.2.5, 4.4 to 4.7. **10 Hrs**

UNIT - III

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations, Virtual Memories, Secondary Storage.
Text 1: Ch 5: 5.1 to 5.4, 5.5.1, 5.5.2, 5.6, 5.7, 5.9 **11 Hrs**

UNIT - IV

Arithmetic: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating-point Numbers and Operations.
Text 1: Ch 2: 2.1, Ch 6: 6.1 to 6.7 **10 Hrs**

UNIT - V

Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control.
Embedded Systems and Large Computer Systems: Examples of Embedded Systems, Processor chips for embedded applications, Simple Microcontroller.
The structure of General-Purpose Multiprocessors
Text 1: Ch 7: 7.1 to 7.5, Ch 9:9.1 to 9.3, Ch 12:12.3 **10 Hrs**

Self –Learning Components

1. Multiprocessors and Multicomputers
2. Example Program: Vector dot product program
3. Use of interrupts in Operating System
4. ARM interrupt structure
5. Examples of caches in Commercial Processors
6. Memory Management requirements
7. Simulating Fast adders by using any simulator
8. Programming Considerations
9. Embedded Processor families

TEXT BOOK:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: "**Computer Organization**", 5th Edition, Tata McGraw Hill, 2002. ISBN 10: 1259005275 / ISBN 13: 9781259005275

REFERENCE BOOK:

1. William Stallings: "**Computer Organization & Architecture**", 9th Edition, Pearson, 2015. ISBN-13: 978-0-13-607373-4. ISBN-10: 0-13-607373-5

C.Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Acquire knowledge of basic organisation of computing system	PO-1,2(L2)
CO2	Analyse and design arithmetic and logical units.	PO-3,4(L3)
CO3	Apply the knowledge gained in the design of Computer.	PO-5(L1)
CO4	Design and evaluate performance of memory systems	PO-4,5(L2)
CO5	Analyse and design arithmetic and logical units.	PO-3, 4(L2)

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
#1	2	2											3	2
#2			3	3									3	2
#3					1								3	2
#4				2	2								3	2
#5			2	2									3	2

Course Title : VLSI Testing and Verification			
Course Code: P17EC664	**Semester : VI**	(**L:T:P:H**: **4:0:0:4**)	**Credits:03**
Contact Period : Lecture :52 Hrs, Exam:3Hrs		**Weightage:CIE:50%SEE:50%**	

A.Course Learning Objectives (CLOs)

After learning all the units of the course, the student is able to
1. Provide the basic knowledge of VLSI Testing and Verification.
2. Provide the understanding of Test Generation for Combinational Logic Circuits.
3. Design of Testable Combinational Logic Circuits and Sequential Circuits.
4. Outline the concepts of Design of Testable Sequential Circuits and Built-In Self Test.
5. Explain the concept of Verification Tools and The verification plan.

B. Course Content

UNIT -I

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing. Faults in Digital Circuits: Failures and Faults, Modeling of Faults.

Test Generation for Combinational Logic Circuits: Fault Diagnosis of Digital Circuits, Test Generation Techniques for Combinational Circuits.

Text 1:1.1, 1.2, 2.1, 2.2. **10 Hrs**

UNIT II

Testable Combinational Logic Circuit Design: The Reed-Muller Expansion Technique, Three-Level OR-AND-OR Design, Automatic Synthesis of Testable Logic, Synthesis of Random Pattern Testable Combinational Circuits, Path Delay Fault Testable Combinational Logic Design, Testable PLA Design.

Test Generation for Sequential Circuits: Testing of Sequential Circuits as Iterative Combinational Circuits, State Table Verification, Test Generation Based on Circuit Structure, Functional Fault Models, Test Generation Based on Functional Fault Models.

Text1:3.1,3.2,3.3,3.5,3.6,3.7,4.1,4.2,4.3,4.4,4.5. **11Hrs**

UNIT III

Design of Testable Sequential Circuits: Controllability and Observability, Ad Hoc Design Rules for Improving Testability, Design of Diagnosable Sequential Circuits, The Scan-Path Technique for Testable Sequential Circuit Design, Level-Sensitive Scan Design, Boundary Scan.

Built-In Self Test: Test Pattern Generation for BIST, Output Response Analysis, Circular BIST, BIST Architectures.

Text 1: 5.1, 5.2, 5.3, 5.4, 5.5, 5.10, 6.1, 6.2, 6.3, 6.4 . **11 Hrs**

UNIT IV

Verification Tools: Linting tools, Simulators, verification intellectual property, waveform viewers, code coverage, Functional coverage, Verification languages, Assertions, Revision Control, Issue Tracking, Metrics.

Text 2: Ch-2 **10 Hrs**

UNIT V

The verification plan: The role of verification plan, Levels of verification, Verification strategies, From specification to features, Directed Testbenches approaches, Coverage-Driven Random- Based approach.

Text 2: Ch-3 **10 Hrs**

Self Learning Components

1. Detection of Multiple Faults in Combinational Logic Circuits
2. Testable design of Multi level Combinational Circuits.
3. PLA design
4. Random Access Scan Technique
5. Testable Sequential Circuit Design using Nonscan Techniques
6. Identify the different Cycle based and Event based simulators.
7. Object Oriented Programming
8. Aspect Oriented Programming

TEXT BOOKS:

1. Parag. K. Lala, **"Digital Circuit Testing and Testability"**, Academic Press, ISBN 0-12-434330-9 (alk. Paper).
2. JanickBergeron, **"Writing testbenches: functional verification of HDL models"**, 2nd edition Kluwer Academic Publishers,2003, ISBN 1-4020-7401-8.

REFERENCE BOOKS:

1. M. Abramovici, M.A. Breuer and A.D. Friedman, **"Digital Systems and Testable Design"**, Jaico Publishing House, 2002, ISBN 0-7803-1062-4.
2. M.L. Bushnell and V.D. Agrawal, **"Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits"**, Kluwar Academic Publishers, ISBN 978-0-306-470470-0.

C.Course outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of Digital and Analog VLSI circuits to understand the concepts of VLSI Circuit testing.	PO1[L2]
CO2	**Analyze** the various concepts of test generation for combinational, sequential logic circuits and BIST.	PO2[L4]
CO3	**Design** the testable combinational, sequential logic circuits and BIST for the given specifications.	PO3[L4]
CO4	**Discuss** the verification tools and verification languages.	PO2 [L4]
CO5	**Analyze** the role and various levels of verification plan	PO2 [L2]

D.Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	**3**												**3**	
#2		**3**												**3**
#3			**3**										**3**	**3**
#4		**2**												**2**
#5		**3**												**3**

A. Course Plan			
Course Title: **Circuit Simulation Laboratory**			
Course Code: **P17ECL67**	Semester: **VI**	**L-T-P:0-0-3**	**Credits: 1.5**
Contact Period - Lab: **36 Hrs**.; Exam: **3 Hrs.**	Weightage: CIE: 50 %;	SEE: 50%	

B. Course Learning Objectives

This course aims to

- Learning computer aided design and simulation tools
- Design and verification of circuits at system level.
- Capturing system requirements and optimise design.

The design flow must consists of the following

PART –A

Draw the schematic and perform

- Transient analysis,
- AC sweep analysis using **Pspice simulator** for given specification
  1. Clipper and Clamper Circuit.
  2. MOSFET Amplifier.
  3. CMOS Inverter.
  4. Current Controlled Voltage Source
  5. Voltage Controlled Current Source.
  6. Summing Amplifier
  7. ADC

PART –B

For the following set of experiments the design flow must consists of

- Draw the schematic
- Draw the PCB layout and verify with DRC
- Generate the gerber file for given specification

1. Inverting amplifier
2. Design a full adder using basic gates.
3. Monostable / Astable multivibrator
4. Power supply design with regulators
5. Amplitude modulator
6. Frequency modulator
7. Counter design with display.

Open Ended Experiment

1. Temperature monitoring based on environmental condition.
2. Implement home automation with the help of relays.

Course outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of the digital system to design the schematic in Pspice Orcad tools.	PO1,PO5
CO2	**Interpret** the concept of transient and ac sweep analysis using Pspice Simulator	PO2,PO4
CO3	**Design** PCB for the basic analog and digital circuit using Orcad tool	PO3,PO5
CO4	**Analyze and optimize** the circuit for given specification	PO2,PO3,PO4, PO5

E. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3				3									
#2		3		3										
#3			2		3									
#4		3	2	2	3									

Course Title : Microwave and Digital Communication Laboratory		
Course Code: P17ECL68	**Semester : VI**	**L-T-P: 0 – 0 – 3 Credits: 1.5**
Contact Period : Lecture :36 Hrs, Exam: 3Hrs	**Weightage :CIE:50% SEE:50%**	

A.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, BPSK, DPSK, DPCM, ADPCM, QAM Generation and its detection.
3. Demonstrate the Measurement of Directivity and Gain of microstrip Yagi antenna.
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.

B.Course Content

1. Demonstration of ASK, FSK and PSK modulation and Demodulation.
2. Demonstration of BPSK and DPSK modulation and Demodulation.
3. Demonstration of Transmission - Reception of Baseband Signals and Measurement of BER.
4. Demonstration of QAM modulation and Demodulation.
5. Demonstration of DPCM Modulation – Demodulation and Observation of Quantization Noise.
6. Demonstration of Adaptive DPCM Modulation – Demodulation.
7. Measurement of Guide Wavelength, Power, VSWR as well as Isolation and Coupling factor of Magic Tee.
8. Measurement of Directivity and Gain of Micro-strip Yagi Antenna (Printed E-plane and H-plane) OR
   Demonstration of Delta and Adaptive Delta Modulation techniques using kits.
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 3dB power divider.
12. (a)Simulation ofQPSKtransmitterandreceivertakingintoaccountthephaseandthefrequency offset (Using WICOMM–TKit).
    (b)Demonstration of the basic aspects of DS–CDMA in single user case and two user case (Using WICOMM–TKit).

Open End Experiments (any Two):

1. Demonstration of Cyclic Redundancy Code (CRC) Encoding and Decoding.

2. Determination of Radiation Pattern of a Horn antenna using Microwave Bench.
3. Demonstration of Scrambling and Descrambling techniques using kits.
4. Demonstration of Minimum Shift Keying Modulation and Demodulation using kits.
5. Demonstration of Delta and Adaptive Delta Modulation techniques using kits.

REFERENCE BOOK:

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

C. Course Outcome (CO)

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Use the Micro-wave Test Bench to determine Guide wavelength, VSWR, Micro-wave Power.	PO1, PO2 [L3]
CO2	Analyze coupling and isolation characteristics of a micro–strip directional coupler and 3dB Power Divider.	PO2 [L4]
CO3	Experiment on ASK, FSK, PSK, BPSK, DPSK, QAM, DPCM and ADPCM Kits to understand modulation and demodulation process .	PO2,PO4 [L4]
CO4	Test the basic concepts of DS–CDMA, QPSK transmitter and receiver taking into account the phase and the frequency offset using WICOMM–T system.	PO1,PO2, PO5 [L4]

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
#1	**2**	**3**											**2**	**2**
#2		**3**											**2**	**2**
#3		**3**		**3**									**2**	**2**
#4	**3**	**3**			**2**								**2**	**2**

Course Title : Aptitude and Reasoning Development - EXPERT (ARDE)			
Course Code : P17HU610	Semester : VI	L:T:P:H -0:0:2:2	Credits: 1
Contact Period: Lecture: 32 Hr, Exam: 3 Hr	Weightage: CIE:50%; SEE:50%		
Prerequisites : Number system, Concept of percentage, Analytical reasoning-2.			

Course Learning Objectives (CLOS)

This course aims to

1. Explain different types of functions, representation of different functions on the graphs.
2. Describe the properties of quadratic equations and application of quadratic equations.
3. Demonstrates the principle of counting.
4. Differentiates between permutation and combination and solve problems conceptually.
5. Predict the probabilities in different scenarios and its application in our day-to-day life.
6. Evaluate the cause and effect of the statements logically.
7. Recognize different ways in which a statement can be strengthened or weakened.
8. Explain the criticality of data sufficiency chapter., universal methodology to solve any problem.
9. Analyse the data in a bar graph , pie chart and tabular column and line graph and the combination of these graphs.
10. Compare the data in different format and understand the difference between them

Course Content

UNIT – I

Functions and Quadratic equations:

Functions: Basic methods of representing functions– Analytical representation, tabular representation, graphical representation of functions. Even and odd functions, Inverse of a function, Shifting of graph. Representation of standard set of equations. Methodology to tackle inverse functions. Graphical process for solving inequalities, graphical view of logarithmic function.

Quadratic equations: Theory, properties of quadratic equations and their roots, the sign of quadratic equation, Equations in more than one variable. Simultaneous equations, number of solutions of the simultaneous equations. **6 Hrs**

UNIT – II

Permutation and Combination: Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2^n, Arrangement in a circle.

Probability: Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes. **8 Hrs**

UNIT – III

Analytical reasoning 3: Punchline: Introduction, format of the problem, An analysis, Does a suggested statement qualify as a punchline?. If a given statement fits as a punchline, what is its idea or wavelength?, The complete method of solving a punchline problem, Solved examples, conclusion, Sample company questions.

Strengthening and Weakening arguments: Format of the problem, An analysis, Suggested methods, solved examples, conclusion, sample company questions.

Cause and Effect : Cause and Effect—A theoretical discussion, Immediate cause, Principal cause, A quick check– Cause always antecedent. The strategy for solution. **6 Hrs**

UNIT IV

Data Sufficiency: Introduction, answer choices in data sufficiency, tips to solve data sufficiency problems, directions of questions, classification of sections in data sufficiency– Number system, Algebra, series and sequence, logical, geometry and mensuration, arithmetic. **6 Hrs**

UNIT V

Data Interpretation: Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs **6 Hrs**

Reference Books:

1. **"The Trachtenberg speed system of basic mathematics**, published by Rupa publications.
2. **CAT Mathematics** by Abhijith Guha. published by PHI learning private limited.
3. **Quantitative aptitude** by Dr. R. S Agarwal, published by S.Chand private limited.
4. **Verbal reasoning** by Dr. R. S Agarwal , published by S. Chand private limited.
5. **Quantitative aptitude** for CAT by Arun Sharma, published by McGraw Hill publication.
6. **Analytical reasoning** by M.K Pandey BSC PUBLISHING.CO.PVT.LTD

Course Outcomes (CO)

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

1. Graphically represent the functions and analyze it.
2. Infer the conclusions based on the roots obtained by solving quadratic equations and establish relationship between them.
3. Effective solve the problems of permutation and combination.
4. Predict different possibilities by the principle of probability.
5. Interpret the data given in the graphical format and infer the results.
6. Analyze the statement critically and solve the questions from verbal logic section.

A. Course Articulation Matrix (CAM)															
Course Outcome (CO)	**Program Outcome (ABET/NBA-(3a-k))**														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Graphically represent the functions and analyze it.	L5	2	-	-	-	2	-	-	-	-	-	-	-	-	-
Infer the conclusions based on the roots obtained by solving quadratic equations and establish relationship between them.	L6	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Effective solve the problems of permutation and combination.	L4	3	-	-	-	2	-	-	-	2	-	-	-	-	-
Predict different possibilities by the principle of probability.	L3	3	-	-	-	-	-	-	-	2	-	-	-	-	-
Interpret the data given in the graphical format and infer the results.	L5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
L- Low, M- Moderate, H-High															