B. E. SYLLABUS

ELECTRONICS & COMMUNICATION ENGINEERING

V & VI SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

1.	Dr. Rekha Bhandarkar	Ph.D	Professor & HoD
2.	Dr. M.K. Parasuram	Ph.D	Director
3.	Dr. Krishna Shenai	Ph.D	Director R&D
4.	Dr. K. Rajesh Shetty	Ph.D	Professor/Dean (Admissions & Alumni Affairs)
5.	Dr. K. V. S. S. S. S. Sairam	Ph.D	Professor
6.	Dr. Veena Devi Shastrimath V.	Ph.D	Professor
7.	Dr. Ananth A. G.	Ph.D	Professor
8.	Dr. K. S. Shivaprakasha	Ph.D	Assoc. Professor
9.	Dr. Krishnananda Shet	Ph.D	Assoc. Professor
10.	Dr. Usha Desai	Ph.D	Assoc. Professor
11.	Mr. Durga Prasad	M.Tech(Ph.D)	Assoc. Professor
12.	Mrs. Sushma P.S.	M.Tech(Ph.D)	Assoc. Professor
13.	Mrs. Shrividya G.	M.Tech(Ph.D)	Assoc. Professor
14.	Mrs. Padmavathi K.	M.Tech(Ph.D)	Assoc. Professor
15.	Mrs. Prabha Niranjan	M.Tech(Ph.D)	Assoc. Professor
16.	Mr. Sukesh Rao M.	M.Tech(Ph.D)	Assoc. Professor
17.	Mr. Subrahmanya Bhat	M.Tech(Ph.D)	Assoc. Professor
18.	Mr. Mahaveera K.	M.Tech(Ph.D)	Asst. Prof Gd III
19.	Mrs. Sunitha Lasrado	M.Tech(Ph.D)	Asst. Prof Gd III
20.	Mrs. Vidya Kudva	M.Tech(Ph.D)	Asst. Prof Gd III
21.	Mr. Satheesh Rao	M.Tech	Asst. Prof Gd III
22.	Dr. Ashish Singh	Ph.D	Asst. Prof Gd III
23.	Dr. Ansal V.	Ph.D	Asst. Prof Gd III
24.	Dr. Jagadeesh V. K.	Ph.D	Asst. Prof Gd III
25.	Mr. Ravindra K.S.	M.Tech	Asst. Prof Gd II
26.	Mr. Pradyumna G.R.	M.Tech	Asst. Prof Gd II
27.	Mrs. Roopa B. Hegde	M.Tech(Ph.D)	Asst. Prof Gd II
28.	Mrs. Charishma	M.Tech	Asst. Prof Gd II

29.	Mrs. Niju Rajan	M.Tech	Asst. Prof Gd II
30.	Mrs. Shubha B.	M.Tech	Asst. Prof Gd II
31.	Mr. Anil Kumar Bhat	M.Tech	Asst. Prof Gd II
32.	Mr. Shivakumar B. R.	M.Tech(Ph.D)	Asst. Prof Gd II
33.	Ms. Amrutha D. Pai	M.Tech	Asst. Prof Gd I
34.	Mrs. Deepa K.	M.Tech	Asst. Prof Gd I
35.	Mr. Bomme Gowda	M.Tech(Ph.D)	Asst. Prof Gd I
36.	Mr. Dileep Kumar M.J.	M.Tech(Ph.D)	Asst. Prof Gd I
37.	Mr. Sudharshana	M.Tech	Asst. Prof Gd I
38.	Mrs. Nagapriya Kamath K.	M.Tech	Asst. Prof Gd I
39.	Mrs. Ramya Shetty	M.Tech	Asst. Prof Gd I
40.	Mr. Prajwal Hegde N.	M.Tech(Ph.D)	Asst. Prof Gd I
41.	Mr. Karthik	M.Tech	Asst. Prof Gd I
42.	Mrs. Anupama B.	M.Tech	Asst. Prof Gd I
43.	Ms. Anusha R.	M.Tech(Ph.D)	Asst. Prof Gd I
44.	Mrs. Ashwini K.	M.Tech	Asst. Prof Gd I
45.	Mrs. Shankari N.	M.Tech	Asst. Prof Gd I
46.	Ms. Harshitha Bhat	M.Tech	Asst. Prof Gd I
47.	Mrs. Vaishali Y Suvarna	M.Tech(Ph.D)	Asst. Prof Gd I
48.	Ms. Lavanya B. L.	M.Tech	Asst. Prof Gd I
49.	Ms. Kavitha S.	M.Tech	Asst. Prof Gd I

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

Vision:

Empowering people, Partnering in Community Development by achieving expertise requiring the knowledge of state of the art technology in the field of Electronics and Communication.

Mission:

To impart specialized education in the field of Electronics & Communication that contributes to the socio-economic development of the region and to generate technical manpower with high degree of credibility, integrity and ethical standards by providing vibrant learning environment.

Program Educational Objectives (PEOs):

PEO1: The graduate should have effective foundation in mathematics, science as well as other relevant disciplines and a strong foundation in Electronics and Communication Engineering.

PEO2: The graduate will inculcate effective communication skills, teamwork, lifelong learning and leadership in preparation for a successful career in industry and academia with credibility, integrity and ethics.

PEO3: The graduate will be able to design and develop innovative system that contribute to socio-economic development.

Program Specific Outcomes (PSOs):

PSO1: Understand the concepts and applications in the field of communication, signal processing, VLSI, embedded systems, power electronics and control systems.

PSO2: Effectively apply the domain knowledge to arrive at optimum solutions to real time applications.

PSO3: Apply acquired skills in project management and execution to Electronics and Communication systems.

Program Outcomes (POs):

Engineering Graduates will be able to:

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Graduate Attributes :

Sl. No.	Graduate Attributes
a	Engineering Knowledge
b	Problem Analysis
c	Design / development of solutions
d	Conduct investigations of complex problems
e	Modern tool usage
f	The engineer and society
g	Environment and sustainability
h	Ethics
i	Individual and team work
j	Communication
k	Project management and finance
l	Life-long learning

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

V SEMESTER B.E. **26 Hours/week**

Sl. No.	CODE	COURSE	Theory/Tuto./Prac./ Self Study	Total Hrs. / Week	C.I.E.	S.E.E.	CREDITS
1.	15EC501	Digital Signal Processing	4+0+0+0	4	50	50	4
2.	15EC502	Digital Communication	4+0+0+0	4	50	50	4
3.	15EC503	Transmission Lines & Waveguides	4+0+0+0	4	50	50	4
4.	15EC504	System Design Using Microprocessor / Microcontroller	4+0+0+S	4	50	50	4
5.	15EC51X	Elective - I	3+0+0+0	3	50	50	3
6.	15EC505	Microprocessor / Microcontroller Applications Lab	0+0+3+0	3	50	50	2
7.	15EC506	Basic Communication Lab	0+0+3+0	3	50	50	2
8.	15EC507	Immersive Group Workshop	0+0+3+0	-	50	-	0
9.	15IL001	Employability Skill Development	0+1+0+0	1	50	0	0
		Total	**19+0+9**	**26**	**400**	**350**	**23**

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

VI SEMESTER B.E. **29 Hours/week**

Sl. No.	CODE	COURSE	Theory/Tuto./Prac./ Self Study	Total Hrs. / Week	C.I.E.	S.E.E.	CREDITS
1.	15EC601	Embedded Systems	4+0+0+0	4	50	50	4
2.	15EC602	Microwave Devices & Communication	4+0+0+0	4	50	50	4
3.	15EC603	VLSI Circuits	4+0+0+S	4	50	50	4
4.	15EC604	Antennas & Wave Propagation	4+0+0+0	4	50	50	4
5.	15EC61X	Elective – II	3+0+0+0	3	50	50	3
6.	15EC62Y	Elective - III	3+0+0+0	3	50	50	3
7.	15EC605	Digital Signal Processing Lab	0+0+3+0	3	50	50	2
8.	15EC606	Advanced Communication Lab	0+0+3+0	3	50	50	2
9.	15IL002	Employability Skill Development	0+1+0+0	1	50	0	0
		TOTAL	29	29	400	400	26

ELECTIVE – I

15EC511	Fiber Optics
15EC512	DSP Processors & Architecture
15EC513	Object Oriented Programming with C++
15EC514	Project Management
15EC515	Consumer Electronics

ELECTIVE - II

15EC611	Modern Radar & Navigational Aids
15EC612	Embedded Linux
15EC613	Computer Operating Systems
15EC614	Comp. Org. & Architecture
15EC615	Machine Learning and its Applications

ELECTIVE-III

15EC621	Fuzzy Logic
15EC622	Advanced Signal Processing
15EC623	Data Base Management System
15EC624	Electronic Measurements & Transducers
15EC625	Error Control Coding

DIGITAL SIGNAL PROCESSING

Sub Code : 15EC501 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

This course will enable students to

1. Understand the concept of Frequency Domain Sampling, Computation of DFT and properties of DFT.
2. Understand Linear Filtering methods using Overlap Add and Overlap Save Algorithms.
3. Understand the Fast Fourier Transform (FFT) using Radix 2 DITFFT and DIFFFT Algorithms.
4. Design and Analyze the characteristics of Analog filters using Butterworth & Chebyshev approximation techniques.
5. Design IIR filter using Impulse Invariance Technique and Bilinear transformation and FIR filter using windowing techniques.
6. Design Linear Phase FIR filters using frequency sampling technique.
7. Design Differentiator and Hilbert Transformer.
8. Implement Digital filters using various structures.

UNIT – I

Discrete Fourier Transform: Its Properties and Applications: Frequency Domain sampling and reconstruction of Discrete-Time signals, Discrete Fourier Transform (DFT), The DFT as a linear Transformation, Relationship of the DFT to Z- Transforms, Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of two DFTs and Circular Convolution, Additional DFT Properties. **11 Hours**

UNIT – II

Efficient Computation of DFT: Direct Computation of the DFT, Radix – 2 Fast Fourier Transform (FFT) algorithms, Decimation in Time FFT (DITFFT) algorithm and In-place computations, Decimation in Frequency FFT (DIFFFT) algorithm, N-point DFT computation of two real sequences using single N-point DFT, 2N-point DFT computation of two real sequences using single N-point DFT. **10 Hours**

UNIT- III

Design of Analog Filters and Frequency Transformations: Characteristics of commonly used Analog filters and Design of Butterworth and Chebyshev Analog filters, Frequency Transformations in the Analog Domain. **10 Hours**

UNIT - IV

Design of Infinite Impulse Response (IIR) Digital Filters and IIR filter structures: Bilinear, Impulse Invariance Transformations, IIR Butterworth and Chebyshev Filter Design by Impulse Invariance, IIR Filter Design by Bilinear Transformation.

Basic IIR Filter structures: Direct forms (I & II), Cascade and Parallel realizations, Signal flow graph, Transposed structure. **10 Hours**

UNIT – V

Design of Finite Impulse Response (FIR) Filters and FIR Filter Structures: Linear phase FIR Digital filters, Different types of windows: Rectangular, Bartlett, Hanning, Hamming and Blackman windows, Design of FIR filters using windows, Design of FIR filters using Frequency Sampling method, Design of Differentiator, Design of Hilbert Transformer.
Basic FIR Filter Structures: Direct Form structure, Frequency Sampling structure, Lattice structure, Linear phase FIR structure. **11 Hours**

Course Outcomes:

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

1. Analyze and appreciate the properties of Discrete Fourier Transform (DFT)
2. Deduce and compute DFT using FFT algorithms
3. Design analog filters using Butterworth and Chebyshev approximations
4. Realize IIR filter from analog filters and to realize IIR filter structures
5. Realize FIR filters using windowing and frequency sampling approach and to realize FIR filter structures

Mapping of PO's and CO's

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	**H**	**H**			**M**							
2	**H**	**H**	**M**		**M**							
3	**H**	**M**	**L**		**H**							
4	**H**	**M**	**L**	**L**	**H**	**L**					**L**	**L**
5	**H**	**M**	**L**	**L**	**H**	**L**					**L**	**L**

TEXT BOOK:

1. Proakis, Monolakis, "**Digital Signal Processing – Principles Algorithms & Applications**", PHI, 4th Edition, New Delhi, 2007. (3rd edition can also be referred)

REFERENCE BOOKS:

1. Oppenheim & Schaffer, "**Discrete Time Signal Processing**", PHI, 2003.
2. S. K. Mitra, "**Digital Signal Processing**", Tata McGraw Hill, 2nd Edition, 2004.

NPTEL/ MOOC Link

1. http://nptel.ac.in/courses/117104070/
2. http://nptel.ac.in/courses/117102060/
3. http://nptel.ac.in/courses/108105055/
4. https://www.mooc-list.com/course/digital-signal-processing-coursera
5. https://www.mooc-list.com/tags/dsp
6. https://www.mooc-list.com/tags/digital-signal-processing

****

DIGITAL COMMUNICATION

Sub Code : 15EC502 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

This course will enable students to

1. Study the basic Nyquist's sampling theorem ,generation of samples, Pulse amplitude modulation and Time division multiplexing.
2. Understand the techniques used in geometric interpretation of signals, designing a correlation receiver and matched filter receiver, maximum likelihood estimation and different types of Waveform Coding Techniques- PCM, DPCM, DM.
3. Understand the difficulties in base-band shaping for data transmission, ISI and Correlative coding techniques.
4. Study the design of Coherent and Non-coherent digital modulation techniques, Coherent Quadrature modulation techniques.
5. Understand the Spread Spectrum technique, Pseudo Noise sequences, Direct Sequence spread spectrum, Frequency Hop spread spectrum.

UNIT – I

Introduction: Sources and signals, Basic signal processing operations in digital communication, Channels for digital communication.
Sampling Process: Sampling theorem, Quadrature sampling of BP signal, Reconstruction of a message from its samples, Signal distortion in sampling, Practical aspects of sampling and signal recovery, PAM, TDM. **10 Hours**

UNIT – II

Detection and estimation: Gram-Schmidt Orthogonalization procedure, Geometric interpretation of signals, Response of bank correlators to noisy input, Detection of known signals in noise, Probability of error, Correlation receiver, Matched filter receiver, Detection of signals with unknown phase in noise, Estimation: concept and criteria, Maximum likelihood estimation.
Waveform Coding Techniques: PCM, Channel noise and error probability, Quantization noise and SNR, Robust quantization, DPCM, DM, **12 Hours**

UNIT – III

Base-band shaping for data transmission: Discrete PAM signal, Power spectra of discrete PAM signals, ISI, Nyquist's criterion for distortionless base-band binary transmission, Correlative coding, eye pattern, Base-band M-ary PAM systems. **10 Hours**

UNIT - IV

Digital modulation techniques: Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques, Non-coherent binary modulation techniques, Comparison of binary and quarternary modulation techniques, M-ary modulation techniques. **12 Hours**

UNIT - V

Spread spectrum modulation: Pseudo noise sequences, notion of spread spectrum, Direct sequence spread coherent binary PSK, Signal space dimensionality and processing gain, Probability of error, Frequency hop spread spectrum, Applications. **8 Hours**

Course Outcomes:

At the end of the course the student will be able to understand:

1. The basic sampling theorem, reconstruction of the signal from samples and generation of natural and flat top samples, PAM-TDM scheme.
2. The geometric interpretation of signals, Correlation receiver and Matched filter receiver and concepts of estimation.
3. Different types of Waveform Coding Techniques: PCM, DPCM, DM and Base-band shaping for data transmission, ISI and its solutions.
4. Coherent and Non-coherent digital modulation techniques, Coherent Quadrature modulation techniques.
5. The need for Spread Spectrum, Pseudo random Noise sequences, Direct Sequence spread spectrum, Frequency Hop spread spectrum.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H			H							
2	H		M		H					L		
3	H	M	H	L	H						L	
4	H	M	H	L	H		M	L		L	L	L
5	H	M				L					L	L

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Simon Haykin, "Digital Communication", John Wiley and sons, 1988.
2. Praokis and Salehi, "Fundamentals of Communication Systems", Pearson Education, First Edition, 2007.

REFERENCE BOOKS:

1. Bernard Sklar, "Digital Communications", Pearson, Second Edition, 2001.
2. Simon Haykin, Communication Systems,This Edition John Wiley & sons, 1998.
3. H. Taub and D. L. Schilling, Principles of Communication Systems, Tata McGraw-Hill, 2008.

NPTEL/MOOC Links		
1.	https://onlinecourses.nptel.ac.in/noc17_ec12	
2	nptel.ac.in/courses/117105077/2	Signals and sampling Theory
3	nptel.ac.in/courses/117105077/20	Matched Filter
4	nptel.ac.in/courses/117105077/21	Nyquist Filtering and ISI
5	nptel.ac.in/courses/117105077/38	Introduction to Spread Spectrum Modulation

****

TRANSMISSION LINES & WAVEGUIDES

Sub Code : 15EC503 **Credit : 04**
Hrs/Week: 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

1. Derive the general solution for transmission line in terms of voltage and current and condition for distrotionless and telephone line.
2. Learn the parameters of open and co-axial wires at high frequencies, concept of standing waves and input impedance of open and short circuited lines.
3. Construct and apply the smith chart for finding basic parameters of the transmission line for the given conditions.
4. Understand the concepts of TM, TE and TEM waves and derive the E and H field equations.
5. Apply Maxwell's equations to derive the field equations for TM and TE waves propagating inside the waveguide.

UNIT - I

TRANSMISSION LINE THEORY: The transmission line general solution, distortionless line, the telephone cable, Reflection on a line not terminated in $Z_{0,}$ Open and short circuited lines. **7 Hours**

Reflection loss, Insertion loss **3 Hours**

UNIT - II

LINE AT RADIO FREQUENCIES: Parameters of open wire line at high frequencies, Parameters of the coaxial line at high frequencies, Constants for the line of zero dissipation, Standing waves; nodes; standing wave ratio, input impedance of open and short circuited lines. **10 Hours**

UNIT - III

SMITH CIRCLE DIAGRAM AND APPLICATIONS: Construction of Smith circle, Applications, Determination of VSWR, Reflection coefficient, Input Impedance and Admittance, Locating short and open circuited points on the line, Finding length of the line, Load impedance/Admittance for the given shift of minima/maxima conditions, Problems. **10 Hours**

UNIT - IV

GUIDED WAVES:

Applications of restrictions to Maxwell's equation, Types of propagation; TM, TE and TEM waves in parallel planes. TE, TM, TEM waves in infinitely conducting planes. Characteristics of TE, TM, &TEM waves, Wave impedance. **12 Hours**

UNIT - V

WAVE GUIDES: Application Maxwell's equations to the rectangular waveguides, TM_{mn} wave in the rectangular guide, TE_{mn} wave in the rectangular guide, Excitation of wave guides, Guide terminations, Resonant cavities. **10 Hours**

Course Outcomes :

This course will enable students to

1. Determine the parameters of the transmission line for the given load conditions.
2. Understand the behavior of transmission line at Radio frequency and estimate the amount of reflection for the given load conditions.
3. Apply the Smith chart as a tool for determining parameters of the transmission line.
4. Distinguish between TE, TM and TEM waves and derive various parameters pertaining to EM wave propagation through parallel plane conductors.
5. Apply Maxwell's equation for TM, TE, TEM modes of propagation of EM waves and determine various parameters.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	**H**	**H**	**H**		**L**							
2	**L**	**H**	**M**		**L**							
3	**H**	**H**	**M**	**L**	**H**							
4	**H**	**M**	**L**	**L**	**L**							
5	**H**	**M**	**L**	**L**	**L**							

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. John D. Ryder, **"Network Lines and Fields",** 2nd edition, PHI, 2003.
2. Samuel Y. Liao, **"Microwave Devices and Circuits"**, 3rd Edition, PHI, 2004.

REFERENCE BOOKS:

1. Annapurna Das & Sisir K. Das, "**Microwave Engineering"**, Tata McGraw Hill, 2000.
2. Hund, **"Microwave Engineering",** McGraw Hill Publications,

NPTEL/ MOOC Link
1. http://nptel.ac.in/downloads/117101057/ 2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-630-electromagnetics-fall-2006/

****

SYSTEM DESIGN USING MICROPROCESSOR/MICROCONTROLLER

Sub Code : 15EC504 **Credit : 04**
Hrs/Week: 4+0+0+S* **Total Hours: 52**

*** Self Study to be exercised under the supervision of Course Instructor and to be restricted to not more than 10% of the total teaching hours.**

Course Learning Objectives :

This course will enable students to

1. Understand the fundamentals of memory, processing unit of an embedded systems.
2. Distinguish Microcontroller and Microprocessor.
3. Understand the need of Interrupts, Timers/Counters.
4. Design of Real time system using 8051.
5. Design basic interfacing circuits using keypad, LCD, stepper motor, etc.

UNIT - I

Introduction to 16 bit Microprocessor 8086: Introduction to Microprocessor, Internal Architecture of 8086 microprocessor, memory segmentation, Programming Model and Addressing Modes.
8 bit Microcontroller 8051 Architecture: Introduction to 8051 Microcontroller, Architecture, Memory organization, Programmer's model of 8051. **10 Hours**
.

UNIT - II

16 bit Microprocessor Instruction Set and Assembly Language Programming: Programmer's model of 8086, operand types, operand addressing, assembler directives, instruction set - Data transfer group, Arithmetic group, logical group, control transfer group, programming (with BIOS function). **12 Hours**

UNIT - III

Programming of 8051 Microcontroller: Basic instructions format, Addressing modes, Instruction set summary, examples, Programming for I/O port, Timers/Counters in Mode1& Mode 2, Serial Communication in Mode 0 and External Interrupts. **12 Hours**

UNIT - IV

System Design Using 8051 Microcontroller: Seven Segment LED display, Matrix Keypad, LCD interface, Analog to Digital conversion using ADC0809/ADC0804 and Digital to Analog Conversion using DAC0808.
Relay Switching, DC & Stepper Motor interface (Self Study). **10 Hours**

UNIT - V

Microprocessor Peripheral Interfacing: Introduction to IO Mapping Techniques, Generation of I/O ports using Isolated IO mapping, Programmable Peripheral Interface (PPI)-Intel 8255, Switch, LED and Seven Segment Interface using 8255 in Mode 0.
Interrupts: Basic interrupt types in 8086 microprocessor and hardware interrupt (Self Study). **8 Hours**

Course Outcomes:

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

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1		**L**	L		**H**							
2		**H**	**L**		**L**							
3		**H**	**M**		**L**							
4			**H**	**M**	**M**							
5			**H**	**M**	**M**							

1. Understand the architecture, memory organization of 8086 microprocessor and 8051Microcontroller.
2. Program using Assembly level language for 8086 Microprocessor.
3. Program using assembly level language for 8051 Microcontroller to configure IO Ports, Timer/Counters, Serial communication and Interrupts.
4. Design and study , basics of IO interfacing circuits using 8051 Microcontroller.
5. Design and study , basics of IO interfacing circuits using 8086 Microprocessor.

Mapping of PO's & CO's:

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Barry B. Brey & C. R. Sarma, **"The Intel Microprocessors Architecture, Programming and Interfacing"**, PHI, 2005.
2. Douglas V. Hall, **"Microprocessors And Interfacing, Programming and Hardware",** TMH, 2006.
3. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, **"The 8051 Microcontroller and Embedded Systems – Using Assembly and C** ", Pearson, 2006.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/106108100/
2. http://nptel.ac.in/courses/108107029/

****

MICROPROCESSOR / MICROCONTROLLER APPLICATIONS LAB

Sub Code : 15EC505 **Credit : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

Course Learning Objectives:

1. Assembly language programming skills are explored using 8086 microprocessor and 8051microcontroller.
2. Usage of different types and operands, function calls are adopted to achieve a efficient programming logic.
3. Real time examples are used to demonstrate the working of basic interfacing experiments with 8051microcontroller.

List of Experiments

I. SOFTWARE PROGRAMMING USING 8086 ASSEMBLY LANGUAGE

1. Data transfer instructions:
   1. Byte and word data transfer in different Addressing modes.
   2. Block move (with and without overlap)
   3. Block interchange

2. Arithmetic & logical operations:
   1. Addition and Subtraction of Byte, Word and multiple byte data.
   2. Multiplication and Division of signed and unsigned Hexadecimal numbers.
   3. ASCII adjustment instructions
   4. Code conversions
   5. Arithmetic programs to find square cube, LCM, GCD, factorial of numbers

3. Bit manipulation instructions:
   1. Whether given data is positive or negative
   2. Whether given data is odd or even
   3. Logical 1's and 0's in a given data
   4. Bit wise and nibble wise palindrome

4. Branch/Loop instructions like:
   1. Arrays: addition/subtraction of N numbers, Finding largest and smallest numbers and ascending and descending order.
   2. Near and Far Conditional and Unconditional jumps, Calls and Returns

5. Programs on String manipulation like string transfer, string reversing, searching for a string.

6. Programs involving Software interrupts Programs to use DOS interrupt INT 21h Function calls for Reading a Character from keyboard, Buffered Keyboard input, Display of character/ String on console

II. HARDWARE PROGRAMMING USING 8051

7. Interfacing simple switches' and LED's

8. Interfacing Seven segment Display

9. Interfacing Hex Keyboard interface to 8051
10. Interfacing ADC0809/08 with 8051
11. Generate different waveforms like Sine, Square, Triangular, Ramp etc. using DAC interface to 8051and change the frequency and amplitude
12. Stepper and DC motor control interface to 8051

Course Outcomes:

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

1. Develop coding logic for the algorithm specified and write assembly language codes.
2. Implement the assembly code using available Microcontroller and IDE to interface it with the given hardware module.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L	L	L		M							L
2	L	L	L		H							L

L: Low M: Medium H: High

****

BASIC COMMUNICATION LAB

Sub Code : 15EC506 **Credit : 02**
Hrs/Week : 0+0+3+0

Course Learning Objectives :

This course will enable students to:

1. Design and study the characteristics of narrow and wide –band pass and band elimination filters
2. Design different types of attenuators – T, π and lattice
3. Study Amplitude Modulation and demodulation
4. Understand the generation and detection of DSB-SC and SSB signals
5. Design a Frequency Modulator using IC 8038 to frequency modulate the given message signal
6. Study the design and application of pre-emphasis and de-emphasis circuits
7. Design circuits for various pulse modulation schemes – PAM, PWM and PPM
8. Study the working of Transistor mixer circuit, PCM and TDM

List of Experiments:

1. (a) Wide Band active Band pass filter
   (b) Narrow Band active Band pass filter
2. (a) Wide Band active Band elimination filter
   (b) Narrow Band active Band elimination filter
3. Design and testing of: T, π and lattice Attenuators
4. Amplitude modulation and demodulation
5. DSB-SC and SSB-SC generation and detection
6. Frequency modulation using IC 8038
7. Design and testing of Pre-emphasis and De-emphasis circuits
8. PAM (modulation and demodulation)
9. Pulse modulation techniques
   (a) PWM (Pulse Width Modulation)
   (b) PPM (Pulse Position Modulation)
10. Transistor mixer – up/down conversions
11. Pulse Code Modulation Technique
12. Time Division Multiplexing scheme

Course Outcomes:

Upon successful completion of this lab, students will be able to:

1. Design narrow and wide - band pass and band elimination filters.
2. Understand various continuous wave modulation schemes such as AM, FM, DSB-SC and SSB-SC
3. Design different type of communication circuits- attenuators, pre-emphasis, de-emphasis circuits and transistor mixer
4. Design circuits for the following pulse modulation schemes – PAM, PWM and PPM.
5. Understand the working of PCM and Time Division Multiplexing scheme.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H									L	
2	M	M			H						L	
3	H	M				H						
4	H	M		L								L
5	H	M			H						L	L

L: Low M: Medium H: High

****

IMMERSIVE GROUP WORKSHOP (IGW)

Sub Code : 15EC507 **Credit : 00**
Hrs/Week : 0+0+3+0

Module 1: Minds-on and hands-on simulation project

- Understanding Task environment – Goals, responsibilities, Task focus
- Working in Teams towards common goals
- Organizational performance expectations–technical and behavioural competencies.

7.5 Hours

Module 2: Re- enforcement of critical individual skills and behaviours

- Application of individual effectiveness skills in team and organizational context – improving self awareness, goal setting, time management, communication and presentation skills. **3.5 Hours**

Module 3: Etiquettes and Ethics

- Professional etiquettes at workplace – dressing, telephone, e-mail, meeting and general behaviour
- Basic honesty & respect for law / rules
- Conflict of interest
- Use of organizational resources
- Misrepresentation and misappropriation
- Intellectual property
- propertyWhistle blowing **7 Hours**

Module 4: Interpersonal Behaviour & relationship skills

- Establishing trust based relationships in team & organizational environment
- Trust equation – credibility, responsiveness, integrity, self-interest

3.5 Hours

Module 5: Dealing with Conflicts

Orientation towards conflicts in team and organizational environment

- Understanding sources of conflicts
- Conflict resolution styles and techniques **3.5 Hours**

<u>Pedagogical tools & techniques used in the workshop</u>

1. Organizational templates for simulating a organizational context- structures, units, roles and activities
2. Metaphoric scenarios for simulating real –life tasks and dynamics in a team/project context
3. LEGO ^{TM} building blocks for simulating last-mile technical activity in teams
4. Case studies, Role play scenarios group learning activities, observation and feedback.

Note: Student is evaluated and a grade of P (pass) or NP(not pass) is awarded

EMPLOYABILITY SKILL DEVELOPMENT

Sub Code : 15IL001 **Credits : Nil (MLC)**
Hrs/Week : 1+0+0+0 **Total Hours : 12**

UNIT-1

Quantitative- Numbers (Odd, even, H.C.F & L.C.M, Square roots & cube roots, Average, Percentage)
Analytical/logical- Numerical logic (next number in series, odd man out)
Verbal- Vocabulary (root words, prefix, suffix)

UNIT-2

Quantitative-Ratios & Proportions, Partnership
Analytical/logical- Coded language
Verbal- Vocabulary (synonyms)

UNIT-3

Quantitative- Time & work
Analytical/logical- Syllogism
Verbal- Vocabulary (antonyms)

UNIT-4

Quantitative- Pipes & Cistern
Analytical/logical- Direction (N-E-W-S)
Verbal- One word substitution

UNIT-5

Quantitative- Speed
Analytical/ Logical- Seating arrangement
Verbal- Idiom/phrases

UNIT-6

Quantitative- Problems on trains
Analytical /logical- Blood relations
Verbal- Sentence completion

UNIT-7

Quantitative- Problems on boats & streams
Analytical/logical- Blood relations
Verbal- Active & Passive voice

UNIT-8

Quantitative- Allegation & Mixtures
Analytical/logical- Statement & Conclusion
Verbal- Direct & indirect speech

References
1. Aggarwal R.S, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing.
2. Aggarwal R.S, "A modern approach to verbal and non-verbal reasoning", S Chand Publishing.
3. Bharath Patodi and Aditya Choudhary, "Verbal Ability & Comprehension", Disha Publication, Second edition, 2015.
4. Shakuntala Devi, "Joy of numbers", Orient Black Swan.
5. Shakuntala Devi, "More puzzles to puzzle you",Orient Black Swan.

****

FIBRE OPTICS

Sub Code : 15EC511 **Credit : 03**
Hrs/Week: 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

This course will enable students to:

1. Competing the different light propagation mechanisms with fundamentals.
2. Justifying the impact of LED and LASER services and their applications.
3. Formulating the different scenarios of fiber optics measurement through industry and medical applications.
4. Elaborating the fiber optics connectivity modes by means of physical components.
5. Minimize the different fiber optic losses by improving the transmission characteristics.

UNIT – I

Optical Fibers and Their Properties: Principles of light propagation through a fiber – different types of fibers and their properties transmission characteristics of optical fiber – absorption losses – scattering losses – dispersion – optical fiber measurement – optical sources – optical detectors – LED-LD-PIN and APD.

Laser Fundamentals: Fundamental characteristics of Lasers – three level and four level lasers – laser modes – resonator configuration – Q-switching and mode locking – cavity dumping – types of lasers gas lasers, solid lasers, and liquid lasers and semiconductor lasers (Basic working principle only). **15 Hours**

UNIT – II

Industrial Application Of Optical Fibersand Lasers: Fiber optic sensors – interferometric method of measurement of length – measurement of pressure, temperature, current, voltage, liquid level and strain – fiber optic gyroscope – polarization maintaining fibers.

Laser for measurement of distance, velocity, acceleration,– material processing – laser heating, welding melting and trimming of materials – removal and vaporization. **16 Hours**

UNIT – III

Laser In Holography And Medical Application: Holography – basic principle; methods; holographic interferometry and applications, holography for non-destructive testing,- medical applications of lasers; laser and tissue interaction – laser instruments for surgery, removal of tumours, brain surgery, plastic surgery. **8 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Determine the evaluation of Networking Principles and Light Propagation Mechanisms.
2. Know the concepts like quality of services w.r.t network services regarding sources and detectors.
3. Solve the problems of fiber optic Communication multi-stage applications.
4. Understand the concepts and working modes of OFNS (Optical Fiber Network Sensors).
5. Know the LASER applications in holography and medical applications.

Mapping of PO's &CO's

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1		M				H						
2	H											M
3				L			M				M	
4					H							
5								M				

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. John F. Read**, "Industrial Applications of Lasers",** Academic Press, 1978
2. Senior J. M., **"Optical Fiber Communication Principles and Practice",** Prentice Hall, 1985.

REFERENCE BOOKS:

1. John and Harry, **"Industrial Lasers and their Applications",** McGraw Hill, 1974
2. Monte Ross, **"Laser applications"**, McGraw Hill, 1968
3. Keiser G., **"Optical Fiber Communication",** McGraw Hill, 1991
4. Markolf H. Niemz, **"Laser-Tissue Interactions, Fundamentals and Applications"**, Springer, 2007

****

DSP PROCESSORS AND ARCHITECTURE

Sub Code : 15EC512 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

This course will enable students to

1. Learn to represent real-time signals in digital format and understand transform-domain representations of the signals.
2. Understand the architectural features for the programmable DSP device.
3. Study the linear systems approach to signal processing problems using high-level programming language.
4. Demonstrate the linear filters on real-time DSP chips.
5. Present the applications of linear filters and their real-time implementation challenges.

UNIT – I

Introduction to Digital Signal Processing: Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.

Architectures for Programmable Digital Signal-Processors: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing. **15 Hours**

UNIT – II

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal Processing Devices, Data Addressing Modes of TMS32OC54xx, Memory Space of TMS320C54xxProcessors, Program Control. Detail Study of TMS320C54X & 54xx, Instructions and Programming, On-Chip peripherals. Interrupts of TMS320C54XXProcessors, Pipeline Operation of TMS320C54xx Processor

Implementation of Basic DSP Algorithms: Introduction, the Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). **15 Hours**

UNIT – III

Implementation of FFT Algorithms: Introduction, FFT Algorithm for DFT Computation, Overflow and Scaling, Bit- Reversed Index Generation & Implementation on the TMS32OC54xx.

Interfacing Memory and Parallel I/O Peripherals to DSP Devices: Introduction, Memory Space Organization, Memory interface. Introduction to TMS320C6713 Processor (Architecture). **9 Hours**

Course Outcomes:

At the end of the course student will be able to

1. Realize the knowledge of digital signal processing techniques for implementation of different algorithms.
2. Understand the basic architectural features for programming
3. Develop innovative algorithms using MATLAB DSP toolbox for analysis and processing of real-time signals.
4. Understand the implementation techniques of FFT algorithm for DFT computation on TMS320C54xx.
5. Apply the DSP processors TMS 320C 54XX for implementation of DSP algorithms and its interfacing techniques with various I/O peripherals.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	H	M	M	L	L	L	L	L	M
2	H	H	M	H	M	M	L	L	L	L	L	M
3	H	H	H	H	M	M	L	L	L	L	L	H
4	H	H	H	H	M	L	L	L	L	L	L	H
5	H	H	H	H	M	L	L	L	L	L	L	M

L: Low M: Medium H: High

TEXT BOOK:

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

REFERENCE BOOKS:

1. Ifeachor E. C., Jervis B. W.**, "Digital Signal Processing : A Practical Approach"**, Pearson- Education, 2002
2. B. Venkataramani, M. Bhaskar, **"Digital Signal Processors",** TMH, 2002
3. Kuo S. M., Gan W-S.S., **" Digital Signal Processors: Architectures, Implementations and Applications"**, Prentice Hall, 2005

****

OBJECT ORIENTED PROGRAMMING WITH C++

Sub Code : 15EC513 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

The course presents basic Object Oriented Programming using C++ programming that aims to:

1. Arm the students with the basic object oriented programming concepts.
2. Introduce different techniques like Inheritance, Polymorphism, Virtual Functions and Constructors.
3. Arm the students with the necessary constructs of OOP C++ programming.
4. Introduce concepts like template classes and STL libraries.

UNIT – I

Principles of OOP: OOP paradigm, Procedural Vs. Object Oriented Programming, Benefits and applications of OOP.
C++ Features: Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures.
C++ Functions: Call and Return by reference, Inline functions, Overloading of functions, default arguments, friend functions, virtual functions.
Objects and classes : Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors, operator overloading, type conversion. **16 Hours**

UNIT – II

Inheritance : Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class.
Polymorphism : Pointers in C++, Pointes and Objects, this pointer, virtual and pure virtual functions, Implementing polymorphism.
I/O and File management : Concept of streams, cin and cout objects, C++ stream classes, Unformatted and formatted I/O, manipulators, File stream, C++ File stream classes, File management functions, File modes, Binary and random files. **16 Hours**

UNIT - III

Templates, Exceptions and STL: What is template? function templates and class templates, Introduction to exception, try-catch-throw, multiple catch, catch all, rethrowing exception, implementing user defined exceptions, Overview and use of Standard Template Library.
7 Hours

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

1. An ability to write simple functions, overload operators, objects & classes in C++.
2. An understanding of the concept of inheritance, polymorphism
3. An ability to control I/O and File management techniques.

4. An ability to incorporate exception handling and use template classes and the STL library in C++.
5. An ability to write object-oriented programs of moderate complexity in C++.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	M	M		M					M	M	H
2	M	M	M		M					M	M	H
3	M	M	M		M					M	M	H
4	M	M	M		M					M	M	H
5	M	M	M		M					M	M	H

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. E Balagurusamy, **"Object Oriented Programming With C++"**, TMH , Third Edition.

REFERENCE BOOKS:

1. Robert Lafore, **"Object Oriented Programming in Turbo C++"**, Galgotia publishers.
2. Bjarne Stroustrup , **"Programming Principles and Practice Using C++"**, Addison-Wesley.

NPTEL/ MOOC Link:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-096-introduction-to-c-january-iap-2011/
2. https://www.coursera.org/learn/c-plus-plus-a
3. https://www.coursera.org/learn/c-plus-plus-b

****

PROJECT MANAGEMENT

Sub Code : 15EC514 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable students to

1. Understand key concepts of project management and project lifecycle
2. Practice the key stages of managing projects.
3. Develop increased awareness of available resources to further develop project management skills.
4. Understand how to apply new knowledge to their own projects and set realistic goals for moving forwards.

UNIT – I

Introduction: Characteristics of project, neat types and forms. Systems approach: Concepts project as a system, design algorithm.
Project organization: Formal and informal organization, forms of organization of structures, project organization, matrix organization, pure project organization, selection of structures.

15 Hours

UNIT – II

Work definition: Planning, work break down, responsibility integration with organizational structure detailed project plan.
Project scheduling: Activities, events Gantt charts network scheduling pert, CPM resource constraints.
Project costing: Estimation and budgeting, project cost, account systems cost, schedules, forecasting, financial evaluation of a project, social costs. **15 Hours**

UNIT – III

Project control and management: Phases types, variance analysis problems, role of project manager, team work and leader ship.
Project termination: Varieties of project termination processes, final report.
Computers in project management: Monitoring information, system software packages, utility and limitations. **9 Hours**

Course Outcomes:

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

1. Manage the selection and initiation of individual projects and of portfolios of projects in the enterprise.
2. Conduct project planning activities that accurately forecast project costs, timelines, and quality. Implement processes for successful resource, communication, risk and change management.
3. Demonstrate effective project execution and control techniques that result in successful projects.
4. Demonstrate a strong working knowledge of ethics and professional responsibility.
5. Demonstrate effective organizational leadership and change skills for managing projects project teams.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	M	M	H	M	H	M	L	L	M	M	
2	M	M			M	M	L		M	H	L	
3	L		H		H	M				M	M	L
4	M					H		H		M	M	
5	H	M	M	L			H	M	H	H	M	M

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. Parameshwar Iyer, " **Engineering Project Management",** Apex publication, 2001

REFERENCE BOOKS:

1. Robert Wysockietal, **"Effective Project Management",** John Wiley, 2001
2. Rory Burke, **"Project Management Planning and Control Techniques",** John Wiley, 3rd Edition, 2001
3. Jack Meredith, **"Project Management: A Managerial Approach"**, John Wiley, 5th edition 2005

****

CONSUMER ELECTRONICS

Sub Code : 15EC515 **Credits : 03**
Hrs/ Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable the students to

1. Learn and design operating principles of "real world" electronic devices
2. Study broader view of key principles of electronic device's operation and presents a block circuit diagram.
3. Learn to integrate the many different aspects of emerging technologies and able to build unique mix of skills required for careers.

UNIT – I

SOUND: Properties of sound and its propagation, Transducers (Micro Phone, Loud Speakers), enclosures, mono-stereo, Amplifiers, Multiplexers, mixers, Synthesizers.
VISION: B/W TV, CTV concepts, B/W & Color Cameras, Displays. **15 Hours**

UNIT – II

RECORDING AND PLAYBACK: Discs, Magnetic tapes and discs, Optical discs; recording and playback, audio and video systems, Theatre Sound, Studios, Editing.
COMMUNICATIONS AND BROADCASTING: Switching Systems, Land lines, Modulation, Carrier, Fiber optics, Radio and TV broad casting
DATA SERVICES: Data services, mobiles, terrestrial & Satellite Systems, GPS, Computers, internet Services. **15 Hours**

UNIT – III

UTILITIES: Fax, Xerox, Calculators, Microwave ovens, Washing Machines, A/C & refrigeration, Dishwashers, ATMS, Set -Top boxes, Auto Electronics, Industrial Electronics, Robotics, Electronics in health / Medicine, nano- technologies. **9 Hours**

Course Outcomes:

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

1. Recall basics of sound.
2. Recall basics of television and camera.
3. Explain basic working of Recording, storage devices,
4. Explain basics of communication and broadcasting.
5. Recall basic working of commonly used electronic gadgets

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L					L					M	M
2	L					L					M	M
3	L					L					M	M
4	L					L					M	M
5	L					L					M	M

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Anand, **"Consumer Electronics",** Khanna publications, 2011.
2. Bali S. P., **"Consumer Electronics",** Pearson Education, 2005.

REFERENCE BOOK:

1. Gulati R. R., **"Modern Television Engineering",** Wiley Eastern

****

EMBEDDED SYSTEMS

Sub Code : 15EC601 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

This course will enable students to

1. Recognize design challenges in embedded system design processes.
2. Design an optimized RT level and General purpose processor.
3. Distinguish different memory types.
4. Understand basic communication protocols
5. Understand different software architectures and operating system services.

UNIT – I

Introduction: Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them. Survey of different embedded system design technologies, trade-offs. Custom Single-Purpose Processors, Design of custom single purpose processors. **10 Hours**

UNIT - II

Processor design: RT level design and optimizing the design. General purpose processors, General-purpose processor design. Standard Single-Purpose Peripherals: Timers/ counters, UART, PWM, LCD, Keypad controllers, Stepper motor controllers, ADC converters, Real Time Clocks. **10 Hours**

UNIT – III

Memory: Introduction, memory write ability and storage permanence, common memory types, composing memory, memory hierarchy, Memory management unit, advanced memories. **10 Hours**

UNIT – IV

Interfacing: Introduction, Communication Basics, General-purpose processor interfacing: I/O addressing Interrupts Direct memory access , Arbitration Multi-level bus architectures, Serial Protocols, Parallel Protocols, Wireless Protocols . **10 Hours**

UNIT – V

Interrupts:Basics - Shared Data Problem, Interrupt latency. Survey of Software Architectures: Round Robin, Round Robin with Interrupts, Function Queue scheduling, RTOS architecture. Introduction to RTOS: Tasks -states - Data - Semaphores and shared data. **12 Hours**

Course Outcomes:

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

1. Design an embedded system, recognize design challenges and to describe different IC and Processor technologies.

2. Optimize the RT level design, and to design a General purpose processor and appreciate the use of peripherals.
3. Explain different memory types and to discuss advanced memories.
4. Explain Communication Basics, General-purpose processor interfacing, Serial Protocols, Parallel Protocols and Wireless Protocols.
5. Explain shared data problem, Interrupt latency, different software architecture, and explain semaphores.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1		M	H	L							M	
2		M	H	M							M	
3	H	M										
4	H	M									L	
5	H	H										

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Frank Vahid, Tony Givargis, "**Embedded System Design - A Unified Hardware/Software Introduction",** John Wiley & Sons, Inc.2002
2. David E. Simon, **"An Embedded Software Primer",** Pearson Education, 1999

REFERENCE BOOKS:

1. Raj Kamal, "**Embedded Systems Architecture, Programming and Design**", TMH-2003.
2. Barnett, Cox & O'cull, "**Embedded C Programming"**, Thomson (2005).

NPTEL/ MOOC Link:

1. **http://nptel.ac.in/courses/108102045/**
2. **http://nptel.ac.in/courses/108105057/**
3. **http://nptel.ac.in/courses/106105159/**

****

MICROWAVE DEVICES & COMMUNICATION

Sub Code : 15EC602 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives :

This course will enable students to

1. Learn the application of Smith chart to solve impedance matching problems in transmission lines.
2. Study the characteristic impedance and different types of losses in micro-strip lines.
3. Study S-parameters for different microwave devices and microwave junctions.
4. Study low power and high power microwave Amplifiers and oscillators and their applications.
5. Analyse parametric amplifiers, Gunn diode, Tunnel diode etc.
6. Study propagation of waves, antenna parameters, RADAR, radio meters used in radiometry.

UNIT – I

Impedance matching using stubs*:* Quarter wave line impedance matching, Stub matching: Single stub impedance matching on a line, Design of Single and double stub matching networks using Smith Chart.

Micro Strip lines: Characteristic impedance, losses and quality factor Q of micro strip lines, Parallel strip lines: Distributed parameters, Characteristic impedance, attenuation losses.

12 Hours

UNIT – II

Microwave devices: S – Parameters, S-matrices of a multiport network. E-plane Tee, H-plane Tee and Hybrid Tee, Hybrid ring, Attenuators, Directional Couplers, Faraday rotation Isolators, Circulators. Phase Shifters. **10 Hours**

UNIT – III

Microwave Signal Generators and amplifiers I*:* High frequency Limitations of conventional microwave devices, Reflex Klystrons oscillators: Velocity modulation, power output and efficiency and electronic admittance, Two cavity Klystron Amplifiers: Velocity modulation, power output, efficiency and voltage gain. Slow wave structures, Helix TWTA, Analysis of TWTA, amplification process, modes of wave propagation and gain characteristics. **12 Hours**

UNIT - IV

Microwave Signal Generators and amplifiers II: Cylindrical Magnetron oscillator, Equations of electron motion, cut off Magnetic field and voltage, resonant modes, Mechanism of oscillations.

Microwave solid state devices: Gunn diode Transferred electron effect, Modes of operations. Parametric devices: Varactor diode, parametric amplifier and Manley- Rowe relations, Negative resistance amplifier, Tunnel diode, IMPATT diode. **10 Hours**

UNIT - V

Microwave Communications: System aspects of antennas, Microwave communication systems, microwave transmitter and receivers. Noise characterization of microwave receivers, Radar systems, Radiometry: Theory and applications of radiometry, total power radiometer and Balanced Dickie radiometer. **8 Hours**

Course Outcomes:

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

1. Apply the Smith chart to solve impedance matching problems using single stub, double stubs and measurement of various parameters different types of micro-strip based lines
2. Analyse the working principle of various microwave devices and junctions in terms of S parameters
3. Understand Low power microwave amplifiers and oscillators
4. Understand the high power microwave signal generator and microwave solid state devices such as Varactor diode, Tunnel diode, Gunn diode and IMPATT diode
5. Perform the noise analysis of microwave transmitter and receivers and understand different types of RADAR and Radiometric devices

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	H		L							
2	H		M	M	M							
3	H					L	L				L	
4						H	H				L	
5		H			H	M					L	

L: Low M: Medium H: High

TEXT BOOKS:

1. Liao S., "**Microwave Devices and Circuits",** Prentice Hall India Ltd., 2004.
2. Annapurna Das & Sisir K. Das, "**Microwave Engineering",** Tata McGraw-Hill 2000**.**
3. David M. Pozar, **"Microwave Engineering",** John Wiley & Sons, 2nd Edition.

REFERENCE BOOK:

1. Robert E. Collin, **"Foundations for Microwave Engineering",** McGraw Hill.

NPTEL/ MOOC Link:

1. https://onlinecourses.nptel.ac.in/noc17_ee16

VLSI CIRCUITS

Sub Code : 15EC603 **Credit : 04**
Hrs/Week: 4+0+0+S* **Total Hours : 52**

*** Self Study to be exercised under the supervision of course instructor and to be restricted to not more than 10% of the total teaching hours.**

Course Learning Objectives:

This course will enable students to

1. Understand the fundamentals of digital VLSI design, design flow, CMOS fabrication process.
2. Design CMOS circuits for any given complex logic function and draw the layout diagrams for them.
3. Perform DC analysis and transient analysis of a given CMOS circuit.
4. Design for minimum delay using driving large capacitive load and logical effort techniques.
5. Design advanced CMOS logic circuits such as C^2 MOS circuit and Domino CMOS circuits.
6. Design basic CMOS Analog Circuits: single stage amplifiers, differential amplifiers and current mirrors.

UNIT – I

Introduction to VLSI: Design flow, VLSI chip types, Moore's law, ideal switches, NMOS and PMOS transistors as switches, MOSFET threshold voltage, pass characteristics, basic logic gates in CMOS, complex logic gates in CMOS, transmission gate circuits, clocking and data flow control, SR- latch, clocked SR- latch, A CMOS Positive Level Sensitive D-latch, Positive edge triggered D register. **10 Hours**

UNIT - II

Basic CMOS Technology: Semiconductor technology overview, basic CMOS technology, p well / n well / twin well process. Physical structure of CMOS integrated circuits: Integrated circuits layers, sheet resistance, P and N- MOSFET layers, CMOS layers, interconnect layers. Stick diagram, Lambda rules for layout, electrical rules, and layout of basic structures, cell concepts, FET sizing and unit transistor, Physical design of logic gates, Structured Design: Hierarchy, Regularity, Modularity, Locality **[Self Study].** Latch-up in CMOS and prevention. **10 Hours**

UNIT – III

Electronic analysis of CMOS logic gates: MOSFET operation, MOSFET current equations, DC characteristics of the CMOS inverter, inverter switching characteristics, power dissipation, DC characteristics of NAND and NOR gates, NAND and NOR transient response, analysis of complex logic gates, gate design for transient performance. **12 Hours**

UNIT – IV

Designing with high speed CMOS logic networks: Gate delays, driving large capacitive loads, Logic Effort, Timing Analysis (T2): Setup-time, Hold-time, Propagation Delay, Contamination Delay, Clock Skew, Clock jitter, Sources of skew and jitter [**Self Study].**

10 Hours

UNIT – V

Advanced techniques in CMOS logic circuits: Mirror circuits, pseudo-NMOS, tri-state circuits, clocked CMOS, dynamic CMOS logic circuits.
MOS Analog Circuits: Basic current mirror, single stage CS (T3, 3.2.1 & 3.2.3) and CD (T3, 3.3) MOS amplifiers, differential amplifier (with current source load). **10 Hours**

Course Outcomes:

1. Understand the fundamentals of digital VLSI design and design CMOS circuits for the desired logic using MOSFET/ CMOS switches.
2. Understand the VLSI physical design aspects namely, stick diagrams, layouts and fabrication process.
3. Perform DC analysis and transient analysis of a given CMOS circuit.
4. Design minimum delay driver circuit to drive large capacitive loads.
5. Design Area efficient CMOS circuits, clocked CMOS circuits and also analyze basic MOS amplifiers.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	M	M	-	-	-	-	-	-	-	L	-
2	-	-	-	-	M	-	-	-	-	L	-	-
3	M	-	-	-	-	-	-	-	-	-	-	-
4	M	-	M	-	-	-	-	-	L	-	M	-
5	M	-	M	-	-	-	-	-	L	-	M	-

L: Low M: Medium H: High

TEXT BOOKS:

1. John Uyemura, **"Introduction to VLSI Circuits and Systems",** John Wiley 2002. Chapters 1, 2, 3,4,5,6,7,8,9.
2. Jan M. Rabaey, **"Digital Integrated Circuits",** 2nd Edition, PHI, 2002.
3. Behazd Razavi, **"Design of Analog CMOS Integrated Circuits",** Tata McGraw-Hill, 2002.

REFERENCE BOOKS:

1. Sung Mo Kang and Yusuf Leblebici, **"CMOS Digital Integrated Circuits - Analysis and Design"**, TMH, 3rd Edition, 2002.

2. Neil H. E. Weste and Kamaran Eshraghian, "**Principles CMOS VLSI Design**", Addison-Wesley, 2nd Edition, 2004.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/117106092/
2. http://nptel.ac.in/courses/108101089/
3. https://www.mooc-list.com/course/vlsi-cad-logic-layout-coursera

****

ANTENNAS & WAVE PROPAGATION

Sub Code : 15EC604 **Credits : 04**
Hrs/Week: 4+0+0+0 **Total Hours: 52**

Course Learning Objectives:

This course will enable students to

1. Recall the concepts of electromagnetic theory to understand the antenna functionality
2. Possess the basic concepts of radiation of electromagnetic energy from a radiator
3. Analyze the radiation pattern in terms of power, radiation intensity or electric field and hence determine antenna parameters from it.
4. Describe the construction and design features of commercial antennas
5. Translate the phenomenon of wave propagation for ground and sky waves

UNIT – I

Antenna Basics: Basic antenna parameters, patterns, beam area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna aperture, Effective height.

Point Sources: Introduction, point sources, Power patterns, Power theorem and applications, Radiation intensity, Examples of Power patterns, field patterns, Phase patterns.

Antenna Arrays: Array of two isotropic point sources, Non- isotropic similar point sources, pattern multiplication, pattern synthesis, linear array of n- isotropic sources of equal amplitude and spacing. **10 Hours**

UNIT – II

Null Directions; Null directions of arrays, broad side case, end-fire case and general case with equal currents of any phase.

Electric Dipole and Thin Linear Antennas: The short electric dipole, the fields of short dipole, radiation resistance, thin linear antenna, Field Pattern for various lengths.

Loop Antenna: The small loop, The Loop antenna (general case), Far – field Patterns of circular Loop Antennas and Uniform Current, The small loop as a special case, Radiation resistance of loops. **10 Hours**

UNIT – III

Helical Antenna And Yagi-Uda Array: Helical antenna, Helical geometry, The Helix modes, Practical design considerations of Monofilar axial-mode helical antenna, dipole arrays with parasitic elements, Yagi-Uda array, Axial- mode pattern and phase velocity of wave propagation on Monofilar helices.

Antenna Types: Slot antenna, Babinet's principle and Complementary antenna, Horn antenna, The rectangular Horn antenna, Reflector antenna (Flat sheet reflector, corner reflector, paraboloidal reflector), Broad band frequency independent antenna, Basics, Rumsey's principle, The log- periodic antennas.

Antennas for special applications: Antennas for terrestrial mobile communication systems, Antennas for Ground Penetrating Radar (GPR), embedded antennas, Ultra-wide band antennas for digital applications, Plasma antennas. **12 Hours**

UNIT - IV

Wave Propagation: Ground wave propagation, plain-earth reflections, space waves and surface waves, elevated dipole antenna above plain earth, wave tilt, spherical earth propagations and Tropospheric waves. **10 Hours**

UNIT - V

Ionospheric Propagation: The Ionosphere, Reflection and Refraction of waves by Ionosphere, Regular and irregular variations of Ionosphere, Attenuation factor, Sky wave transmission, Effect of earth's magnetic field, wave propagation in Ionosphere. **10 Hours**

Course Outcomes:

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

1. Understand the fundamental parameters of antenna and determine null directions.
2. Analyze the pattern using null direction concept and Derive the parameters of dipole and loop antenna.
3. Contrast the design, principle of operation of fundamental antenna and the antennae for special applications.
4. Analyze the ground wave and tropospheric wave propagation.
5. Compile the features of sky wave propagation and summarise the concept of ionospheric wave propagation.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1.	M	M		L	H				L			
2.	H		M		M					M		
3.	L	M		H	M				M			
4.	H			M		M			L			
5.				H		M			L			

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, **"Antennas and Wave Propagation",** Tata McGraw Hill Publication, 4th Edition, 2012.
2. Jordan & Balman, **"Electromagnetic Waves and Radiating Systems"**, 2nd Edition, PHI, 2003.

REFERENCE BOOKS:

1. John D Kraus**, "Antennas for all applications"**, McGraw Hill, 3rd Edition, 2002.
2. Kennedy, **"Electronic Communication Systems",** 5th Edition, Tata McGraw Hill Publication, 2011.
3. F.E. Terman**, "Radio Engineering",** Tata McGraw Hill Publication, 1995.
4. K.D. Prasad, **"Antennas and wave Propagation"**, Sathya Prakashan, 2009.

NPTEL/ MOOC LINK:

1. http://nptel.ac.in/courses/117107035/4

****

DIGITAL SIGNAL PROCESSING LAB

Sub Code : 15EC605 **Credit : 02**
Hrs/Week: 0+0+3+0

Course Learning Objectives :

This course will enable students to:

1. Explain and apply sampling theorem on analog signals
2. Study the impulse response of a given LTI system by using deconvolution operation and verify the result using convolution operation
3. Study, analyze and implement linear convolution of –one sided and two sided aperiodic sequences
4. Study and implement circular convolution of two periodic sequences
5. Analyze autocorrelation and cross correlation of a given sequence and verify symmetry and energy properties
6. Study and obtain impulse response, step response and steady state response of a system described by a difference equation
7. Analyze and understand N-point DFT computation using 'fft' command on a given discrete time signal and plot its magnitude and phase spectrum
8. Perform linear and circular convolution of two given sequences using DFT-IDFT method
9. Study and implement FIR and IIR filters for the given specifications
10. Implement linear convolution, circular convolution, impulse response of an LTI system and FIR filter design on DSP processor using Code Composer Studio platform.

LIST OF EXPERIMENTS USING MATLAB

Experiment No.	Title
1	i) Familiarization with MATLAB software and general functions ii) Generation of Elementary signals • Sinusoidal • Square • Complex waveform • Unit Step • Unit Ramp • Exponential • Noise
2	Verification of Sampling theorem 1. Under Sampling 2. Sampling at Nyquist rate 3. Over Sampling
3	Finite and Infinite Response of an LTI System i) Impulse Response ii) Frequency Response
4	Linear Convolution of two given sequences. i) One sided sequences ii) Two sided sequences
5	Circular Convolution of two given sequences. i) Equal length sequences ii) Unequal length sequences
6	Auto Correlation of a given sequence and verification of its properties. i) Symmetry (Even) ii) Energy iii) Periodicity
7	Cross Correlation of a given sequence and verification of its properties. i) Conjugate Symmetry
8	Response of a system described by given difference equation. i) Impulse Response ii) Step Response iii) Steady state Response iv) Complete Response with a given initial condition
9	Computation of N point DFT of a given sequence and plot high density, high resolution Magnitude and Phase Spectrum. i) Using FFT command ii) Without using FFT command
10	Convolution of two given sequences using DFT and IDFT. i) Linear Convolution ii) Circular Convolution
11	Design and implementation of FIR filter to meet the given specifications using Rectangular /Bartlett /Hanning /Hamming /Blackman window for the following types of filters,

i) LPF
ii) HPF
iii) BPF
iv) BSF

12 Design and Implementation of Analog and Digital IIR filter to meet the given specifications for the following types of filters,

i) LPF
ii) HPF
iii) BPF
iv) BSF

LIST OF EXPERIMENTS USING DSP PROCESSOR

Experiment No.	Title
1	Linear convolution of two given sequences.
2	Circular convolution of two given sequences.
3	Computation of N point DFT of a given sequence.
4	Impulse response of a given system of a given system of first and second order.

Course Outcomes:

Upon successful completion of this lab, students will be able to:

1. Simulate sampling theorem, convolution, correlation, impulse response, DFT-IDFT of a given sequence, IIR and FIR filters using MATLAB.
2. Implement DSP algorithms using C programming with TMS320C6713 floating point DSP processor with CC Studio Platform.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	H	M						H	
2	H	H	H	M	M						M	

L: Low **M: Medium** **H: High**

****

ADVANCED COMMUNICATION LAB

Sub Code : 15EC606 **Credit : 02**
Hrs/Week : 0+0+3+0

Course Learning Objectives:

This course will enable students to:

1. Study the sampling theorem to generate flat top samples and to reconstruct the original signal using kit.
2. Understand various binary digital modulation and demodulation schemes such as ASK, FSK, PSK using kits.
3. Measure transmission line parameters such as free space wavelength, guide wavelength and VSWR using microwave test bench with Reflex Klystron as source.
4. Study optical fiber line and to measure various losses and numerical aperture.
5. Carry out measurement of resonant characteristics of microstrip ring Resonator and determine isolation and coupling coefficient of microstrip line based on directional coupler.
6. Design and conduct an experiment to determine parameters of antenna for Dipole and Yagi antenna.

LIST OF EXPERIMENTS:

1) Verification of sampling theorem using flat top samples
2) Binary ASK generation and detection
3) Binary FSK generation and detection
4) Binary PSK generation and detection
5) DPSK modulation and demodulation
6) QPSK modulation and demodulation
7) Measurement of guide wavelength (λg), frequency and VSWR using Microwave test bench with Reflex Klystron as source
8) Study of optical fibers: measurement of losses in the analog link and numerical aperture
9) Determination of coupling coefficient and isolation characteristics of Microstrip line Directional coupler
10) Measurement of antenna parameters for dipole and Yagi antenna
11) a) Measurement of resonant characteristics of Microstrip ring resonator
    b) Measurement of power division & isolation characteristics of Microstrip 3dB power divider.

Course Outcomes:

Upon successful completion of this lab, student will be able to:

1. Understand the generation of samples and reconstruction of the original signal from the samples.

2. Realize various binary digital modulation and demodulation schemes.

3. Measure microwave parameters using microwave test bench with Reflex Klystron as source and antenna for Dipole antenna and Yagi antenna using RF signal generator as source.
4. Understand the working of optical fiber cables and to measure various losses and numerical aperture.
5. Measure parameters of microstrip ring resonator and determine isolation and coupling coefficient of microstrip line based on directional coupler.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H										
2	M	M			H							
3		M						M	M	L	L	L
4										L		L
5	H										L	

L: Low **M: Medium** **H: High**

****

MODERN RADAR AND NAVIGATIONAL AIDS

Sub Code : 15EC611 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable students to

1. Work with different radar range equations and calculate the effect of various external / internal factors on radar accuracies
2. Learn border view of radar subsystems , Radar measurement and Navigation
3. Apply the knowledge to obtain signal levels in simple direction finders for Navigational instruments
4. Study radar measurement processes, evaluate Doppler shifts and blind speeds.
5. Learn the elements of electronic navigation and integrate with emerging technologies.

UNIT - I

Elementary Modern radar: Radar overview, Radar range equation, Radar search and detection, Radar Cross section, Transmitted power, Pulse Repetition frequency and Radar Clutter **15 Hours**

UNIT - II

MTI & Pulse Doppler Radar: Introduction to MTI & Pulse Doppler Radar, Delay line cancellors, MTD, CW & FMCW Radar

Influencing factors: Propagation effects, target reflectivity, target fluctuations, detection criteria, detection theory, signal processing, pulse compression.

Radar Measurements: Parameter Measurements, Doppler phenomenology, Doppler processing**.** **16 Hours**

UNIT – III

Navigation: Introduction to four methods of Navigation. Radio direction finding, VOR, Hyperbolic systems of navigation- LORAN, DECCA, GPS.
Aids to approach and Landing: ILS, MLS, DME & TECAN **8 Hours**

Course Outcomes:

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

1. Have an appreciation of the working of different radars and calculate radar range values.
2. Describe basic radar subsystems & solve simple numerical problems.
3. Understand the effect of various external / internal factors on radar accuracies.
4. Explain radar measurement processes & evaluate doppler shifts and blind speeds.
5. Discuss different concepts in navigational instruments and obtain signal levels in simple direction finders

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L	M		H								
2				H								
3	M	L	H									
4	M			H								
5		L				L	H					

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Mark A Richards, et al**. "Principles of Modern Radar-Vol. I",** Yes Dee Publishers, 2012.
2. N.S.Nagaraja,**"Elements of Electronic Navigation",** McGraw-Hill Publications,2nd Edition.
3. A. K. Sen et al., **"Radar Systems and Radio Aids to Navigation",** Khanna Publishers, 2010.

REFERENCE BOOKS:

1. Merrill Skolnik, **"Introduction to Radar Systems",** McGraw-Hill Publications.
2. Merrill Skolnik, **"Radar Handbook"**, McGraw-Hill Publications.
3. Simon Kingsley et al., **"Understanding Radar Systems",** McGraw-Hill Publications.
4. Myron Kayton et al., **"Avionics Navigation Systems"** John Wiley Publications, 2nd Edition.

****

EMBEDDED LINUX

Sub Code : 15EC612 **Credit : 03**
Hrs/Week : 2+0+2+0 **Total Hours : 28+14**

NOTE:

1. CIE Evaluation:MSE-1 + MSE-2 + Mini project : 15Marks + 15 Marks +20 Marks
2. No. of Hours allotted for Lab: **14 Hrs**

Course Learning Objectives :

1. Working of basic Linux operating system and usage of basic Linux commands are introduced.
2. Able to understand basic Linux character driver modules and use of its development tools.
3. Covers the basic design framework of an embedded system.

UNIT – I

Overview of Unix/Linux: Introduction to Linux, Unix Commands, Understanding of some basic commands such as echo, pwd, ls, who, date, passwd, cal, cat, grep, cp, rm, chmod ,date and combining commands using pipes and redirection. Shell Programming using Loops, Conditional statements and Command line arguments. **12 Hours**

UNIT – II

Introduction to Linux Device Drivers: Kernel Architecture and Functional Overview, File System, System Calls, Process management, Device Drivers, Char Drivers.
Development Tools: Embedded IDE, cross Compilers. **10 Hours**

UNIT - III

Embedded Linux system Development – System Design and Development, Life Cycle Models, Problem Solving – Five Steps to Design, Design Process, Identifying and formulating the requirements, System Specification Vs System Requirement. **6 Hours**

Course Outcomes:

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

1. Understand the basic terminology of Linux operating system.
2. Use UNIX programming to code system call.
3. Identify and analyze the building blocks of Linux device drivers necessary for the hardware interface.
4. Use basic device drivers to work with hardware.
5. Prepare a design frame work for the embedded system based on generic or Linux based system platform.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1		L	H	H	M	L				L	M	L
2		**H**	**L**		**L**							
3		**H**	**L**		**L**							
4	H	H	H	M	M					M	M	L
5	H	H	H	M	H	M			L	L	M	

L: Low M: Medium H: High

TEXT BOOKS:

1. M. G. Venkateshmurthy "Introduction to Unix and Shell Programming" , Pearson Education.
2. K.V. K. K Prasad, **"Embedded /Real-Time Systems: Concept, Design & Programming"**, Dreamtech, 1st Edition, 2005.
3. James K. Peckol, Wiley, **"Embedded Systems –A contemporary Design Tool"**.

****

COMPUTER OPERATING SYSTEMS

Sub Code : 15EC613 **Credit : 03**

Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

This course will enable students to

1. Define and Describe operating systems, Resource allocation, Operating System structure, Operating System operations and services.
2. Explain Process concept, Operations on processes, Inter process communication, Multi-Threaded Programming and Process management.
3. Explain memory management concepts as applicable to kernel and programs in an Operating System.
4. Define and Describe Virtual memory, Paging policies and Scheduling of processes in an Operating System.

UNIT – I

Introduction And Overview Of Operating Systems : Operating system, Goals of an O.S, Operation of an O.S, Resource allocation and related functions, User interface related functions, Classes of operating systems, O.S and the computer system, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems.

Structure of the Operating Systems: Operation of an O.S, Structure of the supervisor, Configuring and installing of the supervisor, Operating system with monolithic structure, layered design, Virtual machine operating systems, Kernel based operating systems, and Microkernel based operating systems. **15 Hours**

UNIT – II

Process Management: Process concept, Programmer view of processes, OS view of processes, Interacting processes, Threads, Processes in UNIX, Threads in Solaris**.**

Memory Management: Memory allocation to programs, Memory allocation preliminaries, Contiguous and noncontiguous allocation to programs, Memory allocation for program controlled data, kernel memory allocation. **15 Hours**

UNIT – III

Virtual Memory: Virtual memory basics, Virtual memory using paging, Demand paging, Page replacement, Page replacement policies, Memory allocation to programs, Page sharing, UNIX virtual memory.

Scheduling: Fundamentals of scheduling, Long-term scheduling, Medium and short term scheduling, Real time scheduling, Process scheduling in UNIX **9 Hours**

Course Outcomes:

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

1. Understand the structure, operations and services of an Operating System.
2. Distinguish between processes and threads, and management of these in an Operating System.
3. Explain the need for scheduling processes and show the interrelationship between Process Control Block and Event Control Block .
4. Describe the memory allocation to processes and differentiate between contiguous and non contiguous memory allocation methods.
5. Discuss Paging techniques and policies used in Virtual memory management and CPU scheduling techniques in real time applications.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M							L				L
2	H	L										

3		M	H.									
4		H		M								
5	H	H		M.								

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. D.M.Dhamdhare**, "Operating Systems A Concept Based Approach"** TMH, 2nd Ed, 2006.

REFERENCE BOOK:

1. Silberschatz and Galvin, "**Operating Systems Concepts",** John Wiley, 5th Edition, 2001.

****

COMPUTER ORGANIZATION & ARCHITECTURE

Sub Code : 15EC614 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

This course will enable students to

1. Recall and Describe basic structure of computers, machine instructions and programs.
2. Recall and Describe different addressing modes, output operations, Stacks and Queues, Subroutines and Additional Instructions, IEEE standard for Floating point Numbers.
3. Write and describe accessing I/O Devices, Interrupts, Direct Memory Access, Busses, Interface Circuits, and Standard I/O Devices.
4. Describe Semiconductor RAM Memories, Read Only Memories, Cache Memories, Performance Considerations and Virtual Memories.
5. Recall and Describe execution of a Complete Instruction, Multiple Bus Organization, Microprogrammed Control and Hardwired Control.

UNIT – I

Basic Structure of Computers Computer types: Functional units, Basic operational Concepts, Bus structures, Performance, Historical Perspective. Machine Instructions and Programs. Numbers, Arithmetic operations and characters, Memory locations and addresses, characters and character strings addressing modes, assembly language, stack and queues, subroutines, instructions, encoding of machine instruction.
Input /Output Organization: Interrupts, DMA, Bus Arbitration, Buses, and Interface Circuits.

15 Hours

UNIT – II

The memory system: Semiconductor RAM Memories, Read only memories, Cache memories, Virtual memories, Secondary storage.
Arithmetic: Addition and Subtraction of signed numbers, ALU unit, Design of fast adders, Multiplication of positive numbers, Fast multiplication ,Integer Division, Floating point numbers and operations. **15 Hours**

UNIT - III

Basic Processing Unit: Register transfers, Execution of a complete instruction, Multiple bus organization, Hardwired control, Microprogrammed control, Embedded systems.

9 Hours

Course Outcomes:

After studying this course, students will be able to acquire knowledge of:

1. The basic structure of computers & machine instructions and programs.
2. Addressing Modes, Assembly Language, Stacks, Queues and Subroutines.
3. Input/output Organization such as accessing I/O Devices, Interrupts.
4. Memory system basic Concepts, Semiconductor RAM Memories, Static memories, Asynchronous DRAMS, Read Only Memories, Cache Memories and Virtual Memories.
5. Some Fundamental Concepts of Basic Processing Unit, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control and Microprogrammed Control.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M					L						
2		H	M									L
3	H											
4		H		M				L				
5	M		L									

L:Low **M: Medium** **H: High**

TEXT BOOK:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, **"Computer Organization",** McGraw Hill Higher Education, 5th Edition, 2002.

REFERENCE BOOK:

1. William Stallings,**"Computer Organization and Architecture",** Pearson Higher Education, 9th Edition, 2013.

****

MACHINE LEARNING AND ITS APPLICATIONS

Sub Code : 15EC615 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

This course will enable students to:

1. Understand aspects of pattern recognition and its importance in machine learning.
2. Critical understanding of basic statistical significance tests.
3. Practice machine learning algorithms for solving healthcare and biomedical problems.
4. Identify potential applications of machine learning in practice and execution of machine learning tools such as WEKA.

UNIT – I

Introduction to Machine Perception: Feature Extraction, Bio Markers, Feature Selection, Learning and Adaptation-Supervised, Unsupervised and Reinforcement Learning.
Statistical Pattern Recognition: Standard Deviation, Variance, Covariance, Eigenvalue and Eigenvectors, Dimensionality Reduction, Principal Component Analysis, Independent Component Analysis.

15 Hours

UNIT – II

Statistical Significance Test: Multivariate Data Analysis, Methods in Analysis of Two-Class Problem and Multi-Class Problem.
Classification System: Class Labeling, Training and Testing a Classifier, *k*-fold Cross Validation, Confusion Matrices, Statistical Data Interpretation and Visual Tools, Performance Measure Techniques. **15 Hours**

UNIT – III

Classifiers: Decision Tree, *k*-Nearest Neighbor (*k*-NN)classifier and Support Vector Machine (SVM) classifier, Advances in Machine-Learning systems, Introduction to WEKA. **9 Hours**

Course Outcome:

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

1. Recognize the characteristics of pattern recognition that make it useful to real-world problems.
2. Appreciate the significance of statistical techniques in machine learning for discrimination of patterns.
3. Design and implement various machine learning algorithms in a range of healthcare applications using advanced simulation tools.
4. Develop the computer-aided tools using classification techniques.
5. Simulate and analyze the algorithms using modern classification techniques.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	H	L	H	L	M			H	
2	H	L	H	M	H	M	L	H			H	L
3	H	M	H	H	H	L	L			L	M	
4	M			L			H					
5	M		M	L		L		H		M		M

L: Low M: Medium H: High

TEXT BOOKS:

1. R.O. Duda, P.E. Hart, D.G. Stork, **"Pattern Classification"**, John Wiley & Sons, New York, 2012.
2. C.M. Bishop, **"Pattern Recognition and Machine Learning"**, vol. 4, no. 4. NewYork: Springer, 2006.

****

FUZZY LOGIC

Sub Code : 15EC621 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

The course presents basics of Fuzzy Logic that aims to:

1. Introduce concept of Fuzzy logic, Classical and Fuzzy. relations, Member functions and Fuzzy arithmetic.
2. Arm the students with the basics of Fuzzy rule based system.
3. Introduce Fuzzy classification.

UNIT – I

Introduction: Background, Uncertainty and imprecision, Uncertainty in information, Fuzzy sets and membership, Classical sets, Fuzzy sets, Sets as points in hypercubes.

Classical and fuzzy relations: Crisp relations, Operations, Properties, Compositions, Fuzzy relations, operations, Properties, composition, Noninteractive fuzzy sets, Crisp and fuzzy tolerance.

Membership functions: Standards, fuzzification, assignments, Inference, Rank. Neural networks, Genetic algorithms, Inductive reasoning.

Fuzzy arithmetic: Lambda-cuts, Defuzzification methods, fuzzy, Fuzzy transform (Mapping), Practical considerations, Approximate methods, DSW algorithm, Comparisons. **16 Hours**

UNIT – II

Classical logic and fuzzy logic: Classical predicate logic-tautologies, Contradictions, Equivalence, Logical proofs, Deductive Inferences, Fuzzy logic, Fuzzy tautologies, contradictions, Equivalence and logical proofs, Other forms of the implication operation.

Fuzzy rule-based systems: Natural language, hedges, Rule-based system-canonical rule forms, Decomposition, Likelihood and truth qualification, Aggregation, Graphical techniques of inference.

Fuzzy synthetic evaluation, ordering, decision making under fuzzy states**.** **15 Hours**

UNIT – III

Fuzzy classification: Classification by equivalence relations-crisp relations, Fuzzy relations cluster analysis, Cluster validity, c-Means clustering-hard c-Means (HCM), Fuzzy c-Means (FCM), classification metric, Hardening the fuzzy c-Partition, Similarity relations from clustering**.** **8 Hours**

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

1. An understanding of Classical and Fuzzy relations
2. An understanding of Fuzzy arithmetic
3. An understanding of the concepts of Fuzzy logic,
4. An understanding of Fuzzy rule based system
5. An understanding of Fuzzy classification

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L	L	H	M								H
2	L	L	H	M								H
3	L	L	H	M								H
4	L	L	H	M								
5	L	L	H	M								

L: Low M: Medium H: High

TEXT BOOK:

1. Timothy J. Ross, **"Fuzzy Logic with Engineering Applications",** McGraw-Hill, 1997.

REFERENCE BOOK:

1. B. Kosko, **"Neural Networks and Fuzzy Systems A Dynamical System Approach"**, Pearson Education, 1991.

NPTEL/ MOOC Link:

1. **http://nptel.ac.in/courses/108104049/16**

****

ADVANCED SIGNAL PROCESSING

Sub Code : 15EC622 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

1. Homomorphic signals and systems are discussed with cepstral analysis.
2. Different types of adaptive filters with its application are elaborated.
3. Introduces multirate digital signal processing along with different forms of filter bank applications.

UNIT – I

Review of prerequisites for advanced digital signal processing: Signals, Fourier representations, DFT & FFT, IIR and FIR filters
Homomorphism signal processing: Homomorphic system, complex Cepstrum, properties of complex cepstrum, complex cepstrum of exponential signals, Real Cepstrum, Implementation of cepstrum using DFT, Hilbert transform relations in cepstral analysis,
Homomorphic systems: convolution and deconvolution, Examples of Homomorphic signal processing, Communication signal processing and speech processing **16 Hours**

UNIT – II

Adaptive filtering: Principle of Adaptive filters, Tapped delay Line and Weiner filters, Steepest Descent Algorithm, Least Mean Square (LMS) Algorithm, Direct Least Square and Recursive Least Square (RLS) Algorithms
Application of Adaptive filters: Noise canceller, Echo canceller, Side Lobe Canceller, Adaptive Line Enhancer.
Multi-rate Signal Processing: Multi-rate Systems, Decimation and Interpolation (integer and fractional), Decimation Filters, Interpolation File **15 Hours**

UNIT - III

Interpolated FIR filters for decimation and interpolation filters. Uniform DFT filter banks, QMF banks Perfect Reconstruction, Poly Phase Filter structure, Poly Phase Filter structure for Decimation and Interpolation, Filter Banks, Half band and Multiband filters, PR systems.
8 Hours

Course Outcomes:

At the end of the course student will be able to

1. Understand the concept of cepstral analysis in speech signal processing.
2. Adopt homomorphic signal processing in speech signal processing.
3. Understand the adaptive filtering techniques for the stochastic random process.
4. Able to design adaptive filter using Wiener, LMS and RLS algorithms.
5. Design and use filter banks in the field of multirate signal processing.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	L						L	L	
2	M	M	L	L						L	L	
3	H		L	L						L	L	
4	H	M	M	L						L	L	
5	H	M	M	L						L	L	

L: Low M: Medium H: High

TEXT BOOKS:

1. Proakis & Manolakis, **"Digital Signal Processing Principles Algorithms & Applications",** PHI, 4th Edition, New Delhi, 2007.
2. Vaidyanathan P.P, **"Multirate Systems and Filter Banks",** Prentice Hall, India, 1992.
3. Haykin, **"Adaptive Filter Theory",** Prentice Hall, India, 1986.
4. DSP Handbook.
5. Elliot et al Hayes M H, **"Statistical Signal Processing and Modeling",** John Wiley Sons, Inc, 2002.
6. Manolakis D.G., Vinay Ingle K. and Kogan S. M., **"Statistical and Adaptive Signal Processing",** McGraw Hill 2000.

REFERENCE BOOKS:

1. Oppenheim A. V. and Schafer R. W., **"Digital Signal Processing",** Prentice Hall, 1992
2. Orfaneds S. J., **"Optimum Signal Processing",** McGraw Hill, NJ, 1989.

****

DATA BASE MANAGEMENT SYSTEM

Sub Code	**:**	**15EC623**	**Credits**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives :

This course will enable students to

1. Describe databases and database management systems.
2. Understand database structures and their working principles.
3. Design simple database models using Entity-Relationship Modeling.
4. Learn how to relate tables together in a database.
5. Recognize structured query language (SQL) statements and write queries using SQL.
6. Construct the stages of database project design-query processing and optimizing database, concurrency control using locking techniques.
7. Understand the issues associated with Transaction Processing and Recovery

UNIT - I

Introduction: DBMS Administrators, designers, Users, Developers & maintenance users of DBMS.
DBMS: Architecture, Schemes & Interfaces. Entity-Relationship model, Record storage & primary file organization: Hashing techniques, Index structures, Multilevel indexes using B-trees.
Relational data model & Relational algebra: Queries in relational algebra.

16 Hours

UNIT - II

SQL- A Relational Database language, Different clauses & example queries.
Database Design: I, II, III Normal forms, BCNF, Join dependencies, IV & V Normal forms.

14 Hours

UNIT - III

Query processing & Optimization, Transactions, Recovery & Concurrency control. Security & Integrity constraints. **9 Hours**

Course Outcomes:

1. Comprehend database structures and their working principles.
2. Design simple database models using Entity- Relationship Modeling.
3. Write queries using SQL.
4. Construct the stages of database project design with respect to query processing and optimization integrated with security constraints.
5. Identify the issues associated with Transaction Processing and Recovery.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	H						L				
2	H	H	L	L	L	M	L					
3	M	H	H		L							
4	M	H	M								M	
5	M	L	L									

L: Low M:Medium H:High

TEXT BOOK:

1. Ramez Elmasri, Shamkant B. Navathe, **"Fundamentals of Database Systems",** The Benzamin/Cummings, Addison-Wesley, VI Edition, 2011.

NPTEL/ MOOC Link:

1. https://onlinecourses.nptel.ac.in/noc15_cs14

****

ELECTRONIC MEASUREMENTS AND TRANSDUCERS

Sub Code : 15EC624 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable students to

1. Understand the concepts of electronic measurements.
2. Understand the errors in measurements and their rectification.
3. Understand the various bridge circuits used in measurements .
4. Realize the relevance of digital instruments in measurements.
5. Understand the working of instruments used for the measurement of voltage, current and resistance.
6. Make an appropriate selection of sensing devices for particular process.
7. Understand the construction and working principle of different types of display devices
8. Understand the importance of signal generators and signal analyzers in measurements.

UNIT – I

Introduction to Electronic Measurements and Instruments:

Performance characteristics of an instrument, Static characteristics, Error in measurement, Types of static error, Dynamic characteristics. Bridge circuits – DC Bridges (Wheat stone's bridge, Kelvin's Bridge), AC Bridges (Comparison Bridge, Maxwell's Bridge, Hay's Bridge, Schering's Bridge, Wien's Bridge).

AC/DC Ammeters/Voltmeters, Ohmmeter (Series and Shunt), Digital Multimeter, Digital Frequency meter.

Digital voltmeter Techniques - Ramp Technique, Staircase type, Dual slope integrating type, Integrating type, Successive Approximation type.

16 Hours

UNIT – II

Transducers and Display Devices:

Principles and classification of transducers, Electrical Transducers- Requirements and Guidelines for selection of Transducers. Resistive Transducers- Potentiometer, Strain gauges (Types of Strain gauge, Derivation of Gauge Factor), Resistance Thermometer. Inductive Transducers, LVDT. Capacitive Transducer. Piezoelectric Transducer.

Photo electric Transducers- Photo multiplier tube, Photo voltaic cell, Photo Transistor, Photo conductive cell, Photo diode. Temperature Transducer- Thermocouples

CRO-CRT Features, Block diagram, Vertical Amplifier, Horizontal Deflecting system (Continuous sweep, triggered sweep), Trigger pulse circuit, Delay line circuit. Dual Beam and Dual Trace CRO. Digital storage Oscilloscope.

Other display devices- LED, LCD, Electro Luminescent (EL), Electrophoretic Image Display (EPID), and Liquid Vapour Display (LVD), HDTV.

15 Hours

UNIT – III

Electronic instruments for signal generation & analysis:

Signal Generator-Standard signal generator, AF Sine and Square wave generator, Function generators, Pulse generators- requirements of a pulse.

Spectrum analyzers – RF Spectrum analyzer. Frequency synthesizer, Logic analyzer.

8 Hours

Course Outcomes:

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

1. Understand the errors in measurement and their rectification.
2. Use the various measuring techniques available.
3. Make an appropriate selection of sensing devices for particular process.
4. Understand the construction and working principle of different types of display devices.
5. Make out the importance of signal generators and signal analyzers in measurements

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	M	-	-	L	L	L	-	-	-	-	-
2	M	M	M	-	L	L	-	-	-	-	-	-
3	M	M	M	M	L	M	-	-	-	-	L	-
4	M	M	L	-	-	M	-	-	-	-	-	-
5	M	L	L	M	-	-	L	-	-	-	-	-

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. "Electronic Instrumentation", Second edition – H.S. Kalsi, Tata Mc Graw-Hill, 2004.
2. "A Course in Electrical and Electronics *Measurement* and *Instrumentation"- A.K.Sawhney*. Edition, 19. Publisher, Dhanpat Rai, 2011.

REFERENCE BOOKS:

1. "Modern Electronic Instrumentation & Measurement Techniques" – A.D. Hell Frick and W.D Cooper, PH1, 5th 2002.
2. "Electronic Measurements and Instrumentation"- R.K.Rajput, 2nd Edition, Publisher- S.Chandand Company, 2011.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/108105064/
2. http://nptel.ac.in/courses/108106070/

****

ERROR CONTROL CODING

Sub Code : 15EC625 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:
This course will enable students to learn the fundamentals of code construction and how to apply error control coding to achieve error detection and correction in digital communication systems.

UNIT - I

Introduction to coding theory, potential and need of error control coding.
Linear Block Codes: Introduction, Syndrome and error detection, Minimum distance of a block code, Error-detecting and Error-Correcting capabilities of block code, Standard array and Syndrome decoding, Probability of an undetected error for linear codes over BSC, Single-parity-check codes, Repetition Codes and Self-Dual codes, hamming codes, Reed-Muller codes. **15 Hours**

UNIT - II

Cyclic Codes: Introduction, Generator and Parity-check matrices of cyclic codes, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, Cyclic Hamming Codes, Error-Trapping Decoding, Golay Codes, Shortened Cyclic Codes. **14 Hours**

UNIT - III

Convolutional Codes: Encoding, Convolutional Encoder representation, State representation and State diagram, Tree diagram, Trellis diagram, Properties of Convolutional Codes, Hard and Soft decision, Viterbi convolutional decoding algorithm, Other decoding algorithms-Sequential decoding and Feedback decoding. **10 Hours**

Course Outcomes:

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

1. Understand the need of coding theory.
2. Demonstrate the construction and decoding of Linear Block Codes.
3. Understand the construction and decoding of Cyclic Codes
4. Appreciate the construction of convolutional encoder and features of the state diagram, tree diagram and trellis diagram.
5. Understand the classical decoding algorithms as well as Viterbi decoding algorithm.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	H	L	L	M				M	H	M
2	H	H	H	L	M	M				M	M	M
3	H	H	H	L	M	M				M	M	H
4	H	H	H	L	L	M				M	M	H
5	H	H	H	M	M	M				M	M	H

L: Low **M: Medium** **H: High**

REFERENCE BOOKS:

1. Shu Lin and Daniel J Costello, "Error Control Coding – Fundamentals and Applications", Pearson Education, Second Edition, 2011.
2. Bernard Sklar, "Digital Communications – Fundamentals and Applications", Pearson Education, Second Edition, 2005.
3. Todd K Moon, "Error Correction Coding – Mathematical Methods and Algorithms", Wiley, 2005.

****

EMPLOYABILITY SKILL DEVELOPMENT

Sub Code : 15IL002 **Credits : Nil (MLC)**
Hrs/Week : 1+0+0+0 **Total Hours : 12**

UNIT- 1

Quantitative- Permutations & Combinations
Analytical/logical- Cause & Effect statements
Verbal- Sentence corrections (Pronoun errors & misplaced modifiers)

UNIT-2

Quantitative- Area, volume & surface areas
Analytical/logical- Scenario based questions
Verbal- Sentence correction (Parallel construction & Parallel Comparison)

UNIT-3

Quantitative- Profit & loss
Analytical / logical- Figure series & mathematical puzzles
Verbal- Sentence correction (Tense usage)

UNIT-4

Quantitative- Simple and compound interest
Analytical/logical- Statement & assumption
Verbal- Sentence correction (Subject-verb agreement)

UNIT-5

Quantitative- Logarithms
Analytical/logical- Reasoning analogies
Verbal- Verbal analogies

UNIT-6

Quantitative- Stocks & Shares
Data interpretation- Tables, bar charts
Verbal- Reading comprehension (simple passage)

UNIT-7

Quantitative- Discounts (True discounts, bankers' discount)
Data interpretation- Line graphs & Pie charts
Verbal- Reading comprehension (Difficult passage)

UNIT-8

Quantitative- Clocks & Calendars
Data sufficiency
Verbal- Inferences from passages

References

1. Aggarwal R.S, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing.
2. Aggarwal R.S, "A modern approach to verbal and non-verbal reasoning", S Chand Publishing.
3. Bharath Patodi and Aditya Choudhary, "Verbal Ability & Comprehension", Disha Publication, Second edition, 2015.
4. Shakuntala Devi, "Joy of numbers", Orient Black Swan.
5. Shakuntala Devi, "More puzzles to puzzle you",Orient Black Swan.

****