Panchajanya Vidya Peetha Welfare Trust (Regd)

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Affiliated to Visvesvaraya Technological University, Belagavi,
Aided by Govt. of Karnataka, Approved by All India Council for Technical Education (AICTE), New Delhi
Accredited by NBA and NAAC with 'A' Grade

BDA Outer Ring Road, Mallathalli, Bengaluru - 560 056

Ref. No. ..... *Date :* .....

Sl. No	Subject	Subject code		Year
1	Verilog HDL	EC44	Employability & Skill development	2017
2	Antenna and Wave Propagation	EC55	Employability & Skill development	2017
3	Analog and Mixed Mode VLSI	EC61	Employability & Skill development	2017
4	Embedded System	EC63	Employability & Skill development	2017
5	Artificial Neural Network	EC651	Employability & Skill development	2017
6	Adaptive Signal Processing	EC652	Employability & Skill development	2017
7	Computer Communication Network	EC72	Skill development	2017
8	Nano Electronics	EC731	Employability & Skill development	2017
9	Wireless Sensor Network	EC732	Employability & Skill development	2017
10	DSP Algorithm and Architecture	EC733	Employability & Skill development	2017
11	Image Processing	EC734	Employability & Skill development	2017
12	Multimedia Communication	EC741	Employability & Skill development	2017
13	Speeach Processing	EC742	Employability & Skill development	2017
14	Operations Research	EC744	Employability & Skill development	2017
15	Satellite Communication	EC811	Employability & Skill development	2017
16	Cryptography and Network Security	EC812	Employability & Skill development	2017
17	Real Time Operating System	EC813	Employability & Skill development	2017
18	Adhoc Wireless Networks	EC814	Skill development	2017
19	Datastructure using C++	EC815	Employability & Skill development	2017
20	Virtual Instrumentation	EC816	Employability & Skill development	2017
21	Automotive Safety Measurments	ECE02	Employability & Skill development	2017
22	Semiconductor Fabrication	ECE03	Employability & Skill development	2017
23	Wireless Sensor Network	ECE04	Employability & Skill development	2017
24	Mechatronics	ECE06	Employability & Skill development	2017
25	Robotics and Machine Vision System	ECE07	Employability & Skill development	2017
26	Sensors	ECE08	Employability & Skill development	2017
27	Microcontroller Lab	ECL46	Skill development	2017
28	HDL Lab	ECL47	Skill development	2017
29	DSP Lab	ECL57	Skill development	2017
30	Analog Communication Lab	ECL58	Skill development	2017
31	Advanced Communication Lab	ECL66	Skill development	2017
32	Embedded System Lab	ECL67	Skill development	2017

Signature of BOS Chairman

Signature of Principal

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Ref. No. ..... *Date :* .....

33	VLSI Lab	ECL75	Skill development	2017
34	CCN Lab	ECL76	Employability &Skill development	2017
35	Mini-Project	ECP68	Employability & Skill development	2017
36	Project Work	ECP83	Employability & Skill development	2017
37	Technical Seminar	ECS82	Skill development	2017
38	Electronics devices	18EC32	Employability &Skill development	2018
39	Engineering Statistics	18EC35	Employability &Skill development	2018
40	Principles of Communication Systems	18EC43	Employability &Skill development	2018
41	Computer Organization and Architecture	18EC46	Employability &Skill development	2018
42	Programming with Python	18EC552	Employability &Skill development	2018
43	Artificial Neural Networks	18EC553	Employability &Skill development	2018
44	Nanoelectronics	18EC554	Employability &Skill development	2018
45	Mechatronics	18EC562	Employability &Skill development	2018
46	Sensors	18EC564	Employability &Skill development	2018
47	Semiconductor Fabrication	18EC641	Employability	2018
48	System Verilog for verification	18EC644	Skill development	2018
49	Internet of Things	18EC645	Employability &Skill development	2018
50	Robotics and Machine vision systems	18EC654	Employability &Skill development	2018
51	Microwave and Antenna	18EC72	Employability &Skill development	2018
52	5G Technology	18EC731	Employability &Skill development	2018
53	Virtual Reality	18EC732	Employability &Skill development	2018
54	Network and Cyber Security	18EC735	Skill development	2018
55	Real Time Embedded Systems	18EC744	Employability	2018
56	Adaptive Signal Processing	18EC746	Skill development	2018
57	Internet of Things	18EC751	Employability & Skill development	2018
58	Bio Mechatronics	18EC754	Employability &Skill development	2018
59	Introduction to Unmanned Aerial Vehicle	18EC755	Skill development	2018
60	Industry Internship	18ECI69	Employability & Skill development	2018
61	Analog Circuits and Communication Laboratory	18ECL47	Employability &Skill development	2018
62	Computer Programming Laboratory	18ECPL16/26	Employability	2018
65	Television Engineering	18EC563	Skill development	2021

Signature of BOS Chairman

Signature of Principal

Sub Title : Verilog HDL		
Sub Code:EC44	**No. of Credits:4=4 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 04**
Exam Duration : 3 Hours	**CIE +Assignment + SEE = 45 + 05 + 50 =100**	**Total No. of Contact Hours :52**

Course objectives:

1. Describing the EDA flow of digital design and recognizing the importance of HDL.
2. Able to design and analyze the digital circuits using dataflow and gate level modeling.
3. Implementation of digital circuits at behavioral level.
4. Understand the concepts of tasks and functions.
5. To gain the knowledge on synthesis of digital design and understanding the various logic devices available for the synthesis.

UNIT No	Syllabus Content	No of Hours
1	**Overview of digital design with Verilog HDL:** Evolution of Computer Aided Digital Design, Emergence of HDLs, Typical Design flow, Importance of HDLs, Popularity of Verilog HDL, Trends in HDLs. **Basic Concepts:** Lexical conversions, Data types, System tasks and Compiler directives. **Text-1**	10
2	**Modules and ports:** Modules, Ports, Hierarchical Names. **Gate Level Modeling:** Gate types, Gate delays. **Data Flow Modeling**: Continuous assignments, Delays, Expressions, Operators, and operands, operator types, Examples. **Text-1**	11
3	**Behavioral Modeling:** Structured Procedures, Procedural Assignments, Timing controls, Conditional statements, Multiway branching, Loops, Sequential and Parallel Blocks, Generate blocks, Examples. **Text-1**	10
4	**Tasks and functions:** Difference between Tasks and Functions, Tasks, Functions. **Modeling Examples:** Modeling simple elements, Different styles of modeling, Modeling Delays, Modeling a Truth Table, Modeling Conditional Operations, Modeling Synchronous Logic, Generic Shift Register, State Machine Modeling, Interacting State Machines, Modeling a Moore FSM, Modeling a Mealy FSM. **Text-1 & Text-2**	10
5	**Logic synthesis with Verilog HDL**: What is Logic synthesis, Impact of Logic Synthesis, Verilog HDL synthesis, Synthesis Design Flow, Verification of Gate Level Netlist. Programmable Logic Devices: PLA, PAL, Programming of PLA and PAL, CPLDs, FPGA, Applications of CPLDs and FPGAs. **Text-1 & Text-3**	11

Note 1. Unit 4 and Unit 5 will have internal choice.

Note 2. Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3, 4 and 5.

Course Outcomes:

CO1. Understand the HDL design flow and lexical conventions of the language.
CO2. Ability to design combinational and sequential circuits in different styles.
CO3. Able to design and test the circuits using behavioral modeling.
CO4. Ability to design the circuits using the subroutines and to model FSM in Verilog.
CO5. Ability to understand the concept of synthesis and programmable logic device.

Cos	Mapping with POs
CO1	PO2,PO3
CO2	PO2,PO3
CO3	PO2,PO3
CO4	PO2,PO3
CO5	PO2,PO3,PO4

TEXT BOOKS:

1. Samir Palnitkar, **"Verilog HDL – A guide to Digital Design and Synthesis",** Pearson, 2003.
2. J. Bhasker," **A verilog HDL Primer**" BS Publications , 2nd Edition.
3. Stephen Brown, ZvonkoVransic," **Fundamentals of digital logic with verilog Design**", TMH,2 nd Edition.

REFERENCE BOOKS/WEB LINKS:

1. Charles H. Roth, "**Digital Systems Design Using VHDL**", Thomson Learning, Inc, 1st Edition, 2002.
2. D Perry, "**Introduction to VHDL programming**", 4th Edition ,2002
3. Floyd, " **Digital Fundamentals using VHDL**", Pearson Education, 2nd Edition, 2003

Sub Title : MICROCONTROLLER LAB		
Sub Code:ECL46	**No. of Credits:1=0 : 0 : 1 (L-T-P)**	**No. of lecture hours/week : 02**
Exam Duration : 03 Hours	**CIE +Assignment + SEE = 50 + 50 =100**	**Total No. of Contact Hours : 26**

Course objectives:

1. To learn the architecture of 8051 Microcontroller.
2. To learn the Instruction set and Embedded C for MCS51.
3. Ability to write a ALP and C program for a given algorithm and implement the same
4. To learn the I/O ports and interfacing techniques with MCS51.
5. Ability to develop single chip solution using MCS51.

Unit No.	Syllabus contents	No of Hours
PART-A	**PROGRAMMING WITH 8051 MICROCONTROLLER**	
1.	**Data Transfer**: Block move, Exchange, Finding largest element in an array, sorting.	2
2.	**Arithmetic Instructions**: Addition/subtraction, multiplication and division, square, Cube	3
3.	**Counters:** 8/16 bit (Software)	2
4.	**Boolean & Logical Instructions (Bit manipulations):** Logic gates, Adder/Subtractor, multiplexer circuits	2
5.	**Code conversion**: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX.	2
6.	**Programs to generate time delay using** on-Chip timer/Counter, Program as event counter, Programs using serial port and Programs using interrupts.	2
PART B	**INTERFACING PROGRAMS: Write C programs to interface 8051** to interfacing modules to develop single chip solutions.	
7.	Key board and Alphanumeric LCD panel input interface to 8051	2
8.	External ADC and Temperature control interface to 8051.	2
9.	Generation of waveforms: Sine, Square, Triangular, Ramp etc. using DAC interface (change the frequency and amplitude)	4
10.	Stepper and DC motor control interface to 8051	2

Course Outcomes:

CO1. Understand the architectural features of microcontrollers.
CO2. Explain the instruction sets of Microcontrollers and write Assembly and High level Programs.
CO3. Study the various features of Microcontrollers based systems.
CO4. Study the applications of Microcontrollers for real time systems.
CO5. Development of single chip solutions.

Cos	Mapping with POs
CO1	PO2, PO3
CO2	PO2, PO3
CO3	PO2, PO3, PO11, PO12
CO4	PO2, PO3, PO11, PO12
CO5	PO2, PO3, PO11, PO12

TEXT BOOK:

1. **"The 8051 Microcontroller Architecture, Programming & Applications",** 2e Kenneth J. Ayala, Penram International, 1996 / Thomson Learning 2005.
2. **"The 8051 Microcontroller and Embedded Systems – using assembly and C",** Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006

Sub Title : HDL LAB		
Sub Code:ECL47	**No of Credits : 0:0:1:0(L:T:P)**	**No of lecture hours/week : 02**
Exam Duration : 03 Hours	**CIE +Assignment + SEE = 50 + 50 =100**	**Total No. of Contact Hours :26**

Course objectives:

1. Acquire skills to develop programs for digital design.
2. Verify the designs by simulation tools such as Altera/Xilinx.
3. To synthesize the designs on FPGA/CPLDs.
4. To interface different modules to FPGA.

Unit No.	Syllabus contents	No of Hours
1	Write the Verilog code and its test bench to realize all the logic gates.	2
2	Write the Verilog code with test bench to simulate the following combinational designs. a. 2 to 4 decoder b. 8 to 3 (encoder without priority & with priority) c. 8 to 1 multiplexer d. 4 bit binary to gray converter e. Multiplexer f. de-multiplexer g. Comparator	3
3	Write the Verilog code and its test bench to realize the functions of a Full Adder using all modeling styles.	2
4	Write the hardware description code and test benchfor 4-bit ALU. An ALU is a hardware that can give the result of various arithmetic and logical operations of the two numbers based on a control signal.	2
5	Write the Verilog code and its test bench for the SR, D, JK and T flip-flops.	2
6	Design and develop the Verilog code for 4 bit - binary counter, Synchronous, Asynchronous and Ring counter.	3
7	Write the Verilog code for 8-bit register with shift left and shift right modes of operation and test its operation.	2
8	Write a program to illustrate the function and tasks.	2
PART B	**Interfacing Programs.**	
9	Write the Verilog code to control external light using relay.	2
10	Write Verilog code to generate different waveforms (Sine, Square, Triangle and Ramp) vary the frequency and amplitude using DAC.	2
11	Write the Verilog code to interface the stepper motor and vary the speed and direction.	2
12	Write a program to implement keypad interface.	2

Course Outcomes:

CO1. Design, Simulation and synthesis of various digital circuits.
CO2. Waveforms generation using FPGA.
CO3. Interfacing motor and hex keypad on FPAGA.

Cos	Mapping with POs
CO1	PO2,PO3
CO2	PO2,PO3
CO3	PO2,PO3
CO4	PO2,PO3
CO5	PO2,PO3,PO4

TEXT BOOKS:

1. Samir Palnitkar, **"Verilog HDL – A guide to Digital Design and Synthesis",** Pearson, 2003.
2. J. Bhasker," **A verilog HDL Primer**" BS Publications , 2nd Edition.
3. Stephen Brown, ZvonkoVransic," **Fundamentals of digital logic with verilog Design**", TMH,2 nd Edition.

REFERENCE BOOKS/WEB LINKS:

1. Charles H. Roth, "**Digital Systems Design Using VHDL**", Thomson Learning, Inc, 1st Edition, 2002.
2. D Perry, "**Introduction to VHDL programming**", 4th Edition ,2002
3. Floyd, " **Digital Fundamentals using VHDL**", Pearson Education, 2nd Edition, 2003

Subject Title: ANTENNA AND WAVE PROPAGATION

Sub.Code: EC55 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 Describe the fundamental parameters of the antenna.
2 Describe the radiation from electric dipole.
3 Describe the operation of array of antennas and their radiation patterns.
4 Explain the different types of antennas used in LF and VHF.
5 Explain the frequency independent antennas and different modes of wave propagation in free space.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Antenna Terminology** : Introduction, Isotropic radiators, Radiation pattern, radiation intensity, Gain – Directive gain, power gain, Directivity, antenna efficiency, effective area , effective height , transmission between two antennas, radiation resistance , antenna beam width , beam efficiency, polarization, antenna temperatures, Numerical. **Text Book: 1 & 2**	08	L1, L2 , L3.
2	**Electric Dipoles and Thin Linear Antennas:** Introduction, short electric dipole, Retarded vector potential, fields of a short dipole, radiation resistance of short dipole, radiation from a half wave dipole (power radiation and radiation resistance), linear antenna and its effective length, Numerical. **Text Book: 1 & 2**	10	L1, L2, L3.
3	**Point Sources and Arrays**: Introduction, point sources, power patterns, filed patterns, phase patterns, power theorem, radiation intensity and examples. Various forms of antenna array, Array of two isotropic point sources, Non-isotropic but similar point sources, Multiplication of pattern and examples, linear array with n isotropic point sources of equal amplitude and spacing and examples, non-isotropic point sources, broad side array and end fire with non-unipolar amplitude distribution, Binomial arrays. **Text Book: 1 & 2**	11	L1, L2, L4.
4	**Practical Antennas:** Low frequency antennas – The V antenna, Rhombic antenna and design of rhombic antenna , Loop antenna- EMF Equation of loop antenna, errors in loop direction finding, radiation resistance and directivity of loop antenna, examples. VHF antennas –folded dipole antenna, Yagi-Uda antenna, voltage and	11	L2, L3, L5.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	current relations in Yagi-uda antenna, Horn antenna and examples, Babbinet's principle and complementary antennas, micro strip antenna, Introduction microwave antenna. **Text Book: 2**		
5	**Frequency Independent Antennas and Introduction to Wave Propagation:** condition for frequency independence, frequency independent of conical-spiral antenna, frequency independent of log-periodic (dipole array) antenna, design of log periodic dipole antenna **Introduction To Propagation:** Modes of propagations-ground wave, sky wave, space wave and tropospheric scatter propagation. Structure of atmosphere. Characteristics of different ionized regions. Sky Wave Propagation, Definitions- Virtual Height, Maximum Usable frequency, Skip distance, Space wave propagation, Duct Propagation, Numerical **Text Book: 2**	12	L2, L3, L5.

Note 1: **Unit 4 and Unit 5 will have internal choice.**

Note 2: **Two assignments are evaluated for 5 marks: Assignment – 1 from units 1, 2 and 3. Assignment - 2 from unit 4 and 5.**

Course Outcomes:

CO1 Describe and identify different types of antennas and list modes of wave propagation.

CO2 Explain the working and characteristics of each type of antenna and modes of wave propagation

CO3 Draw and illustrate antenna patterns, Design antennas for the given specifications.

CO4 Examine the parameters of antenna and derive radiation resistance of electric dipole of antenna.

CO5 Evaluate the radiation patterns and radiation intensity of antenna.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1, PO2,PO12

CO2 PO1, PO2,PO12

CO3 PO1,PO2,PO4

CO4 PO1, PO2,PO3,PO5,PO12

CO5	PO2, PO5,PO12

Text Books.

1. John D Kraus, Ahmad S Khan, "ANTENNAS AND WAVE PROPAGATION", Forth Edition, Tata McGraw-Hill International, 2010
2. K D Prasad, "ANTENNA & WAVE PROPAGATION", Satya Prakashan,New Delhi, 3rd edition, 2012
3. A Balanis,"Antenna Theory- Analysis and Design",3rd edition, John Wiley Interscience Publication,2004

Reference Text Books.

1. A R. Harish , M. Sachidananda," ANTENNA AND WAVE PROPAGATION", Oxford University Press,2007
2. U A Bakshi, A V Bakshi,"Antenna and Wave Propagation ", Technical Publication
3. G S N Raju," Antenna and Wave Propagation", PEARSON Publication, 2012

Web Links.

1. http://www.rfwireless-world.com
2. https://www.accessengineeringlibrary.com/browse/practical-antenna-handbook-fifth-edition
3. https://www.audiolinks.com
4. http://www.radio-electronics.com/info/propagation/radio-propagation/radio-propagation-overview-tutorial.php

Subject Title : DSP Lab

Sub.Code: ECL57 No. of Credits:1.5=0:0:1.5 (L - T – P) No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs CIE+Assignment +SEE=50+0+50=100 Total No.of Contact Hours:39

Course Learning Objectives:

1 To analyze the sampling process, impulse response, convolution, frequency domain response of LTI systems
2 To analyze and design digital IIR and FIR filters
3 To demonstrate the DSP algorithms using Matlab software
4 To demonstrate the DSP algorithms using Code Composer Studio
5 Enter the course learning objective

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	1. Verification of sampling theorem. 2. Impulse response of a given system 3. Linear convolution of two given sequences. 4. Circular convolution of two given sequences 5. Autocorrelation of a given sequence and verification of its properties. 6. Cross correlation of given sequences and verification of its properties. 7. Solving a given difference equation. 8. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum. 9. Linear convolution of two sequences using DFT and IDFT. 10. Circular convolution of two given sequences using DFT and IDFT 11. Design and implementation of FIR filter to meet given specifications. 12. Design and implementation of IIR filter to meet given specifications. . TEXT 1 and TEXT 1	10	L1,L2,L3.
2	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. Noise: Add noise above 3 KHz and then remove; Interference suppression using 400 Hz tone. 5. Impulse response of first order system. TEXT 2	11	L3,L4,L5

Note 1: Unit 3 and Unit 4 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define and verify the sampling theorem, impulse response, convolution and frequency response of the system

CO2 Understand DFT, IDFT, Auto correlation and Cross correlation

CO3 Analyze and design digital IIR and FIR filters.

CO4 Demonstration of DSP algorithms using Matlab software.

CO5 Demonstration of DSP algorithms using Code Composer Studio software.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO4,PO5, PO11, PO12

CO2 PO1,PO2,PO3,PO4,PO5, PO11, PO12

CO3 PO1,PO2,PO3,PO4,PO5, PO11, PO12

CO4 PO1,PO2,PO3,PO4,PO5, PO11, PO12

CO5 PO1,PO2,PO3,PO4,PO5, PO11, PO12

Text Books.

1 Sanjeet K. Mitra, "Digital Signal Processing using MATLAB", Edition, TMH, 2001

2 B. Venkataramani and Bhaskar, "Digital Signal Processors", edition, TMH, 2002

Reference Text Books.

1 J. G. Proakis & Ingale, "Digital Signal Processing using MATLAB", edition, Mc Graw Hill, 2000

Subject Title : Analog Communication Lab

Sub.Code: ECL58 No. of Credits:04=0:0:1.5 (L - T – P) No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs CIE+Assignment +SEE=50+50=100 Total No.of Contact Hours:36

Course Learning Objectives:

1 To analyze the filter concepts in communication systems
2 To analyze and compare different analog modulation schemes.
3 To demonstrate the concepts of modulation and demodulations of AM
4 To demonstrate the concepts of modulation and demodulations of FM, PWM and PPM
5 To demonstrate the concepts of modulation and demodulations of PWM and PPM

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Second order Butterworth LPF and HPF.	3	L1,L2
2	Second Order Butterworth BPF	3	
3	Second order Butterworth BEF.	3	
4	Design and test R-2R DAC using op-amp	3	
5	Design and test the Astable multivibrator for given frequency and duty cycle using IC 555.	3	
6	Amplitude modulation & Detection.	3	
7	Frequency modulation using 8038/2206. FM detection using PLL	3	
8	Pre-emphasis and De-emphasis.	3	
9	Pulse Amplitude Modulation & Demodulation	3	
10	Pulse Width modulation and Demodulation	3	
11	Pulse Position modulation and Demodulation	3	
12	Time division multiplexing of analog signals.	3	

Note 1: Text Book: 1 & 2

Course Outcomes:

CO1 Define the LPF,HPF and BPF
CO2 Analyze and design filters.
CO3 Demonstration of Modulation and Demodulation
CO4 Illustrate the analog Signals.
CO5 Design the R-2R DAC.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO4,PO5
CO2 PO1,PO2,PO3,PO4,PO5
CO3 PO1,PO2,PO3,PO4,PO5

CO4 PO1,PO2,PO3,PO4,PO5

CO5 PO1,PO2,PO3,PO4,PO5

Text Books.

1 Simon Haykins, "**An Introduction to Analog and Digital Communication**", First Edition, John Wiley, 2003

2 David A. Bell, "**Operational Amplifiers and Linear IC's**", Third Edition, Oxford Publisher, 2011

Subject Title : Analog and Mixed Mode VLSI Design

Sub.Code: EC61 No. of Credits:03=03:0:0 (L - T – P) No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:39

Course Learning Objectives:

1 Understand the concept of Analog Design and Data Converter Fundamentals.
2 Design and Mismatch Error Analysis of DAC Architectures.
3 Design and Mismatch Error Analysis of ADC Architectures.
4 Analysis of Current sources and sinks in VLSI perspective.
5 Analysis of Single stage amplifiers in VLSI perspective.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction to Analog Design:** Why Analog, Why Integrated, Why CMOS, General Concepts: Levels of Abstraction, Robust Analog Design. Basic MOS Device Physics: General considerations, MOS I/V Characteristics, Second Order Effects, MOS Device Models. **Data Converter Fundamentals:** Analog versus Digital discrete time signals, Converting Analog signals to Digital signals, Sample and Hold Characteristics, DAC specifications, ADC specifications, Mixed signal layout issues. TEXT 1 TEXT 2	09	L1,L2,L3.
2	**Data Converter Architectures:** DAC architecture, Digital input code, Resistors string, R-2R ladder networks, Current steering, Charge scaling DACs, Cyclic DAC, Pipeline DAC. TEXT 2	07	L1,L2,L3.
3	**ADC Architecture:** Flash, 2-step flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. TEXT 2	07	L2,L3,L4
4	Current Sources and Sinks: The current mirror, The Cascade Connection, Sensitivity Analysis, Transient response, other current sources & sinks. TEXT 1 TEXT 2	07	L2,L3,L4
5	**Single stage amplifiers:** Common source stage, Common Source stage with resistive load, Common Source stage with Diode connected load, Common Source Stage with Current Source load, Common Source stage with Triode load. TEXT 1	09	L2,L3,L4

Note 1: Unit 1 and Unit 5 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Understanding of Fundaments in Analog and Digital design

CO2 Analysis of DAC Architectures and Mismatch errors.

CO3 Ability of Analyse the ADC architectures and Mismatch Error

CO4 Ability to Analyse and Design of Current sources and sinks.

CO5 Ability to Analyse and Design of Single Stage Amplifiers.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO3, PO4

CO2 PO4, PO5

CO3 PO5, PO7

CO4 PO10, PO12

CO5 PO3, PO12

Text Books.

1 Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Twenty Fifth Reprint, TATA McGraw Hill, 2013.

2 R Jacob Baker, "CMOS Circuit Design, Layout and Simulation", PHI, 2005.

Reference Text Books.

1 Philip E Allen and Douglas R Holberg, "CMOS Analog Circuit Design", Second edition, Oxford University Press, 2004.

2 Adel Sedra and K C Smith, "Microelectronics Circuits", Fifth edition, Oxford University Press, 2009.

Web Links.

1 http://www.nptelvideos.in

Subject Title : Embedded Systems

Sub.Code: EC63 No. of Credits:03=03:0:0 (L - T – P) No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:39

Course Learning Objectives:

1 Understand the basic concepts of Embedded Systems.
2 Explain the need for embedded systems.
3 Explain the Characteristics and quality attributes of Embedded Systems.
4 Get exposure to an advanced microcontroller and Operating system concepts.
5 Analyse Embedded system industrial applications.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Typical Embedded System:** Definition, Embedded systems vs. General Computing Systems, Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components. TEXT 1 Click here to enter text.	08	L1,L2,L3.
2	**Characteristics and Quality Attributes of Embedded Systems:** Characteristics of an Embedded system, Quality attributes of Embedded Systems. **Hardware Software Co-Design and Program Modelling**: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, UML-Use case diagrams. TEXT 1	07	L1,L2,L3.
3	**ARM-32 bit Microcontroller family:** ARM Cortex-M3 Processor-Introduction, Overview of the Cortex-M3, Instruction Sets, LPC 1768 programming. TEXT 2	10	L1,L2,L3.
4	**Real-Time Kernels and Operating Systems:** Introduction, Tasks and Things, Programs and Processes, The CPU is a Resource, Threads, Sharing Resources, Foreground/Background Systems, The Operating System, The Real-Time Operating Systems (RTOS), Operating System Architecture. TEXT 3	08	L1,L2,L3.
5	**Case Study of Embedded Systems**: Digital camera, Embedded Systems in Automobile, Smart Card Reader, Automated Meter Reading System. TEXT 1	06	L1,L2,L3.

Note 1: Unit 1 and Unit 3 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Describe the structure of a Typical Embedded System.

CO2 Justify different characteristics, quality attributes and modelling Techniques of Embedded System design.

CO3 Understand how an advanced microcontroller is programmed.

CO4 Understand the concept of Real time kernels & operating system.

CO5 Evaluate the concept of industrial applications through case studies.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO3

CO2 PO1,PO2,PO3,PO4,PO5

CO3 PO1,PO2,PO3,PO4

CO4 PO1,PO2,PO3,PO4,PO5,PO12

CO5 PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO12

Text Books.

1 Shibu K V, "Introduction to Embedded Systems", First Edition, Tata McGraw Hill Education Private Limited, 2009

2 Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", Second Edition, Newnes, (Elsevier), 2008

3 James K Peckol, "Embedded Systems – A contemporary Design Tool", edition, John Weily, 2008

Reference Text Books.

1 Raj Kamal, "Embedded Systems – Architecture, Programming and Design", edition, Mc Graw Hill, 2012

Web Links.

1 http://nptel.ac.in/

Sub Title : ARTIFICIAL NEURAL NETWORK		
Sub Code:EC651	**No. of Credits:4=4 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 04**
Exam Duration : 3 Hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours :52**

Course objectives:

1. To become familiar with the concepts of Neural Networks.
2. To understand the Analysis of different techniques in neural networks.
3. To study the concepts of the concepts of Prediction Networks.
4. To understand the concepts of Polynomial networks in Artificial Neural Networks.
5. To analyze the Optimization of different techniques.

UNIT No	Syllabus Content	No of Hours
1	Introduction, Fundamental concepts and Models of Artificial Neural systems, Biological Neural Networks, structure and function of single neuron, neural net architectures, neural learning, use of neural networks, Application of MATLAB in Neural Network.	12
2	Simple neural nets for Pattern Classification, Supervised learning Single Layer Feedback Networks, examples, Perceptron learning perceptions, linear separability, perceptions training algorithm Training algorithm: Hebb rule & Delta rule, guarantees of success, modifications.	11
3	Multiclass networks-I, multilevel discrimination, preliminaries, back propagation, setting parameter values, theoretical results.	09
4	Prediction networks, radial basis functions, polynomial networks, regularization, unsupervised learning, winner take all networks.	10
5	Optimization using hop filed networks, simulated annealing, random search, evolutionary computation.	10

Note 1: Unit 3 and Unit 4 will have internal choice.
Note 2:Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3, 4 and 5.

Course Outcomes:

CO1. Understand the basic concepts of Neural Networks.
CO2. Analysis and development of different techniques in neural networks.
CO3. Analysis the concepts of Prediction Networks.
CO4. Understand and analysis of the concepts of Polynomial networks in Artificial
CO5. Neural Networks.
CO6. Design optimization of different techniques.

Cos	Mapping with POs
CO1	P01,P02,P05,PO6
CO2	P02,P07
CO3	P08,P09
CO4	P09,P10
CO5	P07,P09

TEXT BOOKS:

1. Kishan Mehrotra, C. K. Mohan, Sanjay Ranka,Penram, **"Elements of Artificial Neural Networks"**, ***1997.***
2. J. Zurada, Jaico, **"Introduction to Artificial Neural Systems"**, ***2003.***

REFERENCE BOOKS/WEBLINKS:

1. Simon Hayking, **"Neural Networks: A Comprehensive Foundation",**2nd Edition, PHI.
2. Laurene Fausett, **"Fundamentals of Neural Networks: Architecture, Algorithms and Applications",** Person Education, 2004.

Subject Title : Adaptive Signal Processing

Sub.Code: EC652 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To understand the basic concept of adaptive filter and adaptive system
2 To be able to identify the geometrical significance of Eigenvectors and values
3 To analyse the Simple, Newton's and Steepest Descent Gradient search method to search performance surface
4 To study estimation of gradient component using Newton's, Steepest-descent methods and LMS algorithm
5 To be familiar with design of adaptive communication system, adaptive noise canceller and adaptive modeling in FIR digital filter synthesis

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**ADAPTIVE FILTERS:** The Filtering Problem, Linear Optimum Filters, Adaptive Filters, Linear filter structures, Approaches to the development of linear adaptive filters. **ADAPTIVE SYSTEMS:** Definition and characteristics, Areas of application, General properties, Open-and closed-loop adaptation, Applications of closed-loop adaptation, Example of an adaptive system. TEXT 1 and TEXT 2	10	L1,L2,L3.
2	**THE ADAPTIVE LINEAR COMBINER:** General description, Input signal and weight vectors, Desired response and error, the performance function, gradient and minimum mean-square error, Example of a performance surface, Alternative expression of the gradient, Decorrelation of error and input components. **PROPERTIES OF THE QUADRATIC PERFORMANCE SURFACE:** Normal of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, an example with two weights, geometrical significance of eigenvectors and Eigen values. TEXT 1 and TEXT 3	11	L2,L3,L4,L5
3	**SEARCHING THE PERFORMANCE SURFACE:** Methods of searching the performance surface, Basic ideal of gradient search methods, a simple gradient search algorithm and its solution, Stability and rate of convergence, The learning curve, and Gradient search by Newton's method in multidimensional space, Gradient search by the method of steepest descent, Comparison of learning curves. TEXT 1 and TEXT 3	12	L3,L4,L5
4	**GRADIENT ESTIMATION AND ITS EFFECTS ON ADAPTATION:** Gradient component estimation by derivate	10	L3,L4,L5

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	measurement, the performance penalty, Derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight-over solution, excess mean-square error and time constants, mis-adjustment, comparative performance of Newton's and steepest-descent methods, Total mis-adjustment and other practical considerations. **THE LMS ALGORITHM:** Derivation of the LMS algorithm, convergence of the weight vector, an example of convergence, learning curve, noise in the weight-vector solution, mis-adjustment, performance. TEXT 1 and TEXT 3		
5	**ADAPTIVE MODELING AND SYSTEM IDENTIFICATION:** General description, Adaptive modeling of multipath communication channel, adaptive modeling in geophysical exploration, Adaptive modeling in FIR digital filter synthesis. **ADAPTIVE INTERFERANCE CANCELING:** The concept of adaptive noise canceling, stationary noise-canceling solutions, effects of signal components in the reference input, The adaptive interference canceller as a notch filter, The adaptive interface canceller as a high-pass filter. TEXT 1	11	L3,L5,L6

Note 1: Unit 4 and Unit 5 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Understand the basic concept of adaptive filter and adaptive system

CO2 Understand the design of adaptive linear combiner and Identify the geometrical significance of Eigenvectors and values.

CO3 Analyze the Simple, Newton's and Steepest descent Gradient search method to search performance surface.

CO4 Estimate the gradient component using Newton's, Steepest-descent methods and LMS algorithm.

CO5 Design of adaptive communication system, adaptive noise canceller and adaptive modeling in FIR digital filter synthesis.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO4

CO2 PO1,PO2,PO3,PO4

CO3 PO3,PO4,PO7,PO10

CO4 PO3,PO4,PO5,PO7,PO10

CO5 PO5,PO6,PO7,PO10,PO12

Sub Title : Advanced Communication Lab		
Sub Code: ECL66	**No. of Credits:1.5 =0:1.5 : 0 (L-T-P)**	**No. of lecture hours/week : 03**
Exam Duration : 3 Hours	**CIE + SEE = 50 + 50 =100**	**Total No. of Contact Hours :36**

Course objectives:

1. Design and conduct an experiment on ASK,FSK,PSK, in communication systems.
2. Design and conduct an experiment on DPSK.
3. Design and conduct an experiment on QPSK
4. Establish Analog and Digital communication link using optical fiber
5. Understand the concepts of modulation and demodulations like Yagi Antenna, Directional coupler

UNIT No	Syllabus Contents	No of Hours
1.	ASK generation and detection using discrete components.	3
2.	FSK generation and detection using discrete components.	3
3.	PSK generation and detection using discrete components.	3
4.	To prove sampling theorem, To study the effects of under sampling and oversampling.	3
5.	DPSK generation and detection using kit.	3
6.	QPSK generation and detection using kit	3
7.	Establish Analog and Digital communication link using optical fiber and Measure the losses (coupling loss, bending loss, attenuation loss numerical aperture.)	3
8.	Measurement of frequency, guide wavelength, power, VSWR and Attenuation in a microwave test bench.	3
9.	Measurement of directivity and gain of micro strip patch antenna using printed dipole.	3
10.	Measurement of directivity and gain of Yagi antenna (printed) using printed dipole.	3
11.	Determination of coupling and isolation characteristics of a micro strip directional Coupler.	3
12.	Measurement of resonance characteristics of a micro strip ring resonator and determination of dielectric constant of the substrate.	3

Course Outcomes:

CO1. Understanding the concept of Antenna

CO2. Understanding the generation and manipulation of signals using analog modulation schemes

CO3. Able to understand the concepts of modulation and demodulations like ASK

CO4. Able to understand the concepts of modulation and demodulations like FSK

CO5. Able to understand the concepts of modulation and demodulations like QPSK.

Cos	Mapping with POs
CO1	PO1,P02,PO3
CO2	PO1,PO4,PO5
CO3	PO4,P12,PO8
CO4	PO9,P010,P011
CO5	PO3,PO6,PO7,PO10

REFERENCE BOOKS/WEBLINKS:

1. George Kennedy, " Electronic Communication Systems", TMH 4th Edition, 2008.

Subject Title : Embedded System Lab

Sub.Code: ECL67 No. of Credits:1.5=0:1.5:0 (L - T – P) No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs CIE +SEE=50+50=100 Total No.of Contact Hours:36

Course Learning Objectives:

1 To study the features of LPC 1768 MCU.
2 Develop the Assembly level programming of ARM Cortex M3 Processor.
3 Develop the Embedded C level programming of ARM Cortex M3 Processor.
4 Understand Interfacing of different modules to LPC 1768 MCU.
5 Develop 32-bit microcontroller based Embedded system applications.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Write a Assembly language program to link Multiple object files and link them together.	3	L1, L2
2	The Assembly language program i. To calculate the value of the function. ii. To store data in desired Memory location.	3	L1,L2,L3.
3	Write a C program to Output the message using UART.	3	L1, L2, L3,L4
4	Write a C Program to interface LED using LPC 1768.	3	L1, L2, L3, L4
5	Write a C Program to interface Relay using LPC 1768.	3	L1, L2, L3, L4
6	Write a C Program for DC motor/Stepper motor rotation using LPC 1768.	3	L1, L2, L3, L4
7.	Write a C program to interface a Real Time Clock (RTC) of LPC 1768.	3	L1, L2, L3, L4
8.	Write a program to read on-chip ADC value and display it on UART terminal using LPC 1768.	3	L1, L2, L3, L4
9	Write a C program to interface a DAC of LPC 1768.	3	L1, L2, L3, L4
10	Generation of PWM signal for motor control using LPC 1768.	3	L1, L2, L3, L4
11	Write a C program to Design a Stopwatch using interrupts.	3	L1, L2, L3, L4
12	Write a C program to interface Keypad using LPC 1768.	3	L1, L2, L3, L4

Course Outcomes:

CO1 Understanding features of the architecture of ARM Cortex M3.
CO2 Create assembly, Embedded C level programs of ARM Cortex M3.
CO3 Interface different modules to LPC 1768 MCU.
CO4 Design and testing a program for Different Embedded applications.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO2, PO6

CO2 PO2, PO3, PO4, PO5, PO12

CO3 PO2, PO3, PO4, PO12

CO4 PO2, PO3, PO4, PO5,PO12

References Text Books.

1 Joseph Yiu, "**The Definitive Guide to the ARM CORTEX-M3**", Second Edition, Newnes , **2008**

2 NXP Semiconductors, "**LPC17xx user manual**", Choose an item.

3 Micro-CM3768, "**ARM Cortex-M3 Development Board User Manual**

Note: Programming to be done using Keiluvision 4 and download the program on to a M3 evaluation board such as NXP LPC1768.

Sub Title : MINI PROJECT WORK		
Sub Code:ECP68	**No. of Credits:02=0 :0 :02 (L-T-P)**	
Exam Duration :03 Hour	**CIE + SEE = 50+50 =100**	**Total No. of Contact Hours : 03**

A student is required to carry out elaborated project work. The project may be either design and fabrication work or a simulation of a problem on a computer. At the end of the semester student will be required to submit a detailed report of literature survey, design problem formulation, work plan and work done and will defend his/her work carried out before the examiners at the time of final evaluation.

Subject Title : Computer Communication Networks(CCN)

Sub.Code: EC72 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To understand working of networks, mechanics of TCP/IP architecture
2 To elaborates the background concepts, and functionalities of application layer, transport layer, and network layer.
3 To study and analyse the flow and error control schemes.
4 To present ample details about the protocols, technologies, algorithms and standards that are used by each layer as it relates to the internet.
5 To overview LAN concept, link layer , connecting LANs and connecting devices.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Computer Networks and the Internet: What Is the Internet? The Network Edge, The Network Core, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and Their Service Models, Networks Under Attack, History of Computer Networking and the Internet TEXT 1 Click here to enter text.	10	L1,L2,L3.
2	**Application Layer:** Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service, Peer-to-Peer Applications, Socket Programming: Creating Network Applications TEXT 1	10	L1,L2,L3.
3	**Transport Layer:** Introduction and Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control. TEXT 1	12	L1,L2,L3.
4	**The Network Layer:** Introduction, Virtual Circuit and Datagram Networks, What's Inside a Router? The Internet Protocol (IP): Forwarding and Addressing in the Internet, Routing Algorithms, Routing in the Internet, Broadcast and Multicast Routing TEXT 1	10	L1,L2,L3
5	**The Link Layer: Links, Access Networks, and LANs:** Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks, Link Virtualization: A Network as a Link Layer, Data Center Networking, Retrospective: A Day in the Life of a Web Page Request. **Wireless and Mobile Networks:** Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs, Cellular Internet Access, Mobility Management: Principles, Mobile IP,	10	L1,L2,L3

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Managing Mobility in Cellular Networks, Wireless and Mobility: Impact on Higher-Layer Protocols TEXT 2		

Note 1: Unit 2 and Unit 3 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Identify the layered tasks, wireless and mobile networks for data transmission.

CO2 Explain the functionalities of application layer, transport layer , network layer, Wireless and Mobile Networks

CO3 Summarize the Wireless and Mobile Networks

CO4 Analyze the functions of network layer and design of addressing schemes.

CO5 Characterize the various functions of transport layer and application layer.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO2, PO4, PO7,PO11,PO12

CO2 PO2, PO4, PO7,PO11,PO12

CO3 PO2, PO4, PO7,PO11,PO12

CO4 PO2, PO4, PO7,PO11,PO12

CO5 PO2, PO4, PO7,PO11,PO12

Text Books.

1 James F. Kurose, Keith W. Ross, "**Computer Networks**", Pearson Education, 2nd Edition, **2003**.

2 B. Forouzan , " **Data Communication and Networking**", TMH, 4th Edition, ***2006***.

Reference Text Books.

1 Russel Bradford, "**The Art of Computer Networking"**, Pearson Education, Ist Edition, **2007**.

Web Links.

1 nptel.ac.in/courses/106105081/1

2 http://www.bau.edu.jo/UserPortal/UserProfile/PostsAttach/10617_1870_1.pdf

Sub Title : Nano-Electronics		
Sub Code: EC731	**No. of Credits:4=4 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 04**
Exam Duration : 3 Hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours :52**

Course objectives:

1. To learn and understand basic and advance concepts of nanoelectronics.
2. To introduce the students to nanoelectronics, nanodevices, spintronics and molecular electronics. To be able to understand the Photolithography and Etching
3. To identify quantum mechanics behind nanoelectronics.
4. To describe the principle and the operation of nanoelectronic devices.
5. To explain the principle and application of nano devices.

UNIT No	Syllabus Contents	No of Hours
1	**Basics of nanoelectronics** – capabilities of nanoelectronics – physical fundamentals of nanoelectronics – basics of information theory – the tools for micro and nano fabrication – basics of lithographic techniques for Nanoelectronics. **Text1**	10
2	**Quantum electron devices –** from classical to quantum physics: upcoming electronic devices – electrons in mesoscopic structure – short channel MOS transistor – split gate transistor – electron wave transistor – electron spin transistor – quantum cellular automate – quantum dot array – Principles of Single Electron Transistor (SET) – SET circuit design – comparison between FET and SET circuit design. **Text1**	10
3	**Nanoelectronics with tunneling devices and superconducting devices –** tunneling element technology - RTD: circuit design based RTD – Defect tolerant circuits. Molecular electronics – elementary circuits – flux quantum devices – application of superconducting devices – Nanotubes based sensors, fluid flow , gas temperature; Strain –oxide nanowire, gas sensing (ZnO,TiO2,SnO2,WO3), LPG sensor (SnO2 powder)- Nano designs and Nanocontacts – metallic nanostructures. **Text1**	11
4	A survey about the limits – Replacement Technologies – Energy and Heat dissipation – Parameter spread as Limiting Effect – Limits due to thermal particle motion – Reliability as limiting factor – Physical limits – Final objectives of integrated chip and systems. **Text1**	10
5	**Memory devices and sensors –** Nano ferroelectrics – Ferroelectric random access memory – Fe-RAM circuit design – ferroelectric thin film properties and integration – calorimetric sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors – electronic noses – identification of hazardous solvents and gases – semiconductor sensor array.**Text1**	11

Note 1. Unit 3 and Unit 5 will have internal choice.

Note 2. Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2 Assignment - 2 from units 3, 4 and 5.

Course Outcomes:

CO1. Identify the fundamental science and quantum mechanics behind nano-electronics
CO2. Ability to Interpret the concepts of a quantum well, quantum transport and tunnelling effects.
CO3. Creation of microelectronics and nanoelectronics.
CO4. Ability to comparison between FET and SET circuit design
CO5. Create the Nanoelectronics with tunneling devices and superconducting devices

CO6: Ability to Conclude the applications of nanotechnology and nanoelectronics.

Cos	**Mapping with POs**
CO1	PO5,PO7,PO8
CO2	PO7,PO8,PO10
CO3	PO5,PO8,PO12
CO4	PO5,PO9,PO11
CO5	PO9,PO11,PO12
CO6	PO5,PO9,PO11, PO12

TEXT BOOK:

1. Karl Goser, Peter Glosekotter, Jan Dienstuhl., **"Nanoelectronics and Nanosystems",** Springer, 2004
2. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse **"Nanotechnology: basic science and emerging technologies"**, Overseas Press (2005)

REFERENCE BOOKS/WEBLINKS:

1. Rainer Waser (ed.) **"Nanoelectronics and information technology : Advanced electronic materials and novel devices (2nd edition)" ,** Wiley VCH Verlag Weiheim (2005)
2. Rainer Waser, **"Nanoelectronics and Information Technology (edition, 2005)",** John Wiley & Sons, Germany.
3. K. Goser, **"Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices"** (Edition, 2004), Springer. London

Subject Title : Wireless Sensor Network

Sub.Code: EC732 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 Students will be able to describe the unique issues in sensor networks.
2 Students will be able to describe current technology trends for the implementation and deployment of wireless sensor networks.
3 Students will be able to discuss the challenges in designing MAC, routing and transport protocols for wireless sensor networks.
4 Interpret the goals for different protocols
5 Students will be able to describe and implement protocols

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Introduction: Unique Constraints and Challenges, Advantages of Sensor Networks, Energy advantage, Detection advantage, Sensor Network Applications, Habitat monitoring, Wildlife conservation through autonomous, non-intrusive sensing, Tracking chemical plumes, Ad hoc, just-in-time deployment mitigating disasters, Smart transportation: networked sensors making roads safer and less congested, Collaborative Processing.. TEXT1	10	L1, L2,L4
2	**Canonical Problem: Localization and Tracking,** A Tracking Scenario, *Sensing Model, Collaborative Localization, Bayesian State Estimation,* Distributed Representation and Inference of States: *Impact of Choice of Representation, Design consideration in Distributed Tracking,* Tracking Multiple Objects: *State-Space Decomposition, Data Association,* Sensor Models, Performance Comparison and Metrics , TEXT 1	10	L1, L2,L4,L5
3	Networking Sensors: Key Assumptions, Medium Access Control, General Issues, Geographic, Energy-Aware Routing: Unicast Geographic Routing, Routing on a Curve, Energy-Minimizing Broadcast, Energy-Aware Routing to a Region, Attribute-Based Routing. **Infrastructure Establishment:** Topology Control, Clustering, Time Synchronization, Localization and Localization Services, **Sensor Tasking and Control :**Task-Driven Sensing ,Roles of Sensor Nodes and Utilities Information-Based Sensor Tasking Sensor Selection IDSQ: Information-Driven Sensor Querying ,Cluster Leader–Based Protocol ,Sensor Tasking in Tracking Relations TEXT 1	13	L1,L2,L3,L4,L5
4	Sensor Network Databases: Sensor Network Databases,	10	L1,L4,L5

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Sensor Database Challenges, Querying The Physical Environment, Query Interfaces, Cougar sensor database and abstract data types, Probabilistic queries, High-level Database Organization, In- Network Aggregation, Query propagation and aggregation, Tiny DB query processing, Query processing scheduling and optimization, Data-Centric Storage, Data Indices and Range Queries, One-dimensional indices, Multidimensional indices for orthogonal range searching, Non-orthogonal range searching, Distributed Hierarchical aggregation, Multi-resolution, Partitioning, Fractional cascading, Locality preserving hashing, Temporal Data, Data aging, Indexing motion data. TEXT 1		
5	Sensor Network Platforms: Sensor Node Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms, Node-Level Simulators, Programming Beyond Individual Nodes: State-Centric Programming, and Tools Applications and Future Directions: Emerging Applications, Future Research Directions TEXT 1	08	L1,L2,L6

Note 1: Unit 1 and Unit 3 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define WSN, identify issues related to different protocols for WSN

CO2 Understand protocols require for Wireless Sensor Network

CO3 Explore current sensor technologies through algorithms, protocols, and applications

CO4 Analyse routing ,tracking problems, data base requirement and programing challenges

CO5 Interpret the design goals consideration tracking and evaluate the performance of different protocols for wireless Sensor Network Click here to enter text.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO5,PO6,PO10

CO2 P01, PO2, PO5,PO8

CO3 P01, PO4,PO5,PO6

CO4 P01, PO2,PO3

CO5 PO2, PO5,PO6,PO9

Text Books.

1 Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks, An Information Processing Approach", Elsevier, 2004

Reference Text Books.

1 Kazem Sohrabi,Daniel Minoli.Taieb Znati "Wireless Sensor Networks", Wiley Inter science, Wiley India, 2007

Web Links.

1 https://onlinecourses.nptel.ac.in/noc17_cs07

Subject Title : DSP Algorithms and Architecture

Sub.Code: EC733 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To gain the knowledge of basics of DSP like FIR filters, IIR filters, FFT algorithms, architectures of DSP processors and interfacing to other devices
2 To interpret the basics of DSP like FIR filters, IIR filters, FFT algorithms, architectures of DSP processors and interfacing to other devices
3 To apply the concept of FIR filters, IIR filters, FFT algorithms, architectures of DSP processors and interfacing to other devices
4 To illustrate the basics of DSP like FIR filters, IIR filters, FFT algorithms, architectures of DSP processors and interfacing to other devices
5 To design and implement the FIR filters, IIR filters, FFT algorithms on DSP processor.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**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. TEXT 1	12	L1, L2
2	**Programmable Digital Signal Processors:** Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54xx., Memory Space of TMS32OC54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor. TEXT 1	10	L1,L2
3	**Implementation of Basic DSP Algorithms:** Introduction, The Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). TEXT 1	10	L2,L3,L4
4	**Implementation of FFT Algorithms:** Introduction, An 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, External Bus	11	L2,L3,L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I / O Direct Memory Access (DMA). TEXT 1		
5	**Interfacing and Applications of DSP Processor:** Introduction, Synchronous Serial Interface, A CODEC Interface Circuit. DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System. TEXT 1	09	L3,L4,L5

Note 1: Unit 1 and Unit 4 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define the fundamentals of DSP and the general architecture of DSP

CO2 Understand the general architecture of DSP processor and in particular TMS320C54xx DSP to run algorithms.

CO3 Applying the concept of DSP algorithms when they are run on processors.

CO4 Analyze the implementation of FFT algorithms and interfacing memory to DSP processor.

CO5 Creating new designs based on existing algorithms targeted to DSP processor.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO2, PO3, PO4, PO5,PO11,PO12

CO2 PO2, PO3, PO4, PO5,PO11,PO12

CO3 PO2, PO3, PO4, PO5,PO11,PO12

CO4 PO2, PO3, PO4, PO5,PO11,PO12

CO5 PO2, PO3, PO4, PO5,PO11,PO12

Text Books.

1 Avatar Singh and S. Srinivasan, "Digital Signal Processing", Third Edition, Thomsoc Learning, 2004

Reference Text Books.

1 Ifeachor E. C., Jervis B. W Pearson-Education, "Digital Signal Processing: A Practical Approach", edition, Pearson Education, 2002

2 B Venkataramani and M Bhaskar, "Digital Signal Processors", 2nd edition, TMH, 2010

3 Peter Pirsch, "Architectures for Digital Signal Processing", 4th edition, John Wiley, 2007

Web Links.

1 http://bwrcs.eecs.berkeley.edu/Classes/CS252/Notes/Lec09-DSP.pdf

2 http://nptel.ac.in/courses/117102060/

Subject Title : Image processing

Sub.Code: EC734 No. of Credits:04=4:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 Describe image representation in spatial domain.
2 Compare Different image transforms used in different domains of Image Processing.
3 Illustrate improvement of the quality of images by using different filtering techniques
4 Identify filtering techniques to restore image from degraded images.
5 Conversion of colour images from one model to another model and design different techniques of image compression

Prentice Hall of India, Eastern Economy Edition

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	DIGITAL IMAGE FUNDAMENTALS: Definition of Image processing. Some examples of fields that use Digital Image processing, Fundamental Steps in Digital Image Processing: Components of an Image processing system, Image sensing and acquisition, Image Sampling and Quantization, Basic Relationships between Pixels, Mathematical tools used in Digital Image Processing: Array Vs Matrix operation, Linear Vs Nonlinear Operations, Arithmetic operations, Set & Logical operations Text 1	8	L1,L2,L3.
2	**IMAGE TRANSFORMS:** Introduction, Two-dimensional orthogonal & unitary transforms, Properties of unitary transform, Two dimensional Discrete Fourier transform. The Cosine Transform, Sine transform, Hadamard transform, Haar transform. Text 2	10	L1,L2,L3.
3	**INTENSITY TRANSFORMATIONS & SPATIAL FILTERING:** Basics of Intensity transformation and spatial filtering, Basic Intensity transformation functions, Histogram processing, Enhancement using Arithmetic/Logic Operations, Fundamentals of Spatial filtering, Smoothing Spatial filters, Sharpening spatial filters. **FILTERING IN THE FREQUENCY DOMAIN**: Filtering in the frequency domain, Smoothing using Frequency Domain filters, Sharpening using Frequency Domain filters, Homomorphic filtering. Text 1	12	L1,L2,L3.
4	**IMAGE RESTORATION:** A Model of image degradation/restoration process, Noise models, Restoration in the Presence of Noise only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the degradation functions,	10	L1,L2,L3.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Inverse filtering, Minimum mean square error (Weiner) Filtering. TEXT 1		
5	**COLOUR IMAGE PROCESSING**: Color fundamentals , Colour models: RGB Color model, CMY & CMYK Color models, The HSI Colour model, Pseudo colour Image Processing, Basics of full color Image Processing. **IMAGE COMPRESSION**: Fundamentals of coding redundancy, spatial and temporal redundancy, irrelevant information, measuring image information, fidelity criteria, image compression models, JPEG Encoder and decoder using DCT technique, image formats, containers and compression models, Some basic compression methods: Huffman coding, arithmetic coding LZW coding. TEXT 1	12	L1,L2,L3.

Note 1: Unit 3 and Unit5will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Identify image representation in spatial domain.

CO2 Summarise various image transforms applied in Image Processing

CO3 Apply different techniques to improve quality of images

CO4 Apply filtering techniques to restore images from degraded images

CO5 Modify color images from one model to another model and asses different techniques of image compression.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO2, PO11, PO12

CO2 PO5,PO6,PO7, PO11, PO12

CO3 PO5,PO6,PO7, PO11, PO12

CO4 PO5,PO6,PO7, PO11, PO12

CO5 PO5,PO6,PO7, PO11, PO12

Text Books.

1 Rafael C Gonzalez,"Richard E Woods, Digital Image Processing", Third Edition, Prentice Hall India , 2008.

2 Anil K Jain,, "Fundamentals of Image Processing", Fourth Edition Prentice Hall India,2009.

Reference Text Books.

1 B. Chanda and D. DuttaMajumdar,, "Digital Image Processing and Analysis",, Prentice Hall of India, Eastern Economy Edition, 2004

2 S.Shridhar "Digital Image processing", Oxford university Press , 2011

3 S.Jayaraman, S. EsakkiRajan and T.Veerakumar, “Digital Image Processing”, Tata McGaw Hill , 2009.

Web Links.

1. nptel.ac.in/courses/117105079/
2. www. Eee.tufts.edu
3. www.clarifai.com
4. www.cis.rit.edu/class/simg361
5. www.pearsonhiheredu.com

Subject Title : Multimedia Communication

Sub.Code: EC741 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 Describe the ways in which multimedia information is captured, Processed, and rendered
2 Discuss the ways in which multimedia data is transmitted across networks
3 Introduce Multimedia Quality Of Service (QOS) and to compare subjective and objective methods of assessing user satisfaction
4 Discuss privacy and copyright issues in the context of multimedia
5 Understand audio and video compression standards

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Multimedia Communications:** Introduction, Multimedia Information Representation, Multimedia Networks, Multimedia Applications, Media Types, Communication Modes, Network Types, Multipoint Conferencing, Network QOS Application QOS.TEXT 1	12	L1
2	**Multimedia Information Representation:** Introduction, Digital Principles, Text, Images, Audio, Video. TEXT 1	10	L1
3	**Text And Image Compression:** Introduction, Compression Principles, Text Compression, Image Compression. TEXT 1	10	L1,L2
4	**Audio And Video Compression:** Introduction, Audio Compression, DPCM, ADPCM, APC, LPC, Video Compression, Video Compression Principles, H.261, MPEG, MPEG-1, And MPEG-2. TEXT 1	12	L1,L2
5	**Multimedia Information Networks:** Introduction, Lans, Ethernet, Token Ring, Bridges, FDDI High-Speed Lans, LAN Protocol. TEXT 1	08	L1

Note 1: Unit 1 and Unit 4 will have internal choice
Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define Multimedia Representation, Types And Applications.
CO2 Understanding the digital principles, Image and Video features and its characteristics.
CO3 Understanding the image and text compression techniques as well as audio video standards.
CO4 Analyze the multimedia network and its parameters and characteristics.
CO5 Ability to understand Audio and Video Compression.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO2, PO6

CO2 PO2, PO6, PO7

CO3 PO2, PO4, PO6, PO7, PO12

CO4 PO2, PO6

CO5 PO2, PO6,PO7

Text Books.

1 Fred Halsall, "**Multimedia Communications: Applications, Networks, Protocols And Standards**", Second Edition Reprint, Thomson Learning Pearson Education, Asia, 2002

Reference Text Books.

1 Nalin K. Sharda, "**Multimedia Information Networking**", Second Edition, PHI, 2003

2 Ralf Steinmetz, Klara Narstedt, "**Multimedia Fundamentals: Vol 1 - Media Coding And Content Processing**", First Edition, Pearson Education, 2004

Subject Title : Speech Processing

Sub.Code: EC742 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To define the digital models of speech signals, time domain models of speech processing, Fourier transforms, linear predictive coding of speech and homo morphic speech processing.
2 To interpret the digital models of speech signals, time domain models of speech processing using Fourier transforms and to understand linear predictive coding of speech and homo morphic speech processing
3 To apply the Fourier transforms to speech signals and to predict using linear predictive coding of speech and homo morphic speech processing.
4 To illustrate digital models of speech signals, time domain models of speech processing, Fourier transforms, linear predictive coding of speech and homo- morphic speech processing.
5 To design linear predictive coding of speech and homo morphic speech processing.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Digital models for speech signal: Introduction, The process of speech production, The Mechanism of speech production, Acoustic phonetics, Digital models for speech signalsDigital Representations of speech wave form: Sampling of speech signals, Instantaneous quantization, Adaptive quantization.TEXT1	10	L1, L2,L4
2	Time domain models for speech processing: Introduction, Time dependent processing of speech, short time energy and average magnitude , short time Average zero crossing rate, Speech vs. Silence discrimination using Energy and Zero crossings, Pitch period estimation using parallel processing approach,, short-time autocorrelation function.TEXT1	10	L1, L2,L4
3	**Short-time Fourier analysis :** Introduction, definitions and properties: Fourier Transforms interpretation and linear filter interpretation, sampling rates in time and frequency. Filter bank summation and overlap add methods for short time synthesis of speech, sinusoidal and harmonic plus noise method of analysis/synthesis.TEXT1	10	L1,L2,L3,L4,L5
4	**Linear predictive coding of speech:** Introduction, Basic principles of Linear Predictive analysis, Solution of the LPC Equations- Cholesky method-Dublin's Recursive solution, Applications of LPC parameters- Pitch detection using LPC parameters, Formant Analysis- LPC Vocoder-Voice excited voice Vocoder. TEXT1	11	L1,L2,L3,L4,L5
5	**Homo morphic speech processing**: Introduction, homomorphic system for convolution, the complex	11	L1,L2,L3,L6

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	cepstrum of speech, homo morphic vocoder **Digital speech processing for man – machine communication by voice:** Introduction, Voice response systems, speaker recognition system, speech recognition systems.		

Note 1: Unit1and Unit5will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define the digital models of speech signals, time domain models of speech processing, Fourier transforms, linear predictive coding of speech and homo morphic speech processing.

CO2 Interpret the digital models of speech signals, time domain models of speech processing using Fourier transforms and to understand linear predictive coding of speech and homo morphic speech processing.

CO3 Apply the Fourier transforms to speech signals and to predict using linear predictive coding of speech and homo morphic speech processing..

CO4 Illustrate digital models of speech signals, time domain models of speech processing, Fourier transforms, linear predictive coding of speech and homo morphic speech processing.

CO5 Design linear predictive coding of speech and homo morphic speech processing , Evaluate the speech processing algorithms for applications.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO5

CO2 P01, PO2,PO5,

CO3 P01, PO4,PO5

CO4 P01, PO2

CO5 PO2,PO4,PO5,PO12

Text Books.

1 L. R. Rabiner and R.W. Schafer, “Digital Processing of Speech Signals”, Choose an item., Pearson Education Asia, 2004

Reference Text Books.

1 Dr.Shailad D. Apte, “Speech and Audio Processing”, 2012 REPRINT, Wiley India, 2012

2 T. F. Quatieri, “Discrete time speech signal processing ”, Pearson Education Asia, 2002

3 Gold and N. Morgan, “Speech and Audio signal Processing: Processing and Perception of Speech and Music”, John Wiley India Pvt. L, 2004

Web Links.

1 http://nptel.ac.in/syllabus/117104023/

Subject Title : Operation Research

Sub.Code: **EC744** No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To be able to understand Scope of Operations Research and TP Formulation

2 To be able to understand the Assignment Problem.

3 To be able to understand the Network Construction

4 To be able to classify the type Game Theory

5 To be able to understand the Queuing system and their characteristics

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction to Operations Research:** Basics definition, scope, objectives, phases, models and limitations of Operations Research. Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.**Text1**	11	L1,L2
2	**Assignment model:** Formulation. Hungarian method for optimal solution. Solving unbalanced problem. Traveling salesman problem and assignment problem. **Text1**	11	L1,L2
3	**PERT-CPM Techniques:** Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks. **Text1**	10	L1,L2
4	**Game Theory:** Formulation of games, Two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property. **Text1**	10	L1,L2
5	**Queuing Theory:** Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analyzing of M/M/ 1 and M/M/C queuing model. **Text1**	10	L2,L3

Note 1: Unit 1 and Unit 2 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Identify the OR Definitions and Able to apply TP.

CO2 Ability to interpret and explain the Assignment Problem.

CO3 Creation of Network construction, determining critical path, floats and scheduling by network

CO4 Ability to Compare the type of 2x n, m x 2 game.

CO5 Design the Queuing system, Game Theory and their characteristics.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO5,PO7,PO8

CO2 PO7,PO8,PO10

CO3 PO5,PO8,PO12

CO4 PO5,PO9,PO11

CO5 PO9,PO11,PO12

Text Books.

1 P. Sankara Iyer, "**Operations Research**", First Edition, Tata McGraw-Hill, ***2008***

2 A.M. Natarajan, P. Balasubramani, A. Tamilarasi, "**Operations Research**", First Edition, Pearson Education, ***2005***

Reference Text Books.

1 P. K. Gupta and D. S. Hira, "**Operations Research**", Second Edition, S. Chand & co, ***2007***

2 J K Sharma, "**Operations Research, Problems and Solutions**", Third Edition, Macmillan India Ltd, ***2010***

Subject Title : VLSI LAB

Sub.Code: ECL75 No. of Credits:=0:0:1.5:0(L - T – P) No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs CIE+Assignment +SEE=50 Total No.of Contact Hours:39

Course Learning Objectives:

1 Able to understand the simulation and synthesis of digital circuits such as Basic gates, Universal gates, Flip Flops, Counters.
2 Able to design Analog Inverter circuit and verify.
3 Able to design different types of Analog Amplifiers and verify.
4 Able to design Operational Amplifier and verify.
5 Able to draw Layouts of Amplifiers.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Write RTL Code for the following circuits and their Test Bench for verification, observe the waveform and synthesize the code with technological library under the given Constraints. Do the initial timing verification with gate level simulation. i. An Inverter ii. A Buffer iii. Transmission Gate iv. Basic/universal gates v. Flip flop -SR, D, JK, MS and T. vi. 4-bit counter [Synchronous and Asynchronous counter] TEXT 1	12	L1,L2,L3
2	Design an Inverter with given specifications, completing the design flow mentioned below: a. Draw the schematic and verify the following i. DC Analysis ii. Transient Analysis b. Draw the Layout and verify the DRC and Check for LVS TEXT 1	06	L1,L2,L3, L4
3	Design the following circuits, completing the design flow mentioned below: i) A Single Stage differential amplifier ii) Common source amplifier iii)Common Drain amplifier a. Draw the schematic and verify the following. i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC and LVS	15	L1,L2,L3, L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	TEXT 2 & TEXT 3		
4	Design an op-amp using given differential , Common source and Common Drain amplifier in library and completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii). AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC and LVS. TEXT 2 & TEXT 3	06	L1,L2,L3, L4

Course Outcomes:

CO1 To impart the concepts of simulation and synthesis of digital circuits.

CO2 Will be able apply the concepts of simulation and synthesis of digital circuits and understand the Inverter in Analog Perspective.

CO3 Will be able to design and analyze Amplifiers in Analog Perspective.

CO4 Will be able evaluate different amplifiers.

CO5 Will be able create layout and verify Amplifiers.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO2,PO3, PO4,PO5,PO7,PO12

CO2 PO2,PO3, PO4,PO5,PO7,PO12

CO3 PO2,PO3, PO4,PO5,PO7,PO12

CO4 PO2,PO3, PO4,PO5,PO7,PO12

CO5 PO2,PO3, PO4,PO5,PO7,PO12

Text Books.

1 Douglas A. Pucknell & Kamran Eshraghian , "Basic VLSI Design Principles and Practice", 3rd Edition, PHI, 2005

2 Neil H. E. Weste, K. Eshragian, "Principles of CMOS VLSI Design - A Systems Perspective.", 3rd Edition, Pearson Education (Asia) Pvt. Ltd, 2005

3 R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", 3rd edition, John Wiley India Pvt. Ltd, 2008

Sub Title: COMPUTER COMMUNICATION NETWORKS LABORATORY		
Sub Code:ECL76	**No of Credits : 0:0:1.5:0**	**No of lecture hours/week : 3**
Exam Duration :03Hours	**Exam Marks : 50**	**Total No of lecture hours: 13**

Course Learning Objectives(CLOs)

1.	To be able to perform experiment to simulate stuffing /de-stuffing, Encryption/ Decryption of message.
2.	To be able to perform experiment to simulate spanning tree and shortest path algorithm.
3.	To be able to perform experiment to simulate polynomial code checksum for CRC-CCITT.
4.	To be able to perform experiment to simulate various LAN protocols.
5.	To be able to perform experiment to simulate serial using data communication kit.

EX. NO.	**Syllabus**	**No of Hours**
1	Write a C program to implement Bit Stuffing and Character Stuffing.	3
2	Write a C program to implement Encryption and Decryption of Substitution and transposition cryptographic algorithms.	3
3	Write a C program to implement Cyclic Redundancy checksum.	3
4	Write a C program to implement Minimum Spanning Tree algorithm.	3
5	Write a C program to implement Shortest path Algorithm.	3
6	Study and analyze the performance of CSMA/CD protocol using NETSIM.	3
7	Study the performance of network with CSMA/CA protocol and compare with CSMA/CD protocol	3
8	Implement and analyze the Stop-and-wait protocol using LAN TRAINER KIT.	3
9	Compare and Contrast the performance of Go Back N and Selective protocols using LAN TRAINER KIT.	3
10	Cable a network according to the given network topology and test and verify configurations using packet tracer by using ping commands.	3
11	Configuring Wireless LAN Access and test and verify configurations using packet tracer.	3
12	Configuring Traditional Inter-VLAN Routing and test and verify configurations using packet tracer.	3
13	Serial communication using DCT.	3
	TOTAL HOURS	**39**

Programme Outcomes (POs)	
1	Able to perform experiment to simulate stuffing /de-stuffing bit frame and character frame data: coded using C/C++.
2	Able to perform experiment to simulate spanning tree and shortest path algorithm: coded using C/C++.
3	Able to perform experiment to simulate polynomial code checksum for CRC-CCITT: coded using C/C++.
4	Able to perform experiment to simulate Encryption and Decryption of message: coded using C/C++.
5	Able to perform experiment to simulate Serial and parallel communication using data communication kit.

Relationship to the Program Outcomes(POs)

Course Outcomes (COs)	Program Outcomes (POs)
CO1	PO5,PO6,PO7
CO2	PO5,PO6,PO7
CO3	PO5,PO6,PO7
CO4	PO5,PO6,PO7
CO5	PO5,PO6,PO7

Subject Title : SATELLITE COMMUNICATION

Sub.Code: EC811 No. of Credits: 4=4 : 0 : 0 (L-T-P) No. of Lecture Hours/Week : 4
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:56

Course Learning Objectives:

1 To be able to familiar with satellite systems and laws governing satellite orbit.
2 To understand concept of geostationary orbit and various losses on signal transmission in satellite system.
3 To evaluate link power budget estimation, System noise and various space segment subsystems.
4 To study earth segment, interference between satellite circuits and multiple access systems.
5 To understand Direct Broadcast System, Satellite mobile and specialized services.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**OVER VIEW OF SATELLITE SYSTEMS:** Introduction, frequency allocation, INTELSAT , Orbits and launching methods : Kepler's laws, definitions of terms for earth orbiting satellites. Orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits. Numerical problems. **Text 1, Reference 1**	10	L1, L2
2	**GEOSTATIONARY ORBIT:** Introduction, antenna, look angles, polar mount antenna, Limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits. Numerical problems. **Text 1 , Ref. 1** **RADIO WAVE PROPAGATION:** Atmospheric losses, ionospheric effects, rain attenuation. **Text 1**	10	L1,L2
3	**SPACE SEGMENT:** Introduction, power supply unit, attitude control: spinning satellite stabilization, momentum wheel stabilization. Station keeping, thermal control, TT&C subsystem, transponders, antenna subsystem. **SPACE LINK:** Introduction, EIRP, transmission losses: free space transmission, feeder losses, and antenna misalignment losses. Link power budget equation, System noise: antenna noise, amplifier noise temperature, overall system noise temperature. CNR, effects of rain. **Text 1, Ref. 2**	10	L1,L2,L3
4	**EARTH SEGEMENT:** Introduction, receive only home TV system: out-door unit, indoor unit, MATV, CATV, Tx – Rx earth station. Text 1 **INTERFERENCE AND SATELLITE ACCESS:** Introduction, interference between satellite circuits. S**atellite access**: single access, Pre-assigned FDMA, demand assigned FDMA, spade system, TDMA: pre-assigned TDMA, demand assigned TDMA, down link analysis, comparison of uplink	14	L2,,L3

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	power requirements for TDMA & FDMA. **Text 1**		
,l55	**DIRECT BROADCAST SATELLITE SERVICES:** Introduction, orbital spacing, power rating and number of transponders, frequency and polarization, transponder capacity, bit rates for digital TV, **SATELLITE SERVICES:** satellite mobile services, VSAT, RadarSat, Global positioning satellite system, orbcomm. **Text 1**	13	L1,L2,L3

Note 1 **Unit 3 and Unit 4 will have internal choice.**

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Identify the characteristics of satellite communication Orbits, Launching Methods and channels.

CO2 Explain the concept of geostationary orbit and mathematical model for various losses on signal transmission in satellite system.

CO3 Apply analytical and empirical models in the design of satellite networks and space segments. Able to compute link power budget estimation, System noise.

CO4 Illustrate the multiple access schemes for satellite access.

CO5 Compile the Direct Broadcast System, satellite mobile and specialized services

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1, PO2

CO2 PO1, PO2, PO6

CO3 PO2, PO6, PO12

CO4 PO2, PO6, PO12

CO5 PO2, PO6, PO12

Text Books.

1 Dennis Roddy, “Satellite Communications”,4th Edition, McGraw- Hill International edition, 2006,

Reference Text Books.

1 Timothy Pratt, Charles Bostian and Jeremy Allnutt, “Satellite Communications”, 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008.Pearson Education Asia / PHI, Indian Reprint, 1997.

2 W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson. , “‘Communication Systems””, 2nd Edition, Pearson Education , 2007

Web Links.

1 https://www.amazon.com/Satellite-Communications-2nd-Dennis-Roddy/.../00705337...

3 https://www.flipkart.com/satellite-communications-2nd/p/itme9z9vfzvc9gea

Subject Title : Cryptography and Network Security

Sub.Code: EC812 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To impart the basic concepts of network security and classical encryption, number theory, stream ciphers, block ciphers and authentication.
2 To interpret the cryptographic algorithms like stream ciphers and block ciphers using classical encryption techniques
3 To apply the concept of classical encryption techniques to stream ciphers and block ciphers
4 To analyze the stream ciphers and block ciphers and their applications in network security
5 To design the stream ciphers and block ciphers for applications in network security

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction:** Services, mechanisms and attacks, OSI security architecture, Model for network security. **Symmetric ciphers:** Symmetric Cipher Model, Substitution Techniques: Caesar Cipher, Mono Alphabetic Cipher, Playfair Cipher, Hill Cipher, polyalphabetic Cipher and One-Time Pad (OTP). Transposition Techniques, Rotor Machines, Steganography. TEXT 1	10	L1, L2
2	**Finite Fields:** Groups, Rings, Fields. Modular Arithmetic: Divisors, properties of modulo operator, modular arithmetic operations and properties. Euclid's Algorithm, Greatest Common Divisor (GCD), finding GCD. Finite Fields of the form GF (p): Finite fields of order p, finding multiplicative inverse in GF (p). Polynomial Arithmetic: Ordinary polynomial Arithmetic, polynomial Arithmetic with coefficients in Zp. Finding GCD. Finite fields of the form GF(2^n). TEXT 1	10	L1, L2
3	**Block Ciphers:** Simplified DES, Block Cipher Principles, Data encryption standard (DES), Strength of DES, Block Cipher Design Principles and Block Cipher Modes of Operation, Evaluation Criteria for Advanced Encryption Standard, The AES Cipher. TEXT 1	10	L2,L3,L4
4	**Block Ciphers:** Principles of Public-Key Cryptosystems, The RSA algorithm. Key Management, Diffie - Hellman Key Exchange. **Authentication functions and Hash Functions:** Authentication functions, message authentication codes, hash functions, security of Hash functions and MACs. TEXT 1	11	L2,L3,L4
5	**Web Security:** Web Security Consideration, Security socket layer (SSL) and Transport layer Security (TLS), Secure Electronic Transaction (SET).	11	L1,L2,L3.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Intruders: Intruders, Intrusion Detection, Password Management.. TEXT 1		

Note 1: Unit 1 and Unit 2 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define the basic concepts of network security, classical encryption, number theory, Private key, public key, authentication and network security

CO2 Understand the structure of cryptographic algorithms and their applications.

CO3 Apply the concept of classical encryption techniques to existing standard algorithms.

CO4 Illustrate the significance of cryptographic algorithms and their applications in network security.

CO5 Design the private key and public key, authentication functions for applications in network security.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO2,PO4,PO5,PO6,PO11, P12

CO2 P01, PO2,PO4,PO5,PO6,PO11, P12

CO3 P01, PO2,PO4,PO5,PO6,PO11, P12

CO4 P01, PO2,PO4,PO5,PO6,PO11, P12

CO5 P01, PO2,PO4,PO5,PO6,PO11, P12

Text Books.

1 William Stallings, "Cryptography and Network Security: Principles and Practice", Fifth Edition, Pearson Education, 2010

Reference Text Books.

1 Behrouz Forouzan, "Cryptography and Network Security", edition, TMH, 2007

2 Alfred J. Menezes, Paul C. Van Oorschot and Scott A. Vanstone, "Handbook of Applied Cryptography ", edition, CRC press, reprint 2001

3 Bruce Scheiner , "Applied cryptography: protocols, algorithms, and source code in C", 2nd edition, Wiley India, 2008

4 Atul Kahate, "Cryptography and Network Security", 2nd edition, TMH, 2006

Web Links.

1 http://www.nptel.ac.in/courses/106105031/

2 http://faculty.mu.edu.sa/public/uploads/1360993259.0858Cryptography%20and%20Network%20Security%20Principles%20and%20Practice,%205th%20Edition.pdf

Sub Title : Real Time Operating System		
Sub Code:EC813	**No. of Credits:4=4 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 04**
Exam Duration : O3Hhours	**CIE +Assignment + SEE = 45 + 05 + 50 =100**	**Total No. of Contact Hours : 52**

Course objectives:

1. To study the basic concepts of specialized processors
2. To study the various Scheduling strategies
3. To study multiresource services
4. To study the embedded system components
5. To understand design trade-offs

UNIT No	Syllabus Content	No of Hours
1	**Introduction to real-time embedded systems**: Brief history of real time systems, a brief history of embedded systems. **System Resources**: resource analysis, real-time service utility, scheduling classes, the cyclic executive, scheduler concepts, preemptive fixed priority scheduling policies, Real-Time OS, thread safe reentrant functions. Text1	10
2	**Processing**: preemptive fixed-priority policy, feasibility, rate montonic least upper bound, necessary and sufficient feasibility, deadline – monotonic policy, dynamic priority policies. **I/O Resources**: Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture. Memory: Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash file systems. Text1	12
3	**Multiresource Services**: Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion. Soft Real-Time Services: Missed Deadlines, QoS, Alternatives to rate monotonic policy, Mixed hard and soft real-time services. Text1	08
4	**Embedded system components**: firmware components, RTOS system software mechanisms, software application components. Debugging components: exceptions assert, checking return codes, single-step debugging, kernel scheduler traces, test access ports, trace ports, power-on self test and diagnostics, external test equipment, application-level debugging. Text1	12
5	**High availability and reliability design**: reliability and availability, similarities and differences, reliability, reliable software, available software, design trade-offs, hierarchical applications for fail-safe design. Design of RTOS. Text1	10

Note 1: Unit 2 and Unit 4 will have internal choice.

Note 2: Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3 and 4.

Course Outcomes:

CO1:List the basic concepts of specialized processors
CO2:Explain the various Scheduling strategies
CO3:Show the multiresource services
CO4: Illustrate the embedded system components.
CO5: Categorize the design trade-offs

Cos	Mapping with POs

CO1	PO1, PO2
CO2	PO2, PO6
CO3	PO2,PO6, PO10,P12
CO4	PO2,PO6, PO10,P12
CO5	PO2,PO6, PO10,P12

Text Books:

1. Sam Siewert, "**Real-Time Embedded Systems and Components**," Cengage Learning India Edition, ***2007***.
2. MykePredko, **" Programming and Customizing the PIC microcontroller" , 3rd Ed, TMH, *2000*.**
3. C. M. Krishna, Kang. G. Shin**,. "Real Time Systems", Mc Graw Hill, India, *1997***

REFERENCE BOOKS / WEBLINKS:

1. Raj Kamal, "**Embedded Systems**", Tata McGraw Hill, New Delhi, ***2008***.
2. Phillip. A. Laplante, "**Real-Time Systems Design and Analysis**", Prentice Hall India,2nd Edition, ***2005***.
3. Jane. W. S. Liu, "**Real Time Systems**", Pearson Education, ***2005***

Subject Title : ADHOC Wireless Network

Sub.Code: EC814 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To define Adhoc network, identify issues in protocol for Ad hoc wireless Networks
2 To understand different protocols for Ad hoc wireless Networks To demonstrate scheduling mechanism and flooding mechanism.
3 To analyse MAC protocol, routing protocol, transport protocol Ad hoc wireless Networks
4 Interpret the goals for different protocols
5 To understand the Issues and challenges in providing QOS and security in Ad hoc wireless Networks

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	ADHOC NETWORKS: INTRODUCTION, ISSUES IN AD HOC WIRELESS NETWORKS, AD HOC WIRELESS INTERNET.MAC PROTOCOLS FOR ADHOC WIRELESS NETWORKS: INTRODUCTION, ISSUES IN DESIGNING A MAC PROTOCOL FOR AD HOC WIRELESS NETWORKS, DESIGN GOALS OF A MAC PROTOCOL FOR AD HOC WIRELESS NETWORKS, CLASSIFICATION OF MAC PROTOCOLS. TEXT1	10	L1, L2,L4
2	Contention based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols. **ROUTING PROTOCOLS FOR ADHOC WIRELESS NETWORKS:** Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table drive routing protocol, On-demand routing protocol. Text1	10	L1, L2,L4,L5
3	**Hybrid routing protocol,** Routing protocols with effective flooding mechanisms, Hierarchical routing protocols, Power aware routing protocols. **TRANSPORT LAYER PROTOCOLS FOR ADHOC WIRELESS NETWORKS:** Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks, Classification of transport layer solutions, TCP over Ad hoc wireless Networks, Other transport layer protocols for Ad hoc wireless Networks. Text1	10	L1,L2,L3,L4,L5
4	TRANSPORT LAYER PROTOCOLS FOR AD HOC WIRELESS NETWORKS: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless	11	L1,L4,L5

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Networks.		
5	**QUALITY OF SERVICE IN ADHOC WIRELESS NETWORKS:** Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions, MAC layer solutions, network layer solutions. Text1 SECURITY: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning. QUALITY OF SERVICE IN AD HOC WIRELESS NETWORKS Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions.	11	L1,L2,L6

Note 1: Unit 1 and Unit 5 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define Adhoc network, identify issues related to different protocols for Adhoc network, like protocol , routing ,QoS and security aspects

CO2 Understand protocols require for Adhoc wireless network

CO3 Show implementation of routing protocol, scheduling mechanism and flooding mechanism

CO4 Analyse the routing protocol,MAC protocol, and Transport Protocol for Adhoc network

CO5 Interpret the design goals and evaluate the performance of different protocols for Adhoc wireless Network Click here to enter text.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO5,PO6,PO10

CO2 P01, PO2, PO5,PO8

CO3 P01, PO4,PO5,PO6

CO4 P01, PO2,PO3

CO5 PO2, PO5,PO6,PO9

Text Books.

1 Siva Ram Murthy & B. S. Manoj, "Ad hoc wireless Networks", 2nd edition, Pearson Education , 2004

Reference Text Books.

1 Ozan K. Tonguz and Gianguigi Ferrari, "Ad hoc wireless Networks", 2012 REPRINT, Wiley India, 2008
2 Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du "**Ad hoc wireless Networking**", Kluwer Academic publishers, 2009

Web Links.

1 http:// nptel.ac.in/syllabus//

Subject Title : Data Structures using C++

Sub.Code: EC815 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To become familiar with the Data representation and Addressing.
2 To understand Abstract Nature of Stacks and Queues.
3 To study various searching and sorting methods.
4 To understand Recursion and Linked lists.
5 To analyse different trees structures and Hashing.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction:** Linear Lists, Formula based Representation, Linked Representation, Indirect Addressing, Simulating Pointers, Applications, Equivalence Classes, Convex Hull. TEXT 1	10	L1,L2,L3.
2	**Stacks**: The Abstract Data Type, Derived Classes and Inheritance, Formula Based Representation, Linked Representation, Applications. **Queues**: The Abstract Data Type, Formula Based Representation, Linked Representation, Applications TEXT 1	10	L1,L2,L3.
3	**Searching**: Search Techniques- Sequential Search, Binary Search, Fibonacci Search, Indexed sequential Search, Hashed Search. **Sorting**: Bubble sort, Insertion sort, Selection sort, quick sort, Shell sort, Bucket sort and Radix sort. TEXT 2	12	L1,L2,L3.
4	**Recursion**: introduction, Recurrence, use of stack in recursion, variants of recursion, execution of recursive calls, iteration vs recursion. **Linked Lists**: linked list, realization of linked lists, dynamic memory management, linked list abstract data type, circular linked list. TEXT 2	10	L1,L2,L3
5	**Search Trees**: Symbol Table, Optimal Binary Search tree, AVL tree **Hashing**: key terms, Hash Functions, Collision Resolution Strategies. TEXT 2	10	L1,L2,L3

Note 1: Unit 2 and Unit 3 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Outline the basic concepts of abstract data types.

CO2 Explain stacks, queues, recursion, hashing and linked lists.

CO3 Demonstrate the searching and sorting techniques.

CO4 Compare the program on data structure concepts.

CO5 Design the binary and AVL trees.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO4

CO2 PO1,PO2,PO3,PO4

CO3 PO1,PO2,PO3,PO4

CO4 PO1,PO2,PO3,PO4,PO11,PO12

CO5 PO1,PO2,PO3,PO4,PO11,PO12

Text Books.

1 Sahni, "Data Structures, Algorithms and Applications in C++", Edition, McGraw Hill International Edition, 2004

2 Varsha H. Patil, "Data Structures Using C++", edition, Oxford University Press, 2012

Reference Text Books.

1 Mark Allen Wiss, "Data Structures and Algorithms Analysis in C", 3rd Edition, Pearson, 2013

Web Links.

1 https://www.tutorialspoint.com/cplusplus/cpp_data_structures.htm

2 www.sourcetricks.com/p/data-structures-using-c.htm

3 www.cprogramming.com/algorithms-and-data-structures.html

Subject Title: VIRTUAL INSTRUMENTATION		
Subject Code: EC816	No. of Credits**:4= 4:0:0:0**	No. of lecture hours/week **:04**
Exam Duration : **03 Hours**	CIE +Assignment + SEE **= 45 + 5 + 50 =100**	Total No. of Contact Hours **:56**

Course Learning Objectives:

1. To understand the difference between conventional and graphical programming.
2. Differentiate between real and virtual instrumentation.
3. Introduce the basics of LAB VIEW and its programming.
4. Analyse the basics of data acquisition and learning it with Lab VIEW.
5. Provide the concept of interfacing peripherals.

UNIT No	Syllabus Contents	No of Hours	Blooms Taxonomy Level
1	**Fundamentals of Virtual Instrumentation:** Historical perspective, advantages, block diagram and architecture, data flow techniques, graphical programming in data flow, comparison with conventional programming.	10	L1, L2
2	**Software overview:** Lab VIEW, graphical user interface, controls and indicators, data types, data flow programming, editing, debugging and running VI, VIs and sub Vis.	**10**	**L1,L2**
3	**Programming structure:** FOR loops, WHILE loop, CASE structure, formula node, sequence structure, examples. **Introduction to arrays and clusters**: Array operations, Cluster functions, graphs and charts, local and global variables, examples.	**11**	**L1,L2,L3**
4	**File Input / output:** Introduction, file formats, file I/O functions, Sample VIs to demonstrate file WRITE and READ functions. **String handling:** Introduction, string functions, Lab-VIEW string formats, examples.	**11**	**L1,L2,L3**
5	**Basics of data acquisition:** Introduction, Classification of signals, Analog interfacing, connecting to board, Digital I/O.	**10**	**L1,L2,L3**

Note 1: Unit 3 and Unit 4 will have internal choice.

Note 2:Two assignments are evaluated for 5 marks:

Assignment – 1 from units 1 and 2.
Assignment - 2 from units 3, 4 and 5.

Course Outcomes:

1. Understand the architecture and Design front panel using Lab-VIEW.
2. Gain knowledge of debugging and running the Lab VIEW .

3. Understand the importance of FOR , WHILE AND CASE structure in Lab VIEW.
4. Demonstrate the file WRITE and READ functions.
5. Get the basic knowledge of data acquisition.

Cos	**Mapping with POs**
CO1	PO1, PO2
CO2	PO2, PO4
CO3	PO2, PO4, PO12
CO4	PO2, PO4, PO12
CO5	PO2, PO4, PO12

Text Books:

1. Sanjay Gupta, Joseph John, "Virtual instrumentation using Lab-VIEW*", 2nd* Edition, McGraw- Hill International edition, 2010, ISBN: 978-0070700284.

Reference Books:

1. Jovitha Jerome , "Virtual Instrumentation using LABVIEW", PHI , 2011
2. Lisa K. Wills, "Lab-VIEW for everyone", 4th Edition, Prentice hall India, 2008, ISBN: 978-0132681940.

Sub Title : SEMINAR		
Sub Code:ECS82	**No. of Credits:02=0 :0 :10 (L-T-P)**	**CIE + SEE = 50+0 =50**

The seminar should be on any topic having relevance with Electronics and Communication Engineering. The same should be decided by the student and concerned teacher. Seminar work shall be in the form of report to be submitted by the student at the end of the semester. The candidate will deliver a talk on the topic for half an hour and assessment will be made by two internal examiners appointed by Department UG Programme Committee, one of them will be guide. Usually the seminars should be related to dissertation topics. Student should submit report based on his study and is required to make presentation for evaluation

Sub Title : PROJECT WORK		
Sub Code:ECP83	**No. of Credits:10=0 :0 :10 (L-T-P)**	
Exam Duration :03 Hour	**CIE + SEE = 50+50 =100**	**Total No. of Contact Hours : 03**

A student is required to carry out elaborated project work. The project may be either design and fabrication work or a simulation of a problem on a computer. At the end of the semester student will be required to submit a detailed report of literature survey, design problem formulation, work plan and work done and will defend his/her work carried out before the examiners at the time of final evaluation.

Subject Title : Automotive Safety Measurements

Sub.Code: ECE02 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To understand overview of the automobile with emphasis on the basic operation of the engine
2 To understanding of electronic technology
3 To examine how electronics has been applied to the major systems
4 To understand various sensors and actuators and get some ideas and methods that may be used in the future
5 Understand the concepts of vehicle motion control.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Automotive Fundamentals Overview** – Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Ignition Timing, Drive Train- Transmission, Brakes, Steering System. TEXT 1 and REFERENCE TEXT 1	9	L1
2	**Sensors** – Airflow rate sensor, Strain gauge MAP sensor, Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle angle sensor, Temperature sensor, Exhaust Gas Oxygen Sensor Knock Sensor. **Actuator** – Exhaust Gas Recirculation Actuator. TEXT 1 and REFERENCE TEXT 1	12	L1,L2
3	**Electronic Engine Control** – Concepts of an electronic engine control system, definition of general terms - Engine parameters, variables, Engine Performance terms –Power , BSFC, Torque, Volumetric efficiency, thermal efficiency, calibration, Effect of air/fuel ratio on performance, Effect of spark timing on performance, of EGR on performance Electronic fuel control system –open loop control, closed loop control. TEXT 1	12	L2,L3
4	**Vehicle Motion Control** – Cruise Control System-speed response curves, digital cruise control, Antilock Brake System (ABS), Electronic Suspension system, Electronic suspension control system. TEXT BOOK:1,REF. BOOK :1	9	L1,L3
5	**Safety systems -** Collision Avoidance Radar warning Systems, Low tire pressure warning system, navigation-navigation sensor, radio navigation signpost navigation, dead reckoning navigation, voice recognition cell phone dialing.	10	L1,L2,L3.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	TEXT BOOK:1		

Note 1: Unit 2 and Unit 3 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Identify the different sensors, Actuators, Engine Control, Ignition System and Spark plug.

CO2 Summarize the concepts of an electronic engine control system, Cruise Control System.

CO3 Demonstrate the Engine Efficiency.

CO4 To analyse the concepts of an electronic engine control system, Vehicle Motion Control, Safety systems, sensors and actuators.

CO5 Relate Safety systems.

Course Outcomes Mapping with Programme Outcomes.

CO1 P01

CO2 P01

CO3 PO2, PO6, PO10

CO4 PO10, PO12

CO5 PO10, PO12

Text Books.

1 William Ribbons, "**Understanding Automotive Electronics**", Seventh Edition, Elsevier Publishing, 2012

Reference Text Books.

1 Robert Bosch GmbH, "**Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive**",Fifth Edition, Springer Fachmedien Wiesbaden Publishing, 2014

Sub Title : Semiconductor Fabrication		
Sub Code: ECE03	**No. of Credits:4=4 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 04**
Exam Duration : 3 Hours	**CIE +Assignment + SEE = 45 + 05 + 50 =100**	**Total No. of Contact Hours :52**

Course objectives:

1. To be able to understand Scope of semiconductor Materials and Devices.
2. To be able to understand the Process of Crystal Growth.
3. To be able to understand the Photolithography and Etching.
4. To be able to classify the Diffusion and Ion Implantation.
5. To be able to understand the Film Deposition and Process Integration.

UNIT No	Syllabus Content	No of Hours
1	**Introduction to Semiconductor:** semiconductor Materials, Devices, Semiconductor process technology-key semiconductor technology, technology trends. Basic Fabrication Steps-oxidation, photolithography, etching, diffusion, Ion Implantation and metallization. **Text1**	10
2	**Crystal Growth:** Silicon crystal growth from the melt-starting material, czochralski technique, distribution dopant, effective segregation coefficient. Silicon float zone process. GaAs crystal growth techniques- starting materials, crystal growth techniques. Material characterization- wafer shaping, crystal characterization. **Silicon Oxidation:** Thermal oxidation process-kinetics of growth, thin oxide growth. Impurity redistribution during oxidation, Masking properties of silicon dioxide, oxide quality, oxide thickness characterization. **Text1**	10
3	**Photolithography and Etching:** Optical Lithography- the clean room, exposure tools, masks, photo resist, pattern transfer and resolution enhancement technique. **Etching:** Wet chemical etching-Si etching, Silicon dioxide etching, silicon Nitride and poly silicon etching, Aluminum etching and GaAs etching. Dry etching- Plasma Fundamentals, Etch mechanism, plasma diagnostics, and reactive plasma etching technique. **Text1**	10
4	**Diffusion and Ion Implantation:** Basic Diffusion Process- Diffusion Equation, Diffusion profiles. Extrinsic Diffusion and Lateral diffusion. **Introduction Ion Implantation:** Range of Implanted Ions- Ion Distribution, Ion Stopping, Ion Channeling. Implant Damage and Annealing- Implant Damage, Annealing. Implantation Related Processes- Multiple Implantation and Masking. **Text1**	11
5	**Film Deposition and Process Integration:** Epitaxial Growth Techniques- Chemical Vapor Deposition. Structures and Defects in Epitaxial Layers, Dielectric Deposition- Si Dioxide, Si Nitride. Poly silicon Deposition. Metallization- Physical Vapor Deposition and Aluminum Metallization and copper Metallization. **Process Integration:** The Integrated Circuit Resistor, Integrated Circuit Capacitor, Integrated Circuit Inductor and Bipolar Technology. **Text1**	11

Note 1: Unit 3 and Unit 4 will have internal choice.

Note 2: Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2

Assignment - 2 from units 3, 4 and 5.

Course Outcomes:

CO1: Identify the Semiconductor Materials.
CO2: Ability to interpret Fabrication Steps.
CO3: Creation of semiconductor devices
CO4: Ability to Compare the types of Diffusion and Ion Implantation.
CO5: Create the Integrated Circuit.
CO6: Ability to Conclude the best methods of Film Deposition and Process Integration

Cos	Mapping with POs
CO1	PO5,PO7,PO8
CO2	PO7,PO8,PO10
CO3	PO5,PO8,PO12
CO4	PO5,PO9,PO11
CO5	PO9,PO11,PO12
CO6	PO5,PO9,PO11, PO12

TEXT BOOK:

1. Gary S. May, Simon M. Sze, **"Fundamentals of Semiconductor Fabrication"** Wiley, 1st Edition, 2003.
2. Gary S. May, Costas J S, **"Fundamentals of Semiconductor Manufacturing and Process Control**" Wiley IEEE Press, 1st Edition, 2006.

REFERENCE BOOKS/WEBLINKS:

1. Anderson, Anderson" **Fundamentals of Semiconductor Devices**" McGraw-Hill Education, Indian Edition 2013.

Subject Title : Wireless Sensor Network

Sub.Code: ECE04 No. of Credits:04=04:0:0 (L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Assignment +SEE=45+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 Students will be able to describe the unique issues in sensor networks.
2 Students will be able to describe current technology trends for the implementation and deployment of wireless sensor networks.
3 Students will be able to discuss the challenges in designing MAC, routing and transport protocols for wireless sensor networks.
4 Interpret the goals for different protocols
5 Students will be able to describe and implement protocols

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Introduction: Unique Constraints and Challenges, Advantages of Sensor Networks, Energy advantage, Detection advantage, Sensor Network Applications, Habitat monitoring, Wildlife conservation through autonomous, non-intrusive sensing, Tracking chemical plumes, Ad hoc, just-in-time deployment mitigating disasters, Smart transportation: networked sensors making roads safer and less congested, Collaborative Processing.. TEXT1	10	L1, L2,L4
2	**Canonical Problem: Localization and Tracking,** A Tracking Scenario, *Sensing Model, Collaborative Localization, Bayesian State Estimation,* Distributed Representation and Inference of States: *Impact of Choice of Representation, Design consideration in Distributed Tracking,* Tracking Multiple Objects: *State-Space Decomposition, Data Association,* Sensor Models, Performance Comparison and Metrics , TEXT 1	10	L1, L2,L4,L5
3	Networking Sensors: Key Assumptions, Medium Access Control, General Issues, Geographic, Energy-Aware Routing: Unicast Geographic Routing, Routing on a Curve, Energy-Minimizing Broadcast, Energy-Aware Routing to a Region, Attribute-Based Routing. **Infrastructure Establishment:** Topology Control, Clustering, Time Synchronization, Localization and Localization Services, **Sensor Tasking and Control :**Task-Driven Sensing ,Roles of Sensor Nodes and Utilities Information-Based Sensor Tasking Sensor Selection IDSQ: Information-Driven Sensor Querying ,Cluster Leader–Based Protocol ,Sensor Tasking in Tracking Relations TEXT 1	13	L1,L2,L3,L4,L5
4	Sensor Network Databases: Sensor Network Databases,	10	L1,L4,L5

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Sensor Database Challenges, Querying The Physical Environment, Query Interfaces, Cougar sensor database and abstract data types, Probabilistic queries, High-level Database Organization, In- Network Aggregation, Query propagation and aggregation, Tiny DB query processing, Query processing scheduling and optimization, Data-Centric Storage, Data Indices and Range Queries, One-dimensional indices, Multidimensional indices for orthogonal range searching, Non-orthogonal range searching, Distributed Hierarchical aggregation, Multi-resolution, Partitioning, Fractional cascading, Locality preserving hashing, Temporal Data, Data aging, Indexing motion data. TEXT 1		
5	Sensor Network Platforms: Sensor Node Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms, Node-Level Simulators, Programming Beyond Individual Nodes: State-Centric Programming, and Tools Applications and Future Directions: Emerging Applications, Future Research Directions TEXT 1	08	L1,L2,L6

Note 1: Unit 1 and Unit 3 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes:

CO1 Define WSN, identify issues related to different protocols for WSN

CO2 Understand protocols require for Wireless Sensor Network

CO3 Explore current sensor technologies through algorithms, protocols, and applications

CO4 Analyse routing ,tracking problems, data base requirement and programing challenges

CO5 Interpret the design goals consideration tracking and evaluate the performance of different protocols for wireless Sensor Network Click here to enter text.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO5,PO6,PO10

CO2 P01, PO2, PO5,PO8

CO3 P01, PO4,PO5,PO6

CO4 P01, PO2,PO3

CO5 PO2, PO5,PO6,PO9

Text Books.

1 Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks, An Information Processing Approach", Elsevier, 2004

Reference Text Books.

1 Kazem Sohrabi,Daniel Minoli.Taieb Znati "Wireless Sensor Networks", Wiley Inter science, Wiley India, 2007

2

Web Links.

1 https://onlinecourses.nptel.ac.in/noc17_cs07

Subject Title : Electronics Devices

Sub.Code: 18EC32 | No. of Credits:04=2:2:0 (L - T – P) | No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs | CIE+Assignment +SEE=45+5+50=100 | Total No.of Contact Hours:52

Course Learning Objectives: The student should be able to:

1 Understand the basics of semiconductor physics and electronic devices.

2 Describe the mathematical models BJTs and FETs along with the constructional details

3 Understand the construction and working principles of MOSFET

4 Understand the construction and working principles of optoelectronic and high power devices and circuits

5 Understand the fabrication process of semiconductor devices and CMOS process integration

Unit No	Syllabus Contents	No. of Hours	Blooms Taxnomy level.
1	Semiconductor and p-n Junctions Bonding forces in solids, Energy bands, Metals, Semiconductors and Insulators, Direct and Indirect semiconductors, Electrons and Holes, Intrinsic and Extrinsic materials, Conductivity and Mobility, Drift and Resistance, Effects of temperature and doping on mobility, Hall Effect. Forward and Reverse biased junctions-Qualitative description of Current flow at a junction, reverse bias, Reverse bias breakdown- Zener breakdown, avalanche breakdown, Rectifiers, Breakdown diode, Varactor diode.(Text 1)	10	L1,L2
2	Bipolar Junction Transistor Fundamentals of BJT operation, Amplification with BJTS, BJT Fabrication, The coupled Diode model (Ebers-Moll Model), Switching operation of a transistor, Cutoff, saturation, switching cycle, specifications, Drift in the base region, Base narrowing, Avalanche breakdown, Base Resistance and Emitter crowding, Capacitance and Charging times(hybrid-pi model), L1,L2 Heterojunction Bipolar Transistor. (Text 1).	11	L1,L2

Unit No	Syllabus Contents	No. of Hours	Blooms Taxnomy level.
3	Field Effect Transistors Basic pn JFET Operation, MESFET operation, MOSFET, Two terminal MOS structure- Energy band diagram, Depletion layer thickness, Work Function Difference, Flat band Voltage, Threshold Voltage. Ideal Capacitance – Voltage Characteristics and Frequency Effects, Basic MOSFET Operation- MOSFET structure, Current-Voltage Characteristics, Small Signal Equivalent Circuit and frequency limitation. (Text 2).	11	L1,L2
4	Optoelectronic Devices Photodiodes: Current and Voltage in an Illuminated Junction, Solar Cells, Photodetectors. Light Emitting Diode: Light Emitting materials. High Power devices: The P-N-P-N Diode, Insulated Gate Bipolar Transistor. Nanoelectronic Devices: Zero Dimensional Quantum Dots, One Dimensional Quantum Wires, Two Dimensional Layered crystals, Spintronic memory, Nanoelectronic Resistive memory.(Text 1)	10	L1,L2
5	Fabrication of p-n junctions-Thermal Oxidation, Diffusion, Rapid Thermal Processing, Ion implantation, chemical vapour deposition, photolithography, Etching, Metallization. Integrated Circuits: Background, Evolution of ICs: CMOS Process Integration, Integration of Other Circuit Elements. (Text 1).	10	L1,L2,L3.

Note 1: Each Unit will have Internal Choice

Course Outcomes: After the completion of the Course the student should be able to :

CO1 Understand the principles of semiconductor Physics.

CO2 Understand the principles and characteristics of different types of semiconductor devices

CO3 Understand the fabrication process of semiconductor devices

CO4 Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.

CO5 Differentiate the semiconductor devices based on its usage and applications

Course Outcomes Mapping with Programme Outcomes.

CO1	PO1,PO2,PO3,PO5
CO2	PO1,PO2,PO5
CO3	PO1,PO2,PO3
CO4	PO1,PO2,PO3
CO5	PO1,PO2,PO5

Text Books.

1. Ben.G.Streetman, Sanjay Kumar Banergee, "Solid State Electronic Devices", 7th edition, Pearson Education, 2016
2. Donald A Neamen, Dhrubes Biswas, "Semiconductor Physics and Devices", 4th edition, Semiconductor Physics and Devices, 2012

Reference Text Books.

1. S.M.Sze, Kwok K. Ng, "Physics of Semiconductor Devices", 3rd edition, Wiley, 2018
2. A.Bar-Lev, ""Semiconductor and Electronic Devices", 3rd edition, PHI, 1993
3. Enter author name, Christos C. Halkias "Book title", edition, publisher, year
4. Choose an item., "Choose an item.", Choose an item., Choose an item., Choose an item.
5. Choose an item., "Choose an item.", Choose an item., Choose an item., Choose an item.
6. Choose an item., "Choose an item.", Choose an item., Choose an item., Choose an item.

Web Links.

1. www.nptel.in
2. https://www.youtube.com/watch?v=w8Dq8blTmSA

Subject Title : Engineering Statistics & Linear Algebra

Sub.Code: 18EC35 | No. of Credits:03=2:2:0 (L - T – P) | No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs. | CIE+Assignment +SEE=45+5+50=100 | Total No.of Contact Hours:39

Course Learning Objectives: The student should be able to:

1. Understand the meaning of Single and Multiple Random Variables, and extension to Random Processes. Familiarization with the concept of Vector spaces and orthogonality with a qualitative insight into applications in communications..

2. Analyze mathematically the quantitative parameters of Single and Multiple Random Variables as well as Random Processes.

3. Compute the quantitative parameters for functions of single and Multiple Random Variables and Processes. Compute the quantitative parameters for Matrices and Linear Transformations
4. Associate the concepts of Random Processes to examples that involve transmission through Filters.

Unit No	Syllabus Contents	No. of Hours	Blooms Taxnomy level.
1	**Single Random Variables:** Definition of random variables, cumulative distribution function continuous and discrete random variables; probability mass function, probability density functions and properties; Expectations, Characteristic functions, Functions of single Random Variables, Conditioned Random variables. Application exercises to Some special distributions: Uniform, Exponential, Laplace, Gaussian; Binomial, and Poisson distribution. (chapter 4 Text 1)	8	L1,L2,L3
2	**Multiple Random variables:** Concept, Two variable CDF and PDF, Two Variable expectations (Correlation, orthogonality, Independent), Two variable transformation, Two Gaussian Random variables, Sum of two independent Random Variables, Sum of IID Random Variables – Central limit Theorem and law of large numbers, Conditional joint Probabilities, Application exercises to Chi-square RV, Student-T RV, Cauchy and Rayleigh RVs. (chapter 5	8	L1,L2,L3

Unit No	Syllabus Contents	No. of Hours	Blooms Taxnomy level.
	Text 1)		
3	**Random Processes:** Ensemble, PDF, Independence, Expectations, Stationarity, Correlation Functions (ACF, CCF, Addition, and Multiplication), Ergodic Random Processes, Power Spectral Densities (Wiener Khinchin, Addition and Multiplication of RPs, Cross spectral densities), Linear Systems (output Mean, Cross correlation and Auto correlation of Input and output), Exercises with Noise. (chapter 6 Text 1)	8	L1,L2,L3
4	**Vector Spaces:** Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations Orthogonality: Orthogonal Vectors and Subspaces, Projections and Least squares, Orthogonal Bases and Gram- Schmidt Orthogonalization procedure. (Refer chapters 2 and 3 Text 2)	8	L1,L2,L3
5	**Determinants:** Properties of Determinants, Permutations and Co-Factors. (Refer Chapter 4, Text 2) Eigenvalues and Eigen vectors: Review of Eigenvalues and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition. (Refer Chapter 5, Text 2)	7	L1,L2,L3

Note1: Each Unit will have Internal Choice

Course Outcomes: After the completion of the course the student should be able to:

CO1 Associate the concepts of statistics to Communication events and identify corresponding Random Variables and Random Processes in these events.

CO2 Analyse and model the Random events in typical communication events to extract quantitative statistical parameters.

CO3 Analyse and model typical signal sets in terms of a basis function set of Amplitude, phase and frequency.

CO4 Demonstrate by way of simulation or emulation the ease of analysis employing basis functions

CO5 Demonstrate by way of simulation or emulation the ease of analysis employing statistical representation.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO5

CO2 PO1,PO2,PO5

CO3 PO1,PO2,PO3

CO4 PO1,PO2,PO3

CO5 PO1,PO2,PO5

Text Books.

1 Richard H Williams, "Probability, Statistics and Random Processes for Engineers" Cengage Learning, 1st Edition, 2003, ISBN 13: 978-0-534-36888-3, ISBN 10: 0-534-36888-3.

2 Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 4th Edition, 2006, ISBN 97809802327

Reference Text Books.

1 Hwei P. Hsu, "Theory and Problems of Probability, Random Variables, and Random Processes" Schaums Outline Series, McGraw Hill. ISBN 10: 0-07-030644-3.

2 K. N. Hari Bhat, K Anitha Sheela, Jayant Ganguly, "Probability Theory and Stochastic Processes for Engineers", Cengage Learning India, 2019, ISBN: Not in book

Subject Title : Principles of Communication Systems

Sub.Code: 18EC43 | No. of Credits:03=3:0:0 (L - T – P) | No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs | CIE+Assignment +SEE=45+5+50=100 | Total No.of Contact Hours:39

Course Learning Objectives: The student should be able to:

1 Understand the concepts of AM, FM, Low pass sampling and Quantization as process.
2 Analyse and mathematically model AM, FM, white noise and the process of sampling, quantization, and encoding.
3 Compute the crucial performance parameter SNR in the presence of AWGN.
4 Associate the concepts of AM, FM in thematic examples.
5 Understand and Analyze the different building blocks in digital electronics using logic gates and implement simple logic function using basic universal gates.

Unit No	Syllabus Contents	No .of Hours	Blooms Taxnomy level.
1	**Amplitude Modulation:** Introduction, Amplitude Modulation: Time & Frequency Domain description, Switching modulator, Envelop detector**.** **Double Side Band-Suppressed Carrier Modulation:** Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. **Single Side–Band And Vestigial Sideband Methods Of Modulation**: SSB Modulation, VSB Modulation, Frequency Translation, Frequency- Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television. (Chapter 3 of Text).	09	L1, L2, L3.
2	**Angle Modulation:** Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear	08	L1, L2, L3

Unit No	Syllabus Contents	No .of Hours	Blooms Taxnomy level.
	model of PLL, Nonlinear Effects in FM Systems. The Superheterodyne Receiver (refer Chapter 4 of Text).		
3	**Noise:** Review of Random Processes, Mean, Correlation and Covariance function, Properties of autocorrelation and, Cross– correlation functions. Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth (refer Chapter 5 of Text).	07	L1, L2, L3.
4	**Noise In Analog Modulation :** Introduction, Receiver Model, Noise in DSB-SC receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM (refer Chapter 6 of Text). **Sampling And Quantization:** Introduction, Why Digitize Analog Sources?, The Low pass Sampling process Pulse Amplitude Modulation.	07	L1, L2, L3.
5	**Sampling And Quantization:** Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves. The Quantization Random Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing (refer Chapter 7 of Text)	08	L1, L2, L3.

Note 1: Each Unit will have Internal Choice

Note 2: Two assignments are evaluated for 5 marks: Assignment - 1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Course Outcomes: After the completion of the Course the student should be able to :

CO1 Associate and apply the concepts of Low pass sampling, reconstruction to Digital transmitters and receivers used in cellular and other communication devices.

CO2 Analyze and compute performance of FM modulation and digital formatting.

CO3 Test and validate digital formatting schemes with quantization noise under noisy channel conditions to estimate the performance in practical communication systems.

CO4 Design/Demonstrate by way of simulation or emulation the functional blocks of digital formatting.

CO5 Demonstrate their ability to use appropriate engineering mathematical concepts in qualitatively problems pertaining to the Rectifiers, Regulators, Amplifiers, Op-Amp.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO5,PO6

CO2 PO1,PO2,PO5,PO5,PO6

CO3 PO1,PO2,PO3,PO5,PO6

CO4 PO1,PO2,PO3,PO5,PO6

CO5 PO1,PO2,PO5,PO5,PO6

Text Books.

1 **"Communication Systems"**, Simon Haykins & Moher, 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Text Books.

1 **Modern Digital and Analog Communication Systems**, B. P. Lathi, Oxford University Press., 4th edition.

2 **An Introduction to Analog and Digital Communication**, Simon Haykins, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.

3 **Principles of Communication Systems**, H.Taub & D.L.Schilling, TMH, 2011.

4 **Communication Systems**, Harold P.E, Stern Samy and A.Mahmond, Pearson Edition, 2004.

Web Links.

1 www.nptel.in

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to ECE Department, Dr. AIT.

Subject Title : Computer Organization and Architecture

Sub.Code: 18EC46 | No. of Credits:03=2:2:0 (L - T – P) | No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs. | CIE+Assignment +SEE=45+5+50=100 | Total No.of Contact Hours:39

Course Learning Objectives: The student should be able to:

1. Understand the meaning of basic structure of computers, and machine instructions and programs.
2. Analyze addressing modes and assembly language.

3. Compute the quantitative parameters for functions of input and output organization.
4. Associate the concepts of memory system

Unit No	Syllabus Contents	No. of Hours	Blooms Taxnomy level.
1	**Basic Structure of Computers:** Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation (upto 1.6.2 of Chap 1 of Text). **Machine Instructions and Programs**: Numbers, Arithmetic Operations and Characters, IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, (upto 2.4.6 of Chap 2 and 6.7.1 of Chap 6 of Text).	8	L1,L2,L3
2	Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions (from 2.4.7 of Chap 2, except 2.9.3, 2.11 & 2.12 of text).	8	L1,L2,L3
3	**Input/Output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access, (upto 4.2.4 and 4.4 except 4.4.1 of Chap 4 of text).	8	L1,L2,L3
4	**Memory System:** Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks (5.1, 5.2,	8	L1,L2,L3

Unit No	Syllabus Contents	No. of Hours	Blooms Taxnomy level.
	5.2.1, 5.2.2, 5.2.3, 5.3, 5.5 (except 5.5.1 to 5.5.4), 5.7 (except 5.7.1), 5.9, 5.9.1 of Chap 5 of Text).		
5	**Basic Processing Unit:** Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control (upto 7.5 except 7.5.1 to 7.5.6 of Chap 7 of Text).	7	L1,L2,L3

Note1: Each Unit will have Internal Choice

Course Outcomes: After the completion of the course the student should be able to:

CO1 Associate the concepts of structure of computer.

CO2 Analyse and model the machine instruction and programs.

CO3 Analyse and addressing modes.

CO4 Demonstrate the input/output organization

CO5 Demonstrate the memory system.

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO5

CO2 PO1,PO2,PO5

CO3 PO1,PO2,PO3

CO4 PO1,PO2,PO3

CO5 PO1,PO2,PO5

Text Books.

1 Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.

Reference Text Books.

1 David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.
2 William Stallings: Computer Organization & Architecture, 7th Edition, PHI, 2006.
3 Vincent P. Heuring & Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

Subject Title : Analog Circuits and Communication Laboratory

Sub.Code: 18EC47	No. of Credits:02	No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs	02Hr Tutorial (Instructions) + 02 Hours Laboratory	Total No.of Contact Hours:

Course Learning Objectives: The student should be able to:

1 Understand the circuit configurations and connectivity of BJT and FET Ampl Study of frequency response.
2 Design and test of analog circuits using OPAMPs
3 Design and test the communication circuits for different analog modulation schemes.
4 Understand the sampling and reconstruction using simple circuits

Unit No	Syllabus Contents	Blooms Levels	L1, L2, L3
1	Design and setup the Common Source JFET/MOSFET amplifier and plot the frequency response.		
2	Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain- bandwidth product from its frequency response.		
3	Design and set-up i) Colpits Oscillator ii)Hartley Oscillator and iii)Crystal Oscillator		
4	Design active second order Butterworth low pass and high pass filters.		
5	Design Adder, Integrator and Differentiator circuits using Op-Amp		
6	Test a comparator circuit and design a Schmitt trigger for the given UTP and LTP values and obtain the hysteresis.		
7	Design 4 bit R – 2R Op-Amp Digital to Analog Converter (i) using 4 bit binary input from toggle switches and (ii) by generating digital inputs using mod-16 counter.		
8	Design a circuit using LM741 and LF398 to generate Amplitude modulation and DSBSC signal.		
9	Design of Monostable and Astable Multivibrator using 555 Timer.		
10	Frequency modulation using IC 8038/2206 and demodulation		
11	BJT/FET Mixer		

Unit No	Syllabus Contents	Blooms Levels	L1, L2, L3
12	Pulse sampling, flat top sampling and reconstruction		

Course Outcomes: After the completion of the Course the student should be able to :

CO1 Design of analog circuits using BJTs and FETs and evaluate their performance characteristics.

CO2 Design of analog circuits using OPAMPs for different applications

CO3 Understand the use of transistor in the design of continuous or pulse modulation schemes.

CO4 Understand the use of ICs in circuit designs for AM and FM modulation and demodulation

Course Outcomes Mapping with Programme Outcomes.

CO1 PO1,PO2,PO3,PO5

CO2 PO1,PO2,PO5

CO3 PO1,PO2,PO3

CO4 PO1,PO2,PO3

CO5 PO1,PO2,PO5

Text Books.

1 K. A. Navas, "Electronics Lab Manual", 5th edition, PHI, 2015.

Sub Title: Programming with Python		
Sub Code:18EC552	**No. of Credits:3=3: 0: 0 (L-T-P)**	**No. of lecture hours/week: 3**
Exam Duration: 3 hours	**CIE +Assignment + SEE = 40 + 5 +5+ 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. Understanding the basics and data structure- list, tuples, dictionaries
2. To understand the control flow, functions modules and error handling.
3. To understand the object oriented concepts in python.
4. To get familiarised in the concepts of decorators and regular expressions.
5. To work with files and data structures in python.

UNIT No	Syllabus Content	No. of Hours	Bloom's Taxonomy
1	**Introduction:** Basics of Python Programming, Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input- Output, Indentation. Data Types - Integers, Strings, Booleans **Operators and Expressions:** Operators- Arithmetic Operators, Relational Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations. **Data Structures:** Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions. **Text1**	08	L1, L2, L3
2	**Control Flow** - if, if-elif-else, for, while, break, continue, pass. **Functions** - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions. **Modules**: Creating modules, import statement, from .import statement, name spacing, Programming Examples **Text1**	08	L1, L2, L3
3	**Object Oriented Programming in Python**: Creating a class, The Self Variable, Namespaces, Types of Methods, Inner classes Inheritance and Polymorphism: Constructors in Inheritance, The Super() Method, Types of Inheritance: Single/Multiple, Method Resolution order, Polymorphism, Operator Overloading, Method overloading, Method Overriding. Programming Examples **Text1**	08	L1, L2, L3
4	**Files in Python**: Types of files, Working with Text files, Working with Binary Files, Pickle Module. **Data Structures in Python**: Linked Lists, Stacks, Queues, Deques. Programming Examples **Text1**	07	L1, L2, L3
5	**Decorators:** Introduction, Decorating functions with Parameters, Chaining decorators in python, property decorator: Class without getters and setters, Class with getters and setters	08	L1, L2, L3

	Regular Expressions: Regular Expression, Sequence Characters in Regular Expression, Quantifiers in Regular Expression, Special characters in Regular Expression, Using Regular Expression on Files, Retrieving Information from HTML File, Programming Examples **Text1**		

Note:

1. Unit 1,2,3,4, and Unit 5 will have the internal choice
2. Two assignments are evaluated for 5 marks: Assignment1 – From Unit 1 and 2, Assignment2 from units 3,4 and 5
3. Group activity for a group of 4 or 5 students -5 marks
4. UNIT 1 - Digital teaching and learning

Course Outcomes

CO1. Demonstrate the understanding and usage of core python scripting elements, python constructs, data types, lists, tuples and dictionaries

CO2. Demonstrate the understanding and usage of control structures module and exception handling

CO3. Demonstrate usage of object oriented features such as Inheritance, Polymorphism, operator overloading

CO4. Apply the knowledge of python and use the language scripting elements and constructs to develop file handling and build the data structures

CO5. Apply the concept of decorators and regular expressions.

COs	Mapping with POs
CO1	PO5,PO6
CO2	PO5,PO6
CO3	PO5,PO6,PO7,PO8,PO9
CO4	PO5,PO6,PO7,PO8,PO9
CO5	PO5,PO6,PO7,PO8,PO9

TEXT BOOKS:

1. Core Python Programming: Dr.R.Nageshwara Rao, Dream Tech Press 2018

REFERENCE BOOKS/WEB LINKS:

1. Think Python, Allen Downey, Green Tea Press.
2. Core Python Programming, W.Chun, Pearson.
3. Introduction to Python, Kenneth A. Lambert, Cengage.
4. Learning Python, Mark Lutz, Orielly

EBOOKS:

1. http://greenteapress.com/wp/think- python
2. https://www.programiz.com/python-programming/decorator
3. https://www.programiz.com/python-programming/property

Sub Title : ARTIFICIAL NEURAL NETWORK		
Sub Code:EC553	**No. of Credits:3=3 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 03**
Exam Duration : 3 Hours	**CIE +Assignment + SEE = 45 + 5 + 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. To provide a strong foundation of fundamental concepts and structures in Neural Networks.
2. To understand the Analysis of different techniques and algorithms in Neural Networks.
3. To study the concepts of setting parameters and multilayered Networks.
4. To understand the concepts of Prediction, Polynomial Neural Networks.
5. To analyze the Optimization techniques in Neural Networks
6. To enable the student to apply these technique in applications which involve neural models.

UNIT No	Syllabus Content	No of Hours
1	Introduction, Fundamental concepts and models of Artificial Neural Network, Biological Neural Networks, structure and function of single neuron, neural network architectures, modelling of neural network, benefits of neural networks. Learning process. Supervised learning and Un-supervised learning.	08
2	Supervised Learning for single layer network: Perceptron, linear separability, Perceptron Training Algorithm, Delta rule, guarantees of success, modifications. Supervised Learning for Multi- layer network: multilevel discrimination, preliminaries, Back propagation, setting parameter values, theoretical results.	09
3	Prediction networks: Introduction, Recurrent network, William's and Zipser's Algorithm, Radial Basis Functions, Polynomial networks, Higher order network, Sigma–pi network, Function link architecture,Pi-sigma network, Regularization	08
4	Unsupervised learning: Winner take all networks. Hamming networks, Maxnet, Simple competitive learning, Hebb rule, Optimization Methods: Hop filed networks, Travelling Sales person problem, Solving simultaneous Liner equations, Allocating documents to multiprocessors, Iterated Gradient Descent	08
5	Case studies on neural network modelling: Application of MATLAB in Neural Network, UC Irvine Machine Learning Repository	06

Note 1: All Units will have internal choice.

Note 2: Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2. Assignment - 2 from units 3, 4 and 5.

Note 3 : Digital learning – Unit 05

Course Outcomes:

CO1. Understand the basic concepts of Neural Networks.
CO2. Analysis and development of different techniques in neural networks.
CO3. Analysis the concepts of Prediction Networks.
CO4. Understand and analysis of the concepts of Polynomial networks in Artificial
CO5. Analyze and design a real world problem for implementation and understand the dynamic behaviour of a system.
CO6. Use different optimization, machine learning technique for different model and enveloping the application.

Cos	Mapping with POs
CO1	P01,P02,P05,PO6
CO2	P02,P07
CO3	P08,P09
CO4	P09,P10
CO5	P07,P09

TEXT BOOKS:

1. Kishan Mehrotra, C. K. Mohan, Sanjay Ranka,Penram, **"Elements of Artificial Neural Networks"**, ***1997.***
2. J. Zurada, Jaico, **"Introduction to Artificial Neural Systems"**, ***2003.***

REFERENCE BOOKS/WEBLINKS:

1. Simon Hayking, **"Neural Networks: A Comprehensive Foundation",**2nd Edition, PHI.
2. Laurene Fausett, **"Fundamentals of Neural Networks: Architecture, Algorithms and Applications",** Person Education, 2004.

Sub Title : Semiconductor Fabrication		
Sub Code: 18EC641	**No. of Credits:3=3 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 03**
Exam Duration : 3 Hours	**CIE +Assignment + SEE = 45 + 05 + 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. To be able to understand Scope of semiconductor Materials and Devices.
2. To be able to understand the Process of Crystal Growth.
3. To be able to understand the Photolithography and Etching.
4. To be able to classify the Diffusion and Ion Implantation.
5. To be able to understand the Film Deposition and Process Integration.

UNIT No	Syllabus Content	No of Hours
1	**Introduction to Semiconductor:** semiconductor Materials, Devices, Semiconductor process technology-key semiconductor technology, technology trends. Basic Fabrication Steps-oxidation, photolithography, etching, diffusion, Ion Implantation and metallization. **Text1**	7
2	**Crystal Growth:** Silicon crystal growth from the melt-starting material, czochralski technique, distribution dopant, effective segregation coefficient. Silicon float zone process. GaAs crystal growth techniques- starting materials, crystal growth techniques. Material characterization- wafer shaping, crystal characterization. **Silicon Oxidation:** Thermal oxidation process-kinetics of growth, thin oxide growth. Impurity redistribution during oxidation, Masking properties of silicon dioxide, oxide quality, oxide thickness characterization. **Text1**	8
3	**Photolithography and Etching:** Optical Lithography- the clean room, exposure tools, masks, photo resist, pattern transfer and resolution enhancement technique. **Etching:** Wet chemical etching-Si etching, Silicon dioxide etching, silicon Nitride and poly silicon etching, Aluminum etching and GaAs etching. Dry etching- Plasma Fundamentals, Etch mechanism. **Text1**	8
4	**Diffusion and Ion Implantation:** Basic Diffusion Process- Diffusion Equation, Diffusion profiles. Extrinsic Diffusion and Lateral diffusion. **Introduction Ion Implantation:** Range of Implanted Ions- Ion Distribution, Ion Stopping, Ion Channeling. Implant Damage and Annealing- Implant Damage, Annealing. **Text1**	8
5	**Film Deposition and Process Integration:** Epitaxial Growth Techniques- Chemical Vapor Deposition. Structures and Defects in Epitaxial Layers, Dielectric Deposition- Si Dioxide, Si Nitride. Poly silicon Deposition. Metallization- Physical Vapor Deposition and Aluminum Metallization and copper Metallization.	8

	Text1	

Note 1: All the units will have internal choice.

Note 2: Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2
Assignment - 2 from units 3, 4 and 5.

Course Outcomes:

CO1: Identify the Semiconductor Materials.
CO2: Ability to interpret Fabrication Steps.
CO3: Creation of semiconductor devices
CO4: Ability to Compare the types of Diffusion and Ion Implantation.

Cos	Mapping with POs
CO1	PO5,PO7,PO8
CO2	PO7,PO8,PO10
CO3	PO5,PO8,PO12
CO4	PO5,PO9,PO11

TEXT BOOK:

1. Gary S. May, Simon M. Sze, **"Fundamentals of Semiconductor Fabrication"** Wiley, 1st Edition, 2003.

REFERENCE BOOKS/WEBLINKS:

1. Anderson, Anderson" **Fundamentals of Semiconductor Devices**" McGraw-Hill Education, Indian Edition 2013.
2. Gary S. May, Costas J S, **"Fundamentals of Semiconductor Manufacturing and Process Control**" Wiley IEEE Press, 1st Edition, 2006

Sub Title: System Verilog for verification		
Sub.Code: 18EC644	No. of Credits:3=3:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Assignment +SEE=45+5+50=100	Total No.of Contact Hours:39

Course objectives:

1. Insight to apply System Verilog concepts to do synthesis, analysis and architecture design.
2. Understanding of System Verilog and SVA for verification, and understand the improvements in verification efficiency.
3. Analyze coverage driven verification for given design under test (DUT).
4. Understand advanced verification features, such as the practical use of classes, randomization, checking, and coverage.
5. Knowledge to communicate the purpose and results of a design experiment in written and oral presentations.

UNIT No	Syllabus Contents	No of Hours	Blooms Taxonomy level.
1	**Verification Guidelines:** Introduction, Verification Process, Verification Plan, Verification Methodology Manual, Basic Test bench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage. **Text 1**	08	L1, L2, L3
2	**Data Types:** Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings. **Text 1**	07	L1, L2, L3
3	**Basic Object Oriented Programming:** Where to Define a Class, OOP Terminology, Understanding Dynamic Objects. **System Verilog Assertions**: Types of Assertions and examples. **Text 1**	08	L1, L2, L3
4	**Threads and Inter-process Communication:** Working with Threads, Inter-process Communication, Events, Semaphores, Mailboxes, Building a Test bench with Threads and IPC Functional Coverage: Coverage Types, Functional Coverage Strategies, Simple Functional Coverage Example, Coverage Options, Parameterized Cover Groups. **Text 1 and Text 2**	08	L1, L2, L3, L4
5	**Introduction to formal verification:** Introduction to formal techniques and property specification, Reachability analysis, Elements of property languages, Property language layers, PSL basics, Formal test plan process. **Text 2 and Text 3**	08	L1, L2, L3

Note 1.Two assignments are evaluated for 5 marks
Note 2.Group activity is evaluated for 5 marks.
Note 3.Unit-5-Digital learning and teaching.

Course Outcomes

CO1. Use System Verilog to create correct, efficient, and re-usable models for digital designs.
CO2. Use System Verilog to create test benches for digital designs.
CO3. Understand and effectively exploit new constructs in System Verilog for verification.
CO4. Use of threads and inter-process communication for system Verilog.
CO5. Understand the process of formal verification.

COs	Mapping with POs
CO1	PO2, PO3, PO4
CO2	PO2, PO3, PO4, PO5
CO3	PO2, PO3, PO4, PO5, PO12
CO4	PO2, PO3, PO4, PO5, PO12
CO5	PO2, PO3, PO4, PO5, PO12

Text Book:	
1.	Chris Spear, "**System Verilog for Verification: A Guide to Learning the Test bench Language Features"**, Springer 2006.
2.	Janick Bergeron, **"Writing Test benches Using System Verilog**", Springer, 2006.
3.	Stuart Sutherland, Simon Davidman and Peter Flake, **"System Verilog for Design: A Guide to Using System Verilog for Hardware Design and Modeling**", 2nd Edition, Springer.

Reference Books:	
1.	Janick Bergeron, **"Writing Test benches: Functional Verification of HDL Models**", Second edition, Kluwer Academic Publishers, 2003.
2.	Mark Glasser, **"Open Verification Methodology Cookbook**", Springer, 2009.
3.	Andreas S. Meyer, **"Principles of Functional Verification**", Elsevier Science, 2004.
4.	Harry D. Foster, Adam C. Krolnik, David J. Lacey, "**Assertion-Based Design**", 2nd Edition, Kluwer Academic Publishers, 2004.

MOOCS:

1. ElectronicDesignAutomationhttp://nptel.ac.in/courses/106105083/
2. DigitalsystemdesignwithPLDsandFPGAshttp://nptel.ac.in/courses/117108040/ Fundamentals of HDL (Lecture #008)
3. https://www.youtube.com/watch?v=rdAPXzxeaxs&index=8&list=PLE3BC3EBC9CE 15FB0

Sub Title : Microwave and Antenna		
Sub Code: 18EC72	**No. of Credits:4=4 : 0 : 0 (L-T-P)**	**No. of lecture hours/week : 04**
Exam Duration : 3 Hours	**CIE +Group Activity+Assignment + SEE = 40 + 5 + 5 + 50 =100**	**Total No. of Contact Hours :52**

Course objectives:

1. Understanding the basics of microwave and waveguides.
2. Understanding the concepts of microwave networks, microwave passive devices and semiconductor devices.
3. Understanding microwave tubes, microwave design principles and antenna basics.
4. Understanding the importance of point sources, arrays and radiations from wires.
5. To understand different types of antennas like aperture, reflector, broadband and Microstrip antennas.

UNIT No	Syllabus Contents	No of Hours	Blooms Taxonomy level.
1	**Introduction to Microwaves** -History of Microwaves, Microwave Frequency bands, applications of Microwaves, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission. **Waveguides-** Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. **TEXT 1,2**	09	L1, L2, L3.
2	**Microwave Network Analysis -** Network parameters for microwave circuits, Scattering Parameters. **Microwave Passive devices and semiconductor Devices -** Microwave passive devices - Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave Semiconductor Devices - Gunn Diodes, IMPATT diodes, PIN diodes**. TEXT 1,2**	09	L1, L2,L3
3	**Microwave Tubes:** Klystron- two cavity klystron amplifier and reflex klystron (klystron oscillator) **Microwave Design Principles -** Microwave Filter Design, RF and Microwave Amplifier Design **Antenna Basics -** Physical concept of radiation, near and far field regions, basic antenna parameters: radiation patterns, beam area, radiation Intensity, beam efficiency, reciprocity, directivity and gain, antenna apertures, effective height, bandwidth, radiation efficiency, radio communication Link, antenna temperature and antenna field zones. **TEXT 1,2,3.4**	11	L1,L2,L3
4	**Radiations from wires:** Short electric dipole, fields of a short dipole, radiation resistance of dipole, Half wave dipole antenna, folded dipole antennas. **Point Sources & their arrays -** Arrays, Point source, Power theorem and its application, Examples of power patterns, Field patterns, Phase patterns, Array of isotropic point sources different cases, non-isotropic sources, principle of pattern multiplication, linear arrays of n elements of equal amplitude & spacing, broad side, end fire arrays **TEXT 3,4**	11	L1,L2,L3,L4

5	**Aperture and Reflector Antennas**- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. **Broadband Antennas**- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. **Micro strip Antennas**- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas. **TEXT 3.4**	12	L1,L2,L3,L4

Note 1. Unit 1, 2, 3, 4 and Unit 5 will have internal choice.

Note 2. Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2
Assignment - 2 from units 3, 4 and 5.

Note 3. Unit 1- Digital Teaching and Learning

Course Outcomes: After the completion of the Course the student can:

CO1. Identify the microwave frequency band, its applications and different types of waveguides
CO2. Analyze microwave networks, microwave passive devices and semiconductor devices.
CO3. Apply microwave design principle, microwave tubes and antenna basics.
CO4. Be able to analyze the radiation patterns from different types of wires, point sources and their arrays.
CO5. Illustrate and design antennas like aperture, reflector, and broadband. Microstrip antenna.

Cos	Mapping with POs	Mapping with PSOs
CO1	PO1,PO2,PO8,PO9	PSO1,PSO2,PS03
CO2	PO1,PO2,PO4,PO8,PO9,PO12	PSO1,PSO2,PS03
CO3	PO1,PO2,PO3,PO4,PO5,PO7,PO8,PO9,PO12	PSO1,PSO2, PS03
CO4	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO12	PSO1,PSO2, PS03
CO5	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PO9,PO12	PSO1,PSO2, PS03

Text Book:	
1.	Collin RE. **Foundations for microwave engineering**. John Wiley & Sons; 2007.
2.	Annapurna Das, Sisir K Das, **Microwave Engineering,** TMH Publication, 2001
3.	J.D. Kraus**, Antennas**, McGraw Hill, 1988.
4.	C.A. Balanis, **Antenna Theory** - Analysis and Design, John Wiley, 1982.

Reference Books:	
1.	Microwave Devices and circuits- Liao / Pearson Education. 1992
2.	M.Kulkarni., "Microwave devices and Radar Engg."Umesh Publications, 2011
3.	R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4.	I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.

Web Links:	
1.	www.nptel.in
2.	https://www.academia.edu/12559664/Collin_Foundations_for_Microwave_Engineering
3.	https://www.academia.edu/13759443/Basic_Antennas_Understanding_Practical_Antennas_and_Design_Joel_R_Hallas_2009
4.	www.youtube/microwave , www.youtube/antennas

Sub Title: 5G Technology		
Sub Code:18EC731	**No. of Credits:3=3: 0: 0 (L-T-P)**	**No. of lecture hours/week: 3**
Exam Duration: 3 hrs	**CIE +Assignment+Group Activity + SEE = 40 + 5 +5+ 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. Assess the genesis and impact of 5G and use case requirement in real world.
2. Understanding the 5G architecture and its deployment.
3 Understanding the security features in 5G technology..
4. Understanding the wireless spectrum crunch 5G technologies.
5. Analyzing and understanding SON and Green flexible RF in 5G technology.

UNIT No	Syllabus Content	No. of Hours	Bloom's Taxonomy
1	**Drivers for 5G: The 'Pervasive Connected World'** Introduction, Historical Trend of Wireless Communications, Evolution of LTE Technology to Beyond 4G, 5G Roadmap, 10 Pillars of 5G, 5G in Europe, 5G in North America, 5G in Asia, 5G Architecture**Text1**	08	L1, L2, L3
2	**The 5G Internet Introduction,** Internet of Things and Context- Awareness, Internet of Things, Context- Awareness, Networking Reconfiguration and Virtualization Support, Software Defined Networking, Network Function Virtualization, Mobility, An Evolutionary Approach from the Current Internet, A Clean- Slate Approach, Quality of Service Control, Emerging Approach for Resource Over- Provisioning **.Text1**	08	L1, L2, L3
3	**Security for 5G Communications:** Introduction, Overview of a Potential 5G Communications, System Architecture, Security Issues and Challenges in 5G Communications Systems, User Equipment, Access Networks,, Mobile Operator's Core Network, External IP Networks **Text1**	08	L1, L2, L3
4	**The Wireless Spectrum Crunch: White Spaces for 5G?.** Introduction, Background, Early Spectrum Management, History of TV White Spaces, History of Radar White Spaces, TV White Space Technology, Standards, Approaches to White Space, White Space Spectrum Opportunities and Challenges, TV White Space Applications, International Efforts, Role of WS in 5G Text1	07	L1, L2, L3

5	**SON Evolution for 5G Mobile Networks,** Introduction, SON in UMTS and LTE, The Need for SON in 5G, Evolution towards Small- Cell Dominant HetNets, Towards a New SON Architecture for 5G, **Green Flexible RF for 5G:** Introduction, Radio System Design, Nonlinear Crosstalk in MIMO Systems **Text1**	08	L1, L2, L3

Note:

1. Unit 1,2,3,4, and Unit 5 will have the internal choice
2. Two assignments are evaluated for 5 marks: Assignment1 – From Unit 1 and 2, Assignment2 from units 3,4 and 5
3. Group activity for a group of 4 or 5 students -5 marks
4. UNIT 1 - Digital teaching and learning

Course Outcomes

CO1. Introduction to drivers in 5G technology.

CO2. Analyze the 5G architecture and its deployment.

CO3. Elaborate security features in 5G technology.

CO4. Analyze the role of wireless spectrum crunch 5G technologies.

CO5. Elaborate the SON and Green flexible RF in 5G technology.

COs	Mapping with POs
CO1	**PO1,PO2,PO8,PO12**
CO2	**PO1,PO3,PO8,PO12**
CO3	**PO1,PO6,PO8,PO12**
CO4	**PO1,PO3,PO8,PO12**
CO5	**PO1,PO2,PO8,PO12**

TEXT BOOKS:

1. **Jonathan Rodriguez**, "Fundamentals of 5G Mobile", Wiley Publications, 2015.

REFERENCE BOOKS/WEB LINKS:

1. **Afif Osseran, Jose F.Monserrat, Patrick Marsch,** " 5G Mobile and Wireless Communications Technology" Cambridge University Press, 2016
2. **Harri Holma, Antti Toskala, Takehiro Nakamura**, " 5G Technology: 3GPP New Radio", John Wiley & Sons Ltd. 2020

Sub Title: VIRTUAL REALITY		
Sub Code:18EC732	**No. of Credits:3=3: 0: 0 (L-T-P)**	**No. of lecture hours/week: 3**
Exam Duration: 3 hours	**CIE +Group Activity+Assignment + SEE = 40 + 5 + 5 + 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. To become familiar with the basic concepts of virtual reality Technology and input devices
2. To understand the output devices.
3. To study the concepts of Modeling in virtual
4. To understand the human factors in VR
5. To become familiar with the applications of VR

UNIT No	Syllabus Content	No. of Hours	Bloom's Taxonomy
1	**INTRODUCTION:** The three I's of virtual reality, commercial VR technology and the five classic components of a VR system. Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. **Text book1: 1.1, 1.3, 1.5, 2.1, 2.2 and 2.3**	09	L1,L2,L3
2	**OUTPUT DEVICES**: Graphics displays, sound displays & haptic feedback. **Text book1: 3.1,3.2 and 3.3**	07	L1,L2,L3,L4
3	**MODELING:** Geometric modeling, kinematics modeling, physical modeling, behavior modeling, model management. **Text book1: 5.1, 5.2 and 5.3, 5.4 and 5.5**	08	L1,L2, L3,L4
4	**HUMAN FACTORS:** Methodology and terminology, user performance studies, VR health and safety issues. **Text book1: 7.1, 7.2 and 7.3**	07	L1,L2,L3.
5	**APPLICATIONS:** Medical applications, military applications, robotics applications. **Text book1: 8.1, 8.3 and 9.2**	08	L1,L2, L3

Note:

1. Unit 1,2,3,4, and Unit 5 will have the internal choice
2. Two assignments are evaluated for 5 marks: Assignment1 – From Unit 1 and 2, Assignment2 from units 3,4 and 5

Course Outcomes:

CO1: Describe the basic concepts of virtual reality and input devices.

CO2: Compare the input and output devices

CO3: Use the virtual reality modeling techniques

CO4: Illustrate the human factors in virtual reality

CO5: Understanding and identifying the applications of virtual reality

COs	Mapping with POs
CO1	PO1,PO2,PO4,PO5,PO8, PO12
CO2	PO2,PO3,PO4,PO5,PO10,PO12
CO3	PO1,PO2,PO3,PO5,PO6,PO7,PO12
CO4	PO1,PO2,PO4,PO5,PO11,PO12
CO5	PO1,PO2,PO5, PO11,PO12

Text Books.

1. Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons. 2003
2. Introduction to Virtual Reality, John Vince, Springer, London, Springer-Verlag London Limited 2004

Reference Text Books.

1. Virtual Reality Systems. John Vince, Pearson Education, 2007

Web Links.

1. https://doi.org/10.1007/978-0-85729-386-2, 978-1-85233-739-1
2. www.nptelcoursematerial
3. www.youtube/virtual
4. Introduction - Learning Virtual Reality [Book] (oreilly.com)
5. https://www.geeksforgeeks.org/virtual-reality-introduction

Sub Title: NETWORK AND CYBER SECURITY		
Sub Code:18EC735	**No. of Credits:3=3: 0: 0 (L-T-P)**	**No. of lecture hours/week: 3**
Exam Duration: 3 hours	**CIE +Assignment+ Group Activity + SEE = 40 + 5 +5+ 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. Know about security concerns in Email and Internet Protocol. ·
2. Understand cyber security concepts. ·
3. List the problems that can arise in cyber security. ·
4. Discuss the various cyber security frame work.
5. Will be in a position to apply the concepts of cyber security framework in computer system administration.

UNIT No	Syllabus Content	No. of Hours	Bloom's Taxonomy
1	**Transport Level Security:** Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) Text 1:	08	L1, L2
2	**E-mail Security**: Pretty Good Privacy, S/MIME, Domain keys identified mail (Text1)	08	L1, L2
3	**IP Security**: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Combining security Associations Internet Key Exchange. Cryptographic Suites (Text 1:)	08	L1, L2, L3
4	**Cyber network security concepts**: Security Architecture antipattern: signature based malware detection versus polymorphic threads, document driven certification and accreditation, policy driven security certifications. Refactored solution: reputational, behavioural and entropy based malware detection. The problems: cyber antipatterns concept, forces in cyber antipatterns, cyber anti pattern templates, cyber security antipattern catalog (Text-2)	07	L1, L2, L3
5	**Cyber network security concepts:** Enterprise security using Zachman framework Zachman framework for enterprise architecture, primitive models versus composite models, architectural problem solving patterns, enterprise workshop, matrix mining, mini patterns for problem solving meetings. (Text-2: Chapter 3 & 4).	08	L1, L2, L3

Note:

1. **Unit 1,2,3,4, and Unit 5 will have the internal choice**
2. **Two assignments are evaluated for 5 marks: Assignment1 – From Unit 1 and 2, Assignment2 from units 3,4 and 5**
3. **Group activity for a group of 4 or 5 students -5 marks**
4. **UNIT 1 - Digital teaching and learning**

Course Outcomes

CO1. Explain network security protocols ·

CO2. Understand the basic concepts of cyber security ·

CO3. Discuss the cyber security problems ·

CO4. Explain Enterprise Security Framework ·

CO5. Apply concept of cyber security framework in computer system administration.

COs	Mapping with POs
CO1	PO5,PO6
CO2	PO5,PO6
CO3	PO5,PO6,PO7,PO8,PO9
CO4	PO5,PO6,PO7,PO8,PO9
CO5	PO5,PO6,PO7,PO8,PO9

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325- 1877-3.
2. 2. Thomas J. Mowbray, "Cyber Security – Managing Systems, Conducting Testing, and Investigating Intrusions", Wiley.

REFERENCE BOOKS/WEB LINKS:

1. Cryptography and Network Security, Behrouz A. Forouzan, TMH, 2007.
2. Cryptography and Network Security, Atul Kahate, TMH, 2003.

Sub Title: Real Time Embedded Systems		
Sub Code:18EC744	**No. of Credits:3=3: 0: 0 (L-T-P)**	**No. of lecture hours/week: 3**
Exam Duration: 3 hours	**CIE +Group Activity+Assignment + SEE = 40 + 5 + 5 + 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. Introduce the fundamental concepts of the Real time Embedded systems.
2. Study concepts relating to Real time Embedded systems such as Scheduling techniques, Dynamic priority policies.
3. Describe concepts related to Multi resource services like blocking, Deadlock, live lock & soft real time services.
4. Understand the basic hardware and software components of Real time embedded systems.
5. Expose to Real time embedded system applications through different case studies.

UNIT No	Syllabus Content	No. of Hours	Bloom's Taxonomy
1	**Real-Time Embedded Systems:** Introduction, Brief history of Real Time Systems, A brief history of Embedded Systems. **System Resources:** Introduction, Resource analysis, Real-Time Service Utility, scheduling classes, Scheduler concepts, Real-Time OS. (Text 1)	07	L1,L2, L3,
2	**Processing with Real Time Scheduling:** Introduction, Pre-emptive Fixed Priority Scheduling Policies with timing diagrams, Problems and issues, Feasibility, Rate Monotonic least upper bound (No derivation), Necessary and Sufficient feasibility, Dynamic priority policies. (Text 1)	08	L1,L2, L3
3	**I/O Resources**: Execution efficiency, I/O Architecture. **Memory:** Physical hierarchy, ECC Memory, **Multi-resource Services:** Blocking, Deadlock and livelock. **Soft real-time services:** Missed deadline, QoS. (Text 1)	08	L1,L2, L3
4	**Embedded System Components:** HARDWARE COMPONENTS: Sensors, Actuators, IO Interfaces, Processor Complex or SoC, Processor and IO Interconnection, Bus Interconnection, High-Speed Serial Interconnection, Low-Speed Serial Interconnection, Interconnection Systems, Memory Subsystems. FIRMWARE COMPONENTS: Boot Code, Device Drivers, Operating System Services. (Text 1)	08	L1,L2, L3, L4,L5

5	**Case Studies:** ROBOTIC APPLICATIONS: Robotic Arm, Actuation, End Effector Path, Sensing, Tasking, Automation and Autonomy. COMPUTER VISION APPLICATIONS: Object Tracking, Image Processing for Object Recognition, Characterizing Cameras, Pixel and Servo Coordinates, Stereo-Vision. (Text 1)	08	L1,L2, L3,L6

Note:

1. Unit 1,2,3,4, and Unit 5 will have the internal choice
2. Two assignments are evaluated for 5 marks: Assignment1 – From Unit 1 and 2, Assignment2 from units 3,4 and 5

Course Outcomes:

CO1: Discuss the fundamentals of various real time services, real time service utilities, and Real time embedded system.

CO2: Apply priority based static and dynamic Real time scheduling techniques for the given real time embedded system specifications.

CO3: Analyze deadlock conditions, shared memory problem, priority inversion, missed deadlines and QoS of Real time embedded systems.

CO4: Choose the appropriate real time embedded system components to improve the performance.

CO5: Develop the simple real time embedded systems.

COs	**Mapping with POs**
CO1	PO1, PO2, PO6, PO12
CO2	PO1, PO2, PO4, PO5, PO12
CO3	PO1, PO2, PO6, PO12
CO4	PO1, PO2, PO5, PO6, PO12
CO5	PO1, PO2, PO6, PO12

Text Books.

"**Real-Time Embedded Components and Systems",** Sam Siewert, John Pratt, Mercury Learning and Information, 2016.

REFERENCE BOOKS/WEBLINKS

1. James W S Liu, "**Real Time System**", Pearson education, 2008.
2. nptel.ac.in/courses

Sub Title : **Adaptive Signal Processing**		
Sub Code: 18EC746	**No. of Credits:3=3: 0 : 0 (L-T-P)**	**No. of lecture hours/week : 03**
Exam Duration : 3 Hours	**CIE +Group Activity+Assignment + SEE = 40 + 5 + 5 + 50 =100**	**Total No. of Contact Hours :39**

Course objectives:

1. understand the basic concept of adaptive filter and adaptive system
2. identify the geometrical significance of Eigenvectors and values
3. analyse the Simple, Newton's and Steepest Descent Gradient search method to search performance surface
4. study estimation of LMS algorithm
5. familiar with design of adaptive communication system, adaptive noise canceller and adaptive modeling in FIR digital filter synthesis

UNIT No	Syllabus Contents	No of Hours	Blooms Taxonomy level.
1	**ADAPTIVE SYSTEMS:** Definition and characteristics, Areas of application, General properties, Open-and closed loop adaptation, Applications of closed-loop adaptation, Example of an adaptive system. (Text1)	6	L1,L2
2	**THE ADAPTIVE LINEAR COMBINER:** General description, Input signal and weight vectors, Desired response and error, the performance function, gradient and minimum mean-square error, Example of a performance surface **PROPERTIES OF THE QUADRATIC PERFORMANCE SURFACE**: Normal of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, an example with two weights, geometrical significance of eigenvectors and Eigen values.(Text1)	10	L1,L2,L3
3	**SEARCHING THE PERFORMANCE SURFACE:** Methods of searching the performance surface, Basic ideal of gradient search methods, a simple gradient search algorithm and its solution, Stability and rate of convergence, The learning curve, and Gradient search by Newton's method in multidimensional space, Gradient search by the method of steepest descent, Comparison of learning curves. (Text1)	10	L1,L2,L3
4	**THE LMS ALGORITHM**: Derivation of the LMS algorithm, convergence of the weight vector, an example of convergence, learning curve, noise in the weight-vector solution(Text1)	7	L1,L2,L3
5	**ADAPTIVE MODELING AND SYSTEM IDENTIFICATION:** Multipath communication channel, geophysical exploration, FIR digital filter synthesis. (Text1)	6	L1,L2

Note 1. Unit 1, 2, 3, 4 and Unit 5 will have internal choice.

Note 2.Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2
Assignment - 2 from units 3, 4 and 5.

Note 3.Unit 4---digital teaching and learning.

Course Outcomes:

CO1: Understand the basic concept of adaptive filter and adaptive system

CO2: Understand the design of adaptive linear combiner and Identify the geometrical significance of Eigenvectors and values

CO3: Analyse the Simple, Newton's and Steepest descent Gradient search method to search performance surface.

CO4: Estimate the gradient component using Newton's, Steepest-descent methods and LMS algorithm

CO5: Design of adaptive communication system, adaptive noise canceller and adaptive modelling in FIR digital filter synthesis.

Cos	Mapping with POs
CO1	PO1, PO2, PO3, PO4
CO2	PO1, PO2, PO3, PO4
CO3	PO2, PO3, PO4
CO4	PO2, PO3, PO4
CO5	PO5,PO6

Text Book:

1. **Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Edition, Pearson Education, Asia, 2009**
2. **Simon Haykin, "Adaptive filter Theory", 4th edition, Pearson Education Asia, 2008**

Reference Books:

1. **Alexander, Thomas S, "Adaptive Signal Processing: Theory and Applications", edition, Springer-Verlag New York, Inc. New York, NY, USA, 1986**

2. **T. Adali and Simon Haykin, "Adaptive Signal Processing: Next Generation Solutions", edition, Wiley India, 2012**
3. **Jophn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore, "Theory and Design of Adaptive Filters", edition, PHI, 2002**

Web Links.

http://www.nptelvideos.in/2012/12/adaptive-signal-processing.html
http://www.cs.tut.fi/~tabus/course/ASP/Lectures_ASP.html
http://www.signal.uu.se/Courses/CourseDirs/AdaptSignTF/Adapt04. html

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to ECE Department, Dr. AIT.