FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(AICTE Model Curriculum)

and

Syllabi

B.E. V &VI Semesters of

Four Year Degree Programme in

ELECTRONICS & COMMUNICATION ENGINEERING

(With effect from the Academic Year 2021 - 2022)

(As approved in the Faculty Meeting held on X-X-2021)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

19.05.2022

SCHEME OF INSTRUCTION &EXAMINATION
B.E.V-Semester

(ELECTRONICS AND COMMUNICATIONENGINEERING)

S.No.	Course Code	CourseTitle	Schemeof Instruction				Schemeof Examination			Credits
			L	T	P/D	ContactHrs/Wk	CIE	SEE	DurationinHrs	
TheoryCourse										
1	PC408EC	DigitalSignalProcessing	3	-	-	3	30	70	3	3
2	PC409EC	Microprocessorand Microcontroller	3	-	-	3	30	70	3	3
3	PC410EC	AnalogCommunication	3	-	-	3	30	70	3	3
4	PC411EC	AutomaticControlSystems	3	-	-	3	30	70	3	3
5	PC412EC	AntennasandwavePropagation	3	-	-	3	30	70	3	3
6	HS104ME	Industrial Administration andFinancialManagement	3	-	-	3	30	70	3	3
Practical/LaboratoryCourse										
7	PC455EC	MicroprocessorandMicro controllerLab	-	-	2	2	25	50	3	1
8	PC456EC	Systems and Signal ProcessingLab	-	-	2	2	25	50	3	1
9	PW701EC	MiniProject	-	-	2	2	50	-	-	2
Total			**18**	**-**	**6**	**24**	**280**	**520**	**24**	**22**

PC: Professional Core **HS:**HumanitiesandSocialSciences **PW**: Project Work

L:Lecture **T:**Tutorial **P:**Practical **D:**Drawing
CIE: ContinuousInternal Evaluation **SEE:**SemesterEndExamination(Univ.Exam)

EC: ElectronicsandCommunicationEngineering**ME:**MechanicalEngineering

NOTE:

1. Eachcontact houris aClockHour.
2. The duration of the practical class is two clock hours, however it can beextendedwherevernecessary,toenable thestudenttocompletetheexperiment.

DIGITALSIGNALPROCESSING

PC408EC

Instruction:3periodsperweek *Duration of SEE:3 hours*
CIE:30marks *SEE:70 marks*
Credits: 3
Prerequisites: Signals and Systems (EC305EC)

Course Objectives:

1.To describethenecessityand efficiencyofdigital signal processing.
2.To discuss various design methods of FIR & IIR filters.
3.Todescribe the concepts of multirate signal processing and identify important features of TMS320C67XX DSP processors.

Course Outcomes: Onsuccessful completionofthe course,the studentswillbeableto

1.apply the knowledge of FFT Algorithms for computation of DFT.
2.design of FIR filters using various methods.
3.design of IIR filters using various methods.
4.apply decimation and interpolation concepts for the design of sampling rate converters
5.understand TMS320C67XX DSP processors for the design of digital filters.

UNIT– I
Discrete Fourier Transform and Fast Fourier Transform: Discrete Fourier Transform (DFT),ComputationofDFT-LinearandCircularConvolution,FFTalgorithms:Radix-2case,DecimationinTimeandDecimationinFrequencyalgorithms, inplacecomputation, bit Reversal.
UNIT– II
FiniteImpulse-ResponseFilters(FIR): Linearphasefilters,Windowingtechniquesfordesign ofLinearphaseFIRfilters-Rectangular,triangular,Bartlett,Hamming,Hanning,Kaiser windows,Realizationoffilters,Finitewordlengtheffects.
UNIT– III
InfiniteImpulse-ResponseFilters(IIR): Introductiontofilters,comparisonbetweenpracticalandtheoreticalfilters, ButterworthandChebyshevapproximation,IIRdigitalfilterdesign Techniques, Impulse Invariant technique, Bilinear transformation technique, DigitalButterworth&Chebyshev filters, Implementation, Digital filters structures, Comparisonbetween FIRand IIR.
UNIT– IV
Multirate Digital Signal Processing: Introduction, Decimation by factor D and interpolation bya factor I, Sampling Rate conversion by a Rational factor I/D. **Implementation of SamplingRateConversion:** Multistageimplementationofsamplingrateconversion, Sampling conversionbyanarbitraryfactor, Applicationof MultirateSignalProcessing.
UNIT– V

Introductionto DSP Processors: Difference between DSP and other microprocessors architectures Importance of DSP Processors- General purpose DSP processorsTMS320C67XX processor, architecture, registers, pipelining, addressing modes and introduction to instruction set.

SuggestedReading:

1	Alan V. Oppenheim & Ronald W. Schafer, "Digital Signal Processing," PHI, 2nd edition, 2014.
2	John G. Proakis&Dimtris G. Manolakis, "Digital Signal Processing Principles, Algorithms and Application," PHI, 4th edition, 2012.
3	Ashok Ambardar, "Digital Signal Processing: A Modern Introduction," Cengage Learning, 2009.
4	Li Tan, "Digital Signal Processing: Fundamentals and Applications," Elsevier, 2012.
5	B.Venkataramani& M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application," TMH, 2e 2013.

MICROPROCESSORANDMICROCONTROLLER

PC409EC

Instruction:3periodsperweek *Duration of SEE: 3 hours*
CIE:30mark *SEE:70marks*
Credits:3
Prerequisites: Computer Organization and Architecture (PC404EC)

Course Objectives:

1. To understandarchitectureandprogrammingof8086microprocessorand8051microcontroller.
2. To describeinterfacingofmemory,8255 PPI,and 8251 USARTto8086processoranddifferentiation of 8086and8051intermsofinternalarchitecture, memory,andprogramming.
3. To describeinterfacingandprogrammingofI/Oports,TimersandUARTusing8051 controllerand developinterfacingofrealtimedeviceslikeADC,DACandsteppermotorwith8051.

Course Outcomes: Onsuccessfulcompletionofthecourse,thestudentswill beableto

1.explainthearchitectureof8086microprocessorandrecognizedifferenttypesofaddressing modes.
2.writeassemblylanguageprogramming using8086microprocessorinstructionset.
3.interfacedifferentperipheralsto8086microprocessor.
4.explainthearchitectureof8051microcontrollerandwriteassembly/Clanguageprogrammingusin g8051microcontroller.
5.interfacedifferentperipheral modulesto8051microcontroller.

UNIT–I
8086Microprocessor: Intel 8086/8088architecture,Segmentedmemory,MinimumandMaximummodesofoperation,Timingdi agram,addressingmodes,Instructionset,assemblylanguageprogrammingusingdatatransfer,arithm etic,logicaland branchinginstructions.
UNIT–II
8086ProgrammingandInterfacing: Assemblerdirectives,macros,procedures,assemblylanguageprogrammingusingstringmanipulatio n instructions, 8086 Interrupt structure, I/O and memory interfacing concepts using8086,ICChipPeripherals-8255PPI,8251USART and their interfacing with 8086.
UNIT–III
8051 Microcontroller: Internal architecture and pin configuration, 8051 addressing modes,instruction set, bit addressable features. I/O port structures, assembly language programmingusingdata transfer,arithmetic,logicalandbranchinstructions.
UNIT–IV
8051Timers,SerialPortandInterrupts: 8051Timers/Countersanditsprogramming,Serialdatacommunication,Serialport anditsprogramming,8051 interrupts, Interrupt vectortable,Interruptsprogramming.
UNIT–V

8051Interfacing: Interfacingof8051withLCD,ADC,DAC,externalmemory,steppermotorin terfacing.

SuggestedReading:

1.	RayA.KandBhurchandiK.M,"AdvancedMicroprocessorsandPeripherals",3/e,Tata McGraw Hill Education Pvt Ltd, 2013.
2.	Mazidi M.A,MazidiJ.G andRolinD.Mckinlay,"The8051Microcontroller&EmbeddedSystemsUsingAssemblyandC",2/e,PearsonEducation,2008.
3.	DouglasV. Hall,"MicroprocessorsandInterfacingProgrammingandHardware", 2nd Edition, TataMcGraw-HillpublishingcompanyLimited,NewDelhi,2008.
4.	AyalaK.J,"The8051MicrocontrollerArchitecture,programming&Applications", PenramInternational, 2007.
5.	Scott Mackenzie and Raphael C. W. Phan. "The 8051 Microcontroller", 4th Edition, Pearson education, 2008.

ANALOG COMMUNICATION

PC410EC

Instruction:3periodsperweek *Duration of SEE:3 hours*
CIE:30marks *SEE:70 marks*
Credits: 3
Prerequisites: Signals & Systems (ES305EC)
Probability Theory and Stochastic Processes (ES304EC)

Course Objectives:

1.	To understand the concept of modulation.
2.	To describe the generation and detection of various analog and pulse modulation techniques.
3.	To describe the structures of AM, FM transmitters and Receivers and analyze the noise performance of analog modulation techniques.

Course Outcomes: Onsuccessful completionofthe course,the studentswillbeableto

1.	understand the need for modulation, transmitter and receiver structures.
2.	understand the generation, detection of Amplitude and Angle modulation schemes.
3.	compute and compare power and bandwidth requirements of AM, DSB-SC, SSB and FM techniques.
4.	understand and compare pulse analog and digital modulation techniques.
5.	identify the sources of noise and evaluate the performance of analog communication systems over a noisy channel.

UNIT– I
Introduction: Introduction to communication system, Communication channels, Need for modulation. **Amplitude Modulation:** Definition, Time and Frequency domain description – AM, DSB-SC, Single tone modulation, Power relations in AM, Generation of AM signal– Square-law, Switching modulators, AM demodulation- envelop Detector, Generation of DSB-SC Signal – Balanced, Ring modulators, DSB-SC demodulation – Coherent Detector, COSTAS loop. **SSB Modulation:** Definition,Time and Frequency domain description, Generation of SSB Signal – Frequency discrimination and phase discrimination methods, Demodulation of SSB – Coherent Detection, Frequency Division Multiplexing, Vestigial Sideband Modulation – Time and Frequency domain description, Generation of VSB signal, Envelop detection of VSB plus carrier, Comparison of all AM techniques, Applications of different AM systems, AM Transmitter, AM super heterodyne receiver, Receiver characteristics.
UNIT– II
Angle Modulation: Definition, basic concepts, Frequency modulation: Single tone FM, Spectrum analysis of sinusoidal FM wave, Narrow band FM, Wide band FM. Constant average power, Transmission bandwidth of FM wave. Generation of FM - Direct and Indirect (Armstrong's) methods. Detection of FM - Balanced frequency discriminator, Phase Locked Loop. Comparison of FM and AM. FM Transmitter, FM Super heterodyne receiver

UNIT-III
Pulse Analog Modulation schemes: Review of sampling theorem, types of sampling. Types of Pulse Analog and Digital Modulation Schemes, Generation and demodulation of Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM). Time Division Multiplexing.
UNIT– IV
Pulse Digital Modulation Schemes: Quantization, Analog to Digital Conversion, PCM, Companding in PCM – mu law, A law. DPCM, DM and ADM. Comparison of PCM, DPCM, DM and ADM. SNR_Q of PCM and DM.
UNIT– V
Noise: Definition, Sources of noise, Atmospheric noise, thermal noise, shot noise, Noise in two-port network: noise figure, equivalent noise temperature of Single and cascade stages, noise equivalent bandwidth. Narrow band noise representation **Noise in Analog Communication Systems:** Signal to Noise Ratio (SNR) and Figure of merit calculations in AM, DSB-SC, SSB and FM systems, Pre-Emphasis and De-Emphasis.

SuggestedReading:

1	Simon Haykin, “Communication Systems,” 2nd edition, Wiley India, 2011.
2	H. Taub, D.L. Schilling, “Principles of communication systems”, Tata McGraw Hill, 2001.
3	B.P. Lathi, Zhi Ding, “Modern Digital and Analog Communication Systems”, 4th edition, Oxford University Press, 2016.
4	Leon W Couch II., “Digital and Analog Communication Systems”, 6th edition, Pearson Education Inc., 2001.
5	P. Ramakrishna Rao, “Analog Communication,” 1st edition, TMH, 2011.

AUTOMATIC CONTROL SYSTEMS

PC411EC

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3
Prerequisites: Signals & Systems (EC305EC)

CourseObjectives:

1.	To analyze the stability and performance of dynamic systems in both time and frequency domain.
2.	To understand the impact of various compensators and controllers on system performance.
3.	To provide the knowledge of state variable models and digital control systems.

Course Outcomes: On successful completion of the course, the students will be able to

1.	develop the mathematical model of the physical systems and find the transfer function using different approaches.
2.	analyze system stability using time domain techniques.
3.	analyze system stability using frequency domain techniques.
4.	verify the stability of digital control systems.
5.	illustrate the control systems via state space models.

UNIT – I
Control System Fundamentals: Classification of control systems including Open and Closed loop systems, Effect of feedback on Control systems, Mathematical modeling of Mechanical systems and their conversion into electrical systems, Transfer function representation, Block diagram representation, Block diagram algebra and reduction and Signal flow graphs and Mason's gain formula.
UNIT – II
Time Response Analysis: Transfer function and types of input. Transient response of first and second order system for step input. Time domain specifications, Characteristic equation of Feedback control systems, Static error coefficients, Error series, **Stability:** Concept of Stability, Routh-Hurwitz criterion for stability, Root locus technique and its construction
UNIT – III
Frequency Response Analysis: Introduction to Frequency response of the system. Frequency domain Specifications, Bode plots, Stability analysis, Nyquist plot and Nyquist criterion for stability **Compensation Techniques:** Types of Compensation. Phase Lag, Lead and Lag-Lead compensators. Types of controllers proportional (P), integral (I), derivative (D), PID controller
UNIT – IV
Digital Control Systems: Digital control, advantages and disadvantages, Digital control system architecture. Sample and Hold Circuit. Transfer function of sample data systems. Stability analysis by Jury's test.
UNIT – V
State Space Representation: Concept of state and state variables. State models of linear time

invariant systems, Derivation of Transfer Function from State Model, State transition matrix, Solution of state equations. Controllability and Observability.

Suggested Reading:

1	Nagrath, I.J, and Gopal, M., "Control System Engineering", 5^{th} edition, New Age Publishers, 2009
2	NagoorKani, "Control systems Engineering", Oxford & IBH Publishing Company Private Limited, 2021.
3	Ogata, K., "Modern Control Engineering", 5^{th} edition, Pearson India Education Services Pvt. Limited, 2015
4	Alan V Oppenheim, A. S. Wlisky, "Signalsand Systems", Prentice-Hall ofIndia Private Limited, 2008.
5	A.K.Jairath , "Problems and Solutions of Control Systems" , CBS Publishers, 2022.

ANTENNAS AND WAVE PROPAGATION

PC412EC

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3
Prerequisites: Electromagnetic Theory & Transmission Lines (PC405EC)

Course Objectives:

1.To describe the basic principles of antennas and introduce the antenna terminologies.
2.To discuss the working principles of wire antennas, non-resonant antennas, antenna arrays and techniques for measurement of antennas characteristics.
3.To explain the various modes of radio wave propagation.

CourseOutcomes: Onsuccessfulcompletionofthecourse, thestudentswillbeableto

1.illustrate the basic principles of antennas and learn the antenna terminology.
2.apply the design considerations of different types of wire antennas and make proficient in analytical skills for understanding practical antennas
3.analyse the non-resonant antennas for various ranges of frequencies and get updated with latest developments in the smart antennas.
4.apply the principles and design considerations of antennas as well as antenna arrays, measure standard antenna parameters and obtain awareness about radiation hazards.
5.understand and compare various modes of radio wave propagation used for different applications.

UNIT – I
Antenna Fundamentals: Introduction, principle of radiation, isotropic radiator, basic antenna parameters: radiation pattern, beam area, radiation intensity, beam efficiency, directivity, gain, resolution, antenna apertures, effective length and effective area, Friis transmission equation, fields from oscillating dipole, antenna field zones, antenna polarization, front–to-back ratio, antenna theorems, antenna impedance and antenna temperature. Retarded potential: Lorentz and Coulomb gauge conditions.
UNIT – II
Thin Linear Wire Antennas: Introduction, current distributions, radiation from infinitesimal/short dipole or an alternating current element, half-wave dipole and quarter wave monopole, loop antennas-small loop, comparison of far fields of small loop and short dipole, far field pattern of circular loop with uniform current, radiation resistance of loops, slot antennas, helical antennas- helical geometry, helix modes: transmission and radiation, practical design considerations for monofilar helical antenna in axial modes, wideband characteristics of monofilar helical antenna radiating in axial mode, radiation efficiency.
UNIT – III
Non-Resonant Antennas: Comparison between resonant and non-resonant antennas, Long-wire antennas: V-antenna and Rhombic Antenna, Yagi-Uda Antenna, Folded dipole antennas, Broadband and frequency-independent concept, Log-periodic Antenna, Aperture Antennas-

Huygen's principle, Babinets principle, Radiation from Horns and design considerations, Parabolic Reflector and Cassegrain Antennas, Lens Antennas, Micro Strip Antennas- Basic characteristics, feeding Methods, Design of Rectangular Patch Antennas, Smart Antennas-Fixed weight and Adaptive Beam forming.
UNIT – IV
Antenna Arrays: Array of point sources, two element array with equal and unequal amplitudes, different phases, linear n-element array with uniform distribution, Broadside and End fire arrays, Principle of Pattern Multiplication, Effect of inter element phase shift on beam scanning, Binomial array. EFA with Increased Directivity, Derivation of their characteristics and comparison; Effects of Uniform and Non-uniform Amplitude Distributions. **Antenna Measurements:** Introduction, Basic Concepts-Reciprocity, Near and Far fields, Source of Errors, Antenna Test Site. Measurement setup and distance criterion for directional patterns, gain (absolute and comparison methods) and impedance, Radiation Hazards.
UNIT – V
Wave Propagation: Ground, Space and Surface waves, Troposphere refraction and reflection, Duct propagation, Sky wave propagation, Regular and irregular variations in ionosphere Line of sight propagation.

Suggested Reading:

1.	J. D. Kraus, R. J. Marhefka, and Ahmad S. Khan, "Antennas and Wave Propagation", McGraw-Hill, 4th Edition, 2010.
2.	Constantine A. Balanis, "Antenna Theory: Analysis and Design", 3rd Edition, John Wiley, 2005.
3.	Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 1968.
4.	Robert E. Collin, "Antennas and Radiowave Propagation", McGraw-Hill, 1985.
5.	A.R.Harish and M. Sachidananda, "Antennas and Wave Propagation", Oxford University Press, 2007.

INDUSTRIALADMINISTRATIONANDFINANCIAL MANAGEMENT

HS104ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks Credits: 3*
Prerequisites: Finance and Accounting (HS103CM)

Course Objectives

1.To understand various types of organizational structures, manufacturing processes and importanceof plant layout and the role of scheduling function in optimizing the utilization of resources.
2.To understand the importance of quality, inventory control and concepts like MRP I and MRPII.
3.To understand the nature of financial management and concepts like breakeven analysis, depreciation and replacement analysis.

Course Outcomes

After completing this course, the student will be able to

1.Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems and role of scheduling function in better utilization ofresources.
2.Understand the Fundamental concepts of quality control, process control, material control and appreciate the importance of MRP-I and MRP—H.
3.Know the different terminology used in financial management and understand the different techniques of capital budgeting and various types of costs involved in running an industrial organization.

UNIT-I
Industrial Organization: Types of various business organisations,organisationstructuresand their relative merits and demerits. Functions of management.Plant Location and Layouts: Factors affecting the location of plant and layout. Types of layouts and their merits and demerits.
UNIT-II
Work Study: Definitions, objectives of method study and time study. Steps in conducting method study. Symbols and charts used in method study. Principles of motion economy. Calculation of standard time by time study and work sampling. Performance rating factor. Types of ratings. Jobs evaluation and performance appraisal. Wages, incentives, bonus, wage payment plans.
UNIT-III
Inspection and Quality Control: Types and objectives of inspection S.Q.C., its principles. Quality control by chan and sampling plans. Quality circles, introduction to ISO.
UNIT-IV
Optimization: Introduction to linear programming and its graphical solutions. Assignment problems.Project Management: Introduction to CPMand PERT. Determination of critical path.Material Management: Classification of materials, Materials planning. Duties of purchase manager.Determination of economic ordering quantities. Types of materials purchase.
UNIT-V
Cost Accounting: Elements of cost(Various costs) types of overheads, Breakeven analysis and its

applications. Depreciation. Methods of calculating depreciation fund. Nature of financial management. Time value of money. Techniques of capital budgeting and methods. Cost of Capital, Financial leverage.

Suggested Reading:

1.	Pandey I M, “Elements of Financial Management”, Vikas Publications House New Delhi 1994
2.	Khanna O P, “Industrial Engineering and Management”, Dhanpat Rai &Sons.
3.	Marshall/Bansal, "Financial Engineering”, PHI.
4.	Keown,"Financial Management”, 9th edition, PHI.
5.	Chandra Bose, “Principles of Management &Administration”, PHI.

MICROPROCESSORANDMICROCONTROLLERLAB

PC455EC

Instruction:2periodsperweek *Duration ofSEE: 3hours*
CIE:25marks *SEE:50marks*
Credits: 1

Course Objectives:

1. Applyassemblylanguageprogramson8086trainerkitinstandalone/serialmode.
2. Classifyinterfacemodulesinto input/outputandmemoryinterfaceswith8086.
3. Developandexecutetheassembly languageprogrammingconceptsof8051microcontroller andfor variousinterfacemodules.

Course Outcomes: Onsuccessfulcompletionofthecourse,thestudentswill beableto

1.applydifferentaddressingmodesandmodelprogramsusing8086 Instructionset.
2.explaintheusageofstring instructionsof8086for stringmanipulation,andcomparison.
3.developinterfacingapplicationsusing8086processor.
4.developdifferentprogramsusingCcrosscompilersfor8051microcontroller.
5.developinterfacingapplicationsusing8051microcontroller.

ListofExperiments

PART-A

1. Use of 8086 trainer kit and execution of programs. (Instruction set for simple Programsusing4to5linesofinstructioncodeunderdifferentaddressingmodes fordatatransfer,manipulation,and arithmeticoperations).
2. Branchingoperationsandlogicaloperationsinagivendata.
   i) Transferbyteandworddatafromsourcetodestination memory.
   ii) Countevenand oddnumbersfromgivenarrayoftenbytes.
   iii) FindLargestandSmallestnumberfromgivenarrayofwords.
   iv) Sort thegivenarrayin ascendingorder,descendingorder.
3. MultiplicationandDivision
   i) UseMULandIMULforUnsignedandsignedmultiplicationon8bitand16 bitsets.
   ii) UseDIVand IDIVfor Unsignedandsigneddivisionon8bitand16 bitdatasets.
   iii) Obtaingivendecimalnumberto unpacked BCD ex: 123410 as01,02,03,04and store inmemoryusingDIV.
   iv)FindFactorialofagivennumberusingmultiplicationinstructions.
4. Singlebyte,multibyteBinaryandBCDadditionandsubtraction.
5. Codeconversions.
   i) BCDUnpacked toPacked BCD code.
   ii) ASCIIcodetoBCDcode.
   iii) BCDtoASCII code.
6. StringSearchingandSorting.(Usingstringinstructions)
   i) Find numberofrepetitionsofacharacterinastring.
   ii)Findandreplaceacharacterinthegivenstring.
   iii) Convert Case ofagivenstring.

iv) Findwhether givenstringispalindromeornot.

PARTB

[Experimentsfor8051usinganyC-CrossCompiler&appropriatehardware]

1.Familiarityand useof8051/8031 microcontroller trainer,andexecutionofprograms.
2.Instructionsetforsimpleprograms(using4to5linesofinstructioncode).
3.Timer andcounteroperations&programmingusing8051.
4.SerialcommunicationsusingUART.
5.Programmingusinginterrupts.
6.Interfacing8051 withDACtogeneratewaveforms.
7. Interfacingtrafficsignalcontrolusing8051.
8.Programtocontrolstepper motorusing8051.
9. ADC interfacingwith8051.
10. SerialRTCinterfacingwith8051.
11. LCDinterfacingwith8051.

NOTE:1. At least ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and 5 from Part B is compulsory.
3. In Part-B, perform the experimentsusingassemblersimulatorslike edsim51/Keil software.

SYSTEMS ANDSIGNALPROCESSINGLAB

PC456EC

Instruction:2periodsperweek *Duration of SEE: 3 hours*
CIE:25marks *SEE:50 marks*
Credits: 1

Course Objectives:

1. To develop C & MATLAB programs for operation of sequences.
2. To implementthealgorithms ofDFT,IDFT,FFTand IFFT on discrete time signals
3. To design and obtain the frequency response of various digital filters.

Course Outcomes: Onsuccessful completionofthe course,the studentswillbeableto

1.develop MATLAB files for the verification of system response.
2.design and analyze the digital filters using MATLAB
3.verify the functionality of FFT algorithms.
4.experiment with multirate techniques using MATLAB & CCS
5.design and implement the digital filters on DSP processor

PART-A

Listof Signal ProcessingExperiments

PerformthefollowingprogramsusingMATLABSimulator

1. IntroductiontoMATLABandsignalgeneration.
2. PerformLinear Convolution.
3. PerformCircular Convolutions.
4. PerformDFTand FFT algorithm
5. PerformFIRfiltersdesignusingdifferentwindow functions.
6. PerformIIRfiltersdesign:Butterworthand Chebyshev, LPF, HPF, BPF & BSF filter.
7. PerformInterpolationand Decimation.
8. Implementationofmulti-rate systems.

PART-B

Listof DSPProcessorExperiments

ImplementthefollowingexperimentsusingDSK (TMS320C67XX)

1. IntroductiontoDSP processors andStudyofproceduretowork in real-time.
2. ImplementSolutionofdifference equations
3. Implement ImpulseResponse.
4. ImplementLinear Convolution.
5. ImplementCircular Convolution.
6. ImplementFastFourierTransform Algorithms.
7. Design of FIR (LP/HP) USING windows: (a) Rectangular (b) Triangular(c)Hammingwindows.
8. DesignofIIR(HP/LP) filters.

NOTE:

1. Atleasttenexperimentstobeconductedinthe semester.
2. Minimumof5fromPartAandPartBis compulsory.
3. ForSection-A‘MATLABwithdifferenttoolboxeslikesignal processing.
4. BlocksetandSIMULINK/MATHEMATICA/anypopularsoftwarecanbe used.

MINI PROJECT

PW701EC

Instruction: 2 periods per week *Duration of SEE: NA*
CIE: 50 marks *SEE: NA*
Credits: 2

Course Objectives:

1.	To conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
2.	To provide training in soft skills and also train them in presenting seminars and technical report writing.
3.	To design, implement and test the prototype/algorithm in order to solve the conceived problem.

Course Outcomes: On successful completion of the course, the students will be able to

1.	get practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2.	gain working practices within Industrial/R&D Environments
3.	prepare reports and deliver effective presentation.
4.	demonstrate effective written and oral communication skills
5.	innovate in various engineering disciplines and nurture their entrepreneurial ideas.

Guidelines for Mini Project

1. The mini-project is a team activity having maximum of 3 students in a team. This is electronic product design work with a focus on electronic circuit design.

2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.

3. Mini Project should cater to a small system required in laboratory or real life.

4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.

5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.

6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.

7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

SCHEMEOFINSTRUCTION&EXAMINATION
B.E.VI-Semester
(ELECTRONICS AND COMMUNICATIONENGINEERING)

S.No.	Course Code	CourseTitle	Schemeof Instruction				Schemeof Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration inHrs	
TheoryCourse										
1	PC413EC	DigitalCommunication	3	-	-	3	30	70	3	3
2	PC414EC	VLSIDesign	3	-	-	3	30	70	3	3
3	PC415EC	Data Communication andComputerNetworks	3	-	-	3	30	70	3	3
4	PE5XXEC	ProfessionalElective-I	3	-	-	3	30	70	3	3
5	PE5XXEC	ProfessionalElective-II	3	-	-	3	30	70	3	3
6	OE6XXYY	OpenElective-I	3	-	-	3	30	70	3	3
Practical/LaboratoryCourse										
7	PC458EC	Communication SystemsLab	-	-	2	2	25	50	3	1
8	PC459EC	Digital Integrated Circuits Lab	-	-	2	2	25	50	3	1
9	PC460EC	Data Communication andComputerNetworksLa b	-	-	2	2	25	50	3	1
*10	*PW701EC	*SummerInternship	-	-	-	-	*50		-	*2
Total			**18**	**-**	**6**	**24**	**255**	**570**	**27**	**21**

PC: ProfessionalCore **PE:**ProfessionalElective
OE:OpenElective **PW:**ProjectWork
L:Lecture **T:**Tutorial **P:**Practical
CIE: ContinuousInternal Evaluation **SEE:**SemesterEndExamination(Univ.Exam)
EC: ElectronicsandCommunicationEngineering

Note:

1. Eachcontact houris aclock hour.
2. The duration of the practical class is two clock hours, however it can beextendedwherevernecessary,toenable thestudenttocompletetheexperiment.
3. *The students have to undergo a Summer Internship of four to six weeksduration after VI semester and credits will be awarded in VII semesterafter evaluation.

ProfessionalElective-I		
S. No.	**Course Code**	**Course Title**
1	PE501EC	DigitalImageandVideoProcessing
2	PE502EC	AdvancedMicrocontrollers
3	PE503EC	PythonProgramming and Applications
4	PE504EC	NeuralNetworks

ProfessionalElective-II		
S.No.	**Course Code**	**Course Title**
1	PE505EC	FPGAArchitectures
2	PE506EC	Advanced DigitalSignalProcessing
3	PE507EC	CMOSAnalogICDesign
4	PE508EC	IoTsystemDesignand Applications

OpenElective-I		
S. No.	**Course Code**	**Course Title**
1	OE611AE	BasicsofAutomobileEngineering(NotforMech./Prod./AutomobileE ngg.students)
2	OE601CE	DisasterMitigation(NotforCivilEngg.Students)
3	OE601CS	OperatingSystems(Not forCSEStudents)
4	OE602CS	OOPusing Java(NotforCSEStudents)
5	OE601EE	ElectricalEnergyConservationandSafety(NotforEEE&EIEStudents)
6	OE602EE	ReliabilityEngineering(NotforEEE&EIEStudents)
7	OE601EG	SoftSkills& InterpersonalSkills
8	OE601IT	DatabaseSystems(NotforITStudents)
9	OE602IT	DataStructures(NotforITStudents)
10	OE601LW	CyberLawandEthics
11	OE611ME	IndustrialRobotics (NotforMech./Prod./AutomobileEngg.students)
12	OE602MB	HumanResourceDevelopmentandOrganizationalBehaviour
13	OE601EC	PrinciplesofElectronicCommunication(NotforECEstudents)
14	OE602EC	DigitalSystemDesignusingVerilogHDL(NotforECEStudents)

DIGITAL COMMUNICATION

PC413EC

Instruction:3periodsperweek *Duration of SEE:3 hours*
CIE:30marks *SEE:70 marks*
Credits: 3
Prerequisites:Probability Theory and Stochastic Processes (ES304ES)
Analog Communication (PC410EC)

Course Objectives:

1.	To introduce the concepts of optimum receiver, baseband digital data transmission and analyze the error performance of different digital carrier modulation schemes like ASK, FSK, PSK etc.
2.	To familiarize the students with the concepts of information theory, basic source coding and channel coding techniques.
3.	To familiarize the students with the concepts of spread spectrum communication with emphasis on DSSS and FHSS.

Course Outcomes: Onsuccessful completionofthe course,the studentswillbeableto

1.	understand the design of optimum receiver and analyze the Performance of Baseband and Band pass Modulation schemes based on Probability of error.
2.	apply concepts of Information theory and assess information capacity of various channels.
3.	encode the source alphabet using Shannon Fano and Huffman encoding methods.
4.	distinguish different types of Error control codes along with their encoding/decoding algorithms.
5.	understand generation of PN sequence and analyze the performance of Spread Spectrum communication systems.

UNIT– I
Introduction to Digital Communication: Elements of Digital Communication System**,** Comparison of Digital and Analog Communication Systems. **Detection and Estimation:** Receiver structure,Detection of signals in the presence of noise **-** Gaussian error probability, optimum receiver – matched filter, Gram-Schmidt orthogonalization procedure, correlation receiver, Maximum Likelihood decoding. **Base band digital data transmission –** Block diagram, Inter Symbol Interference, Nyquist criterion for Zero ISI, Eye pattern.
UNIT– II
Digital Carrier Modulation Schemes — Description and generation of ASK, FSK, PSK. Signal Constellation, Coherent detection of Binary ASK, FSK, PSK. DPSK. Comparison of digital carrier modulation schemes. **M-arysignaling schemes:** Introduction, QPSK- generation and detection, Signal Constellation, Synchronization methods.
UNIT– III
Information Theory and Source Coding: Uncertainty, Information, entropy, information rate.. Discrete memory less channel – Probability relations in a channel, priori & posteriori entropies, Joint entropy, conditional entropy, mutual information, Channel capacity - Binary Symmetric

Channel, Binary Erasure Channel, cascaded channels, Shannon-Hartley Theorem – Shannon Bound. **Source coding:** Shannon – Fano and Huffman coding.
UNIT– IV
Channel Coding: Introduction to error correcting codes,types of transmission errors, need for error control coding. **Linear Block Codes (LBC):** Matrix description of LBC, generation, Syndrome calculation and error detection, Minimum distance of Linear block code, error detection and error correction capabilities, Hamming codes. **Binary cyclic codes (BCC):** Polynomials, Algebraic description of cyclic codes, systematic encoding using generator polynomial and parity check polynomial, syndrome calculation, decoding and error correction using shift registers. **Convolution codes:** Encoding, Decoding using code tree, state diagram.
UNIT– V
Spread Spectrum Communication: Advantages of Spread Spectrum, generation and characteristics of PN sequences. Direct sequence spread spectrum and Frequency hopping spread spectrum systems. CDMA, ranging using DSSS. Acquisition and Tracking of DSSS and FHSS signals.

SuggestedReading:

1	Simon Haykin, “Digital Communication”, 4th edition, Wiley India 2011.
2	Sam Shanmugam K, “Digital and Analog Communication systems”, Wiley 1979.
3	B.P.Lathi, “Modern digital and analog communication systems”, 3rd edition, Oxford University Press. 1998.
4	Leon W.Couch II., “Digital and Analog Communication Systems”, 6th edition, Pearson Education inc., New Delhi, 2001.
5	H. Taub, D.L. Schilling, “Principles of communication systems”, Tata McGraw Hill, 2001.

VLSI DESIGN

PC414EC

Instruction: 3 periods per week *Duration of SEE:- 3hours*
CIE: 30 marks *SEE:- 70 Marks*
Credits: 3
Prerequisites: Digital Electronics (ES215EC)

Course Objectives:

1.	To explain electrical properties of MOS devices to analyze the behavior ofinverters designed with various loads.
2.	To give exposure to the design rules to be followed to draw the layout of any logic circuitand Provide concept to design different types of Combinational and sequential circuits
3.	To describe verilog HDL and develop digital circuits using various modeling styles.

Course Outcomes: On successful completion of the course, the students will be able to

1.	analyze modes of operation of MOS transistor and its basic electrical properties.
2.	draw stick diagrams and layouts for any MOS transistors and calculate the parasitic R&C
3.	familiarize with the constructs and conventions of the verilog HDL programming in gate level and data flow modeling.
4.	generalize combinational and sequential logic circuits in behavioralmodeling and concepts of switch level modelling.
5.	analyse the operation of various arithmetic and sequential logic circuits using CMOS transistors

UNIT I
Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS Fabrication Process. **Basic Electrical Properties**: Basic Electrical Properties of MOS: Ids- Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design.
UNIT –II
VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates. Basic circuit concepts, Sheet Resistance R_S and its concept to MOS, Area Capacitance Units, Calculations – RC Delays.
UNIT- III
Introduction to HDLs: Basic Concepts of Verilog, Data types, system tasks and compiler directives. Gate level modeling: Gate types and gate delays, dataflow modeling: Continuous assignments and Delays. Design of stimulus blocks. Design of Arithmetic Circuits using Gate level/ Data flow modeling –Adders, Subtractors, 4- bit Binary and BCD adders and 8-bit Comparators.
UNIT – IV

Behavioral modeling: Structured Procedures, Procedural Assignments, Timing Control, Conditional Statements, Sequential and parallel blocks, generate Blocks, Switch level modeling. Behavioral modeling of sequential logic modules: Latches, Flip Flops, counters and shift registers applications Tasks, Functions, Procedural Continuous Assignments, Design of Mealy and Moore FSM models for sequence detector using Verilog. Logic Synthesis, Synthesis Design Flow, Gate level netlist
UNIT –V
Subsystem Design: Shifters, Carry skip adder, carry select adder , Booth Multiplier, Memory Elements: 6T SRAM cell, 1T DRAM cell. **Sequential Logic Design**: Behavior of Bi-stable elements, CMOS D latch and Edge triggered Flip flops.

Suggested Reading:

1.	Kamran EshraghianDougles and A. Pucknell, ‘Essentials of VLSI circuits and systems’, PHI, 2005Edition
2.	Weste and Eshraghian ‘Principles of CMOS VLSI Design’, Pearson Education, 2^{nd}edition,1999.
3.	John .P. Uyemura, ‘Introduction to VLSI Circuits and Systems’, JohnWiley, 2003
4.	John M. Rabaey, ‘Digital Integrated Circuits’, PHI, EEE, 1997.
5.	Wayne Wolf, ‘Modern VLSI Design’, Pearson Education, 3^{rd}edition, 1997

DATA COMMUNICATION AND COMPUTER NETWORKS

PC415EC

Instruction: 3 periodsperweek *Duration of SEE: 3 hours*
CIE:30 marks *SEE: 70marks*
Credits: 3
Prerequisites: Digital Electronics(ES215EC)
Analog Communication (PC410EC)

Course Objectives:

1. To understand concepts of switched communication networks and functions of each layer of OSI model for layered architecture and introduce TCP/IP suite of protocols.
2. To understand performance of data link layer protocol for flow and error control.
3. To understand different routing protocols, and various networked applications such as DNS, FTP, www architecture and network security.

Course Outcomes: On successful completion of the course, the students will be able to

1. study function of layers in OSI model and understand various network topologies.
2. understand network layer protocols, IP addressing and internetworking.
3. understand transport layer working with TCP, and UDP.
4. understand functionality of application layer and its protocols
5. understand the importance of network security principles.

UNIT-I
Introduction to Data communication: A Communication Model, The Need for Protocol Architecture and Standardization, Network Types: LAN, WAN, MAN. Network Topologies: Bus, Star, Ring, Hybrid, Line configurations. Reference Models: OSI, TCP/IP. Transmission modes, DTE-DCE Interface, Transmission media- Guided media, Unguided media, Circuit Switching principles and concepts, Virtual circuit and Datagram subnets.
UNIT-II
Data Link Layer: Need for Data Link Control, Design issues, Framing, Error Detection and Correction, Flow control Protocols: Stop and Wait, Sliding Window, ARQ Protocols, HDLC. MAC Sub Layer: Multiple Access Protocols: ALOHA, CSMA, LAN- IEEE 802.2, 802.3, Wireless LAN- 802.11, 802.15, 802.16 standards. Bridges and Routers.
UNIT-III
Network Layer: Network layer Services, Routing algorithms: Shortest Path Routing, Flooding, Hierarchical routing, Broadcast, Multicast, Distance Vector Routing, and Congestion Control Algorithms. Internet Working: The Network Layer in Internet: IPV4, IPV6, Comparison of IPV4 and IPV6, IP Addressing.
UNIT-IV
Transport Layer: Transport Services, Elements of Transport Layer, Connection management, TCP and UDP protocols, ATM AAL Layer Protocol.
UNIT-V
Application Layer: Domain Name System, SNMP, Electronic Mail, World Wide Web. **Network Security**: Cryptography Symmetric Key and Public Key algorithms, Digital Signatures, Authentication Protocols.

Suggested Reading:

1.	Behrouz A. Forouzan, “Data Communication and Networking,”3/e, TMH, 2008.
2.	William Stallings, “Data and Computer Communications,” 8/e, PHI, 2004.
3.	Andrew S Tanenbaum, “Computer Networks,” 5/e, Pearson Education, 2011.
4.	Douglas E Comer, “Computer Networks and Internet”, 5/e, Pearson Education Asia, 2009.
5.	Prakash C. Gupta, “Data Communications and Computer Networks”, 2/e, PHI learning, 2013.

PROFESSIONAL ELECTIVE-I

DIGITAL IMAGE AND VIDEO PROROCESSING

PE501EC

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3
Prerequisites: Digital Signal Processing(PC408EC)

Course Objectives:

1.	To provide an introduction to the basic concepts and methodologies for Digital Image and Video processing.
2.	To acquaint with spatial and transform domain techniques used in Image Enhancement and to gain knowledge about various Image compression and segmentation methods.
3.	To study applications of motion estimation in video processing.

Course Outcomes: On successful completion of the course, the students will be able to

1.	develop a foundation that can be used as the basis for higher study and research in the Image and Video processing areas.
2.	design various filters for processing of images without destroying fine details like edges and lines.
3.	apply image processing techniques for processing and analysis of remotely sensed, Microscope, Radar and Medical images
4.	understand the requirement for various image and video compression algorithms.
5.	understand and analyze the performance of block matching algorithms in video coding standards.

UNIT – I
Fundamentals of Image Processing: Basic steps in Image Processing, Sampling and Quantization of an image, Relationship between pixels. **Image Transforms**: 2D- Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform and Hoteling Transform.
UNIT – II
Image Processing Techniques: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. **Frequency domain methods:** Basics of filtering in frequency domain, Image smoothing, Image sharpening, Selective filtering.
UNIT – III
Image Compression: Functional Block diagram of a general image compression system, Various types of redundancies, Huffman coding, Arithmetic coding. **Segmentation:** Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region based segmentation.
UNIT – IV
Basic concepts of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image formation, sampling of video signals, filtering operations.
UNIT – V

2-D Motion Estimation: Optical flow, Pixel Based Motion Estimation, Block Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, multi resolution motion estimation. Application of motion estimation in Video coding.

Suggested Reading:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson Education, 2009, 3rd edition.
2. Yao Wang, Joern Ostermann, Ya-quin Zhang, ‘Video processing and Communication’, 1st edition, Prentice Hall International.
3. Vipul Singh, 'Digital Image Processing with MATLAB and Lab view', Elsevier 2013.
4. Anil K Jain, 'Fundamentals of Digital Image Processing', Prentice-Hall of India Private Limited, New Delhi, 1995.
5. M. Tekalp,‘Digital Video Processing’, Prentice Hall International,1995.

ADVANCED MICROCONTROLLERS

PE502EC

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3
Prerequisites: Microprocessor & Microcontroller (PC409EC)

Course Objectives:

1. To describe industry standard ARM microcontroller architecture.
2. To explain ability of programming ARM using Assembly language and Embedded C.
3. To discuss the Bus Architecture of ARM microcontroller.

Course Outcomes: On successful completion of the course, the students will be able to

1. illustrate the basic architecture of ARM.
2. analyse the instruction set of ARM and thumb instructions.
3. understand basic Embedded C concepts and multitasking.
4. program and interface the ARM with peripheral devices using Assembly Language and C.
5. understand the advance microprocessor bus architecture (AMBA).

UNIT – I
Introduction: Introduction to advanced microcontrollers, Difference between RISC and CISC architectures, Endianness (Little and Big), Design philosophy of RISC and ARM architectures. History of ARM microprocessor, ARM processor family, Development of ARM architecture. **The ARM Architecture and Programmers' Model:** The Acorn RISC Machine, ARM core data flow model, architectural inheritance, The ARM7 TDMI programmer's model: General purpose registers, CPSR, SPSR, ARM memory map, data format, load and store architecture, Core extensions, Architecture revisions, ARM development tools.
UNIT – II
ARM Instruction Set: Data processing instructions, Arithmetic and logical instructions, Rotate and barrel shifter, Branch instructions, Load and store instructions, Software interrupt instructions, Program status register instructions, Conditional execution, Multiple register load and store instructions, Stack instructions, Thumb instruction set, advantage of thumb instructions, Assembler rules and directives.
UNIT – III
Basics of Embedded C : Overview of C compiler and optimization, Basic data types, Looping and branching, Register allocations, function calls, pointer aliasing, structure arrangement, bit fields, unaligned data, Division, floating point, Inline functions and inline assembly, Portability issues, Multitasking.
UNIT – IV
Assembly and C Programming for ARM: Assembly language programs for shifting of data, factorial calculation, swapping register contents, moving values between integer and floating point registers. C programs for General purpose I/O, general purpose timer, PWM Modulator, UART, I2C

Interface, SPI Interface, ADC, DAC.
UNIT – V
Advanced Microprocessor Bus Architecture (AMBA): Advanced Microprocessor Bus Architecture (AMBA), AMBA Bus System, User peripherals, Exception handling in ARM, and ARM optimization techniques.

Suggested Reading:

1.	Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide: Designing & Optimizing System Software", Elsevier, 2004.
2.	Muhammad Ali Mazidi, "ARM Assembly Language Programming & Architecture", Kindle Edition, 2013.
3.	William Hohl, Christopher Hinds, "Arm Assembly Language: Fundamentals and Techniques", 2nd Edition, CRC Press, 2014.
4.	Michael J. Pont, "Embedded C", Pearson Education India, 1st Edition, 2007.
5.	Dr.Yifeng Zhu, "Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C", E-Man Press LLC, 3rd Edition, 2017.

PYTHON PROGRAMMING AND APPLICATIONS

PE503EC
Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3
Prerequisites: Network Theory (PC402C), Signals and Systems(PC405EC)

Course Objectives:

1. To acquire programming skills by learning Syntax, Semantics and Regular expressions in core Python.
2. To analyse electronic circuits and examine the various signal transformation techniques using Python
3. To build IoT solutions using MicroPython running on small, dedicated microcontroller boards

Course Outcomes: On successful completion of the course, the students will be able to

1. build basic programs using fundamental programming constructs like variables, conditional logic, looping, and functions
2. examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
3. create, run and manipulate Python Programs using core data structures like Lists, dictionaries and use Regular Expressions
4. develop programs in Python for implementation of non-linear circuits and analyze filters.
5. program their own IoT solutions in Python using MicroPython on small microcontroller boards.

UNIT-I
Introduction to Python: History of Python, Need of Python programming, Features of python, Python basics: Tokens, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure **Functions:** default values of arguments, named arguments, local and global variables, **Modules**: creating, documenting and Importing modules, Use of standard modules.
UNIT-II
Lists:basic lists,creating and processing list of lists, Tuples, Dictionaries **Data structures**: Implementation of stacks and sets, binary search trees, Graph searching, working on sequences- reversing, permuting, sorting, Data Visualization: Different types of charts and graphs, selection of correct data visualization elements, software and tools available for data visualization.
Unit-III
Python Installation and Packages: Introduction to PIP, installing and uninstalling packages via PIP, Using python Packages: Numpy, Matplotlib, Scipy. **Circuit analysis**: Operations on vectors and matrices, Circuit representation, processing of components, Data structures of components, Introduction to Nodes, Branches and Loops, Loop and Nodal analysis. **Case study**: Model circuits and perform nodal analysis and loop analysis using **Lcapy(**open-source) Python package for solving linear circuits using matrix operations.
Unit- IV

Signal Analysis: Representation Continuous time signals, Discrete time signals, Python Implementation of sampling, Fourier Transform, Laplace transform, Z-transform, Discrete Fourier Transform, Fast Fourier transform, Design of LTI filters, FIR filters and IIR filters using Python **Case study:** Cleaning Up Data Noise with Fourier Transform using Python
Unit-V
MicroPython : Introduction, Installing and running MicroPython, **Pyboard**- Architectural overview and Networking, hardware features of BBCmicro:bit, Overview of MicroPython libraries **Case study:** Traffic light simulation using MicroPython

Suggested Reading:

1.	Michael Urban and Joel Murach, "Python Programming", Mike Murach& Associates, Incorporated, 2016.
2.	Kalilur Rahman, "Python Data Visualization Essentials Guide", BPB publications,2021.
3.	Shivkumar V. Iyer , " Simulating Nonlinear Circuits with Python Power Electronics-An Open-Source Simulator, Based on Python, Springer International Publishing, 2018.
4.	Thomas Haslwanter, "Hands-on Signal Analysis with Python: An Introduction",Springer International Publishing, 2021.
5.	Charles Bell, "MicroPython for the Internet of Things A Beginner's Guide to Programming with Python on Microcontrollers", Apress, 2017

NEURAL NETWORKS

PE501EC

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3
Prerequisites:Probability Theory and Stochastic Processes (ES304ES)

Course Objectives:

1.	To understand the functioning of biological neuron and its electronic implementation using different neuron models
2.	To acquire knowledge on learning algorithms, architecture of deep learning, CNN and transfer learning.
3.	To implement simple neural network using python programming.

Course Outcomes: On successful completion of the course, the students will be able to

1.	differentiate between biological neuron & artificial neuron and different neuron models
2.	apply learning algorithms and different feed forward neural networks
3.	understand deep learning concepts and its architectures.
4.	learn concepts of CNN and transfer learning techniques.
5.	develop programs in Python for implementation of neural networks models

UNIT – I
Introduction to Neural Networks: Description of Biological Neuron, Mathematical model of Artificial Neural Network, Classification of Neural Networks, Different Neuron models: McCulloch-Pitts Neuron model, Perceptron Neuron model and ADALINE Neuron model, Basic learning laws.
UNIT – II
Neural Networks Algorithms: Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient decent, Curse of Dimensionality.
UNIT – III
Introduction to Deep Learning & Architectures: Machine Learning Vs. Deep Learning, Representation Learning, Width Vs. Depth of Neural Networks, Activation Functions: Sigmoid, RELU, LRELU, ERELU, Tanh. Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Autoencoders.
UNIT – IV
Convolution Neural Networks: Architectural Overview – Motivation - Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet . Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.
UNIT – V
Python programming: Python basics, Arrays and array operations, Functions and Files, Simple implementation of Artificial Neural Network, Classification with Multilayer Perceptron using Scikit-learn (MNIST Dataset).

Suggested Reading:

1.	B. Yeganaranarana, "Artificial Neural Networks", Eleventh EditionPrentice Hall, New Delhi, 2007.
2.	Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2017.
3.	Subir Varma and Sanjiv Das," Deep Learning" , 1st Edition, Published by Bookdown , 2018.
4.	Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
5.	Ahmed Gad and Fatima Jarmouni, "Introduction to Deep Learning and Neural Networks with Python," A Practical Guide by Elsevier 1st Edition, 2020.

PROFESSIONAL ELECTIVE-II

FPGA Architectures

PE505EC

Instruction:3periodsperweek *Duration of SEE:3 hours*
CIE:30marks *SEE:70 marks*
Credits: 3
Prerequisites: Digital Electronics (ES303EC)

Objectives:

1.	To discuss about ApplicationSpecificIC(ASIC)fundamentals and FPGA
2.	To describe thepowerconsumptionin IC design
3.	To discuss about the interconnection, placementandrouting, verificationandtestingschemes.

Outcomes: Onsuccessfulcompletionofthecourse,the studentswillbeableto

1.	understandthedesignflowofASICsandidentifytheimplementationtoolsrequiredforsimulationandsynthesisof FPGADesign.
2.	demonstrate thearchitectureofFPGAs.
3.	explainthephysical designofFPGAsandCADtoolsforlowlevel designentry.
4.	Identifytheplacement&routingalgorithms.
5.	validatethedigitaldesignandanalyse thegeneraldesignissues.

UNIT– I
IntroductiontoASICs: TypesofASICs,ASICdesignflow,EconomiesofASIC's,Programmable ASICs: CPLD and FPGA. Commercially available CPLDs and FPGAs: XILINX,ALTERA,ACTEL.FPGADesigncycle,Implementationtools:Simulationandsynthesis,Programmingtechnologies.Applicationsof FPGAs.
UNIT– II
FPGA logic cell for XILINX, ALTERA and ACTEL ACT, Technology trends, Programmable I/Oblocks,FPGAinterconnect:Routingresources,Elmore'sconstant,RCdelayandparasiticcapacitance,FPGAdesignflow,DedicatedspecializedcomponentsofFPGAs.
UNIT– III
FPGA physical design, CAD tools, Power dissipation, FPGA Partitioning, Partitioning methods.Floorplanning:I/O,Powerandclockplanning,Low-leveldesign entry.
UNIT– IV
Placement and Routing: Placementalgorithms:Min-cutbasedplacement,IterativeImprovementandsimulatedannealing. Routing: introduction,Globalrouting:Globalroutingmethods,Back-annotation. Detailed Routing: Channel density, Segmented channel routing,Mazerouting,Clockandpowerrouting,CircuitextractionandDRC.

UNIT– V
Verification and Testing: Verification: Logic simulation, Design validation, Timing verification.Testing concepts: Failures, mechanism and faults, and fault coverage. Design Applications: GeneralDesign issues, Counter Examples, Case study of adders and accumulator architectures with XilinxVivadotool.

Suggested Reading:

1	Michael John Sebastian Smith, "Application Specific Integrated Circuits", PearsonEducationAsia,3rd edition, 2001.
2	Pak and Chan, Samiha Mourad, "Digital Design using Field Programmable Gate Arrays",PearsonEducation,1st edition, 2009
3	S.Trimberger,Edr, "FieldProgrammableGateArrayTechnology",KluwerAcademicPublications,1994.
4	John V. Oldfield, Richard C Dore, "Field Programmable Gate Arrays", WileyPublications.
5	CliveMaxfield, "TheDesignWarrior'sGuidetoFPGAs‟,Elsevier,2004.

ADVANCED DIGITAL SIGNAL PROCESSING

PE506EC

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3
Prerequisites: Digital Signal Processing (PC408EC)

Course Objectives:

1.	To comprehend characteristics of discrete time signals and systems
2.	To analyze signals using various transform techniques
3.	To identify various factors involved in design of digital filters

Course Outcomes: On successful completion of the course, the students will be able to

1.	design FIR and IIR filters structure for different applications
2.	design FIR and IIR type digital filters with error analysis
3.	interpret various DSP algorithms for arithmetic operations
4.	identify filter structures and evaluate the coefficient quantization effects
5.	estimate power spectrum of signals using different methods

UNIT – I
Digital Filter Structures:FIR filters - Direct form, Cascade form, Frequency sampling, Lattice IIR filter - Direct form I, Direct form II, Cascade form, Parallel form Lattice & Lattice loader, Quantization of filter coefficients - Sensitivity to Quantization of filter coefficients, Quantization of coefficients in FIR filters, Round off effects in digital filters - Limit cycle, scaling to prevent overflow.
UNIT – II
Digital Filter Design: Linear phase FIR filter, characteristic response, location of zeros, Design of FIR filter - Windowing, Frequency sampling, Design of IIR filters from Analog filters - Impulse invariance, Bilinear transformation, Matched z-transform. Spectral transformations of IIR filters – FIR filter design –based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least –square design of FIR digital filters.
UNIT – III
DSP Algorithm Implementation: ComputationofthediscreteFouriertransform, Numberrepresentation, arithmeticoperations, handlingofoverflow, tunabledigitalfilters, functionapproximation.
UNIT – IV
Analysis of Finite Word Length Effects: TheQuantizationprocessanderrors, Quantizationoffixed–pointandfloating–pointNumbers, AnalysisofcoefficientQuantization effects, Analysis of Arithmetic Round-off errors, Dynamic range scaling, signal-to-noise in Low-order IIR filters, Low-Sensitivity Digital filter, Reduction ofProductround-offerrorsfeedback, LimitcyclesinIIRdigitalfilter, Round-offerrors inFFTAlgorithms.
UNIT – V

Power Spectrum Estimation: Estimation of spectra from finite duration observationsignals, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods. Parametric Method of Power Spectrum Estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models.

Suggested Reading:

1	John G.Proakisand DimitrisG. Manolakis, “Digital Signal Processing-Principles,Algorithms and Applications”, PHI, 3rdedition, 2002.
2	AlanV.Oppenheim and Ronald W.Schafer , “DiscreteTimeSignalProcessing” 3rdEdition, PHIPublications.
3	Glenn Zelniker,Fred J. Taylor, “AdvancedDigitalSignalProcessing-TheoryandApplications”, CRC Press.
4	Li Tan, “Digital Signal Processing-Fundamentals and Applications”, Academic Press Publications.
5	nanuel C. Ifeacher, Barrie. W. Jervis, “DSP – A Practical Approach”, 2ndedition, Pearson Education.

CMOS ANALOG IC DESIGN

PE507EC

Instruction: 3 periods per week *Duration of SEE:- 3hours*
CIE: 30 marks *SEE:- 70 Marks*
Credits: 3
Prerequisites: VLSI Design (PC414EC)

Course Objectives:

1.	To develop models of basic CMOS amplifiers and Learn the concepts of advanced current mirrors.
2.	To design and analyse differential amplifier and two-stage operational amplifier.
3.	To study the Bandgap Reference circuits.

Course Outcomes: On successful completion of the course, the students will be able to

1.	describe the small signal model of MOSFET and analyse the Single Stage Amplifiers.
2.	analyse the differential amplifiers with MOS Loads and Current mirror loads.
3.	analyse the frequency response of amplifiers.
4.	design a fully compensated opamp and analyse the frequency response of the opamp.
5.	analyse the bandgap reference circuits.

UNIT I
Basic MOS device Physics: MOS FET device I/V characteristics, second order effects, MOS device Capacitances, MOS small signal Model, NMOS verses PMOS devices. **Single stage amplifiers:** Common source stage with resistive load, diode connected load, triode load, current source load, CS stage with source degeneration, source follower, Common Gate stage, Gain boosting techniques, Cascode, folded cascode, choice of device models.
UNIT –II
Differential amplifiers: Single ended and differential operation, Basic differential pair, Common mode response, Differential amplifier with MOS loads, Gilbert cell. **Passive and Active Current mirrors:** Basic Current mirrors, Cascode Current mirrors, Active Current mirrors, Wilson and Widlar current mirrors
UNIT- III
Frequency Response of Amplifiers: General Considerations, Common-Source Stage, Source Followers, Common–Gate Stage, Cascode Stage, Differential Pair.
UNIT – IV
Operational Amplifiers: General Considerations, One stage Op-amp, 2- stage OP amp, Gain Boosting, Common mode feedback, Phase Margin, Frequency compensation.
UNIT –V
Band Gap References: General considerations, Supply independent biasing, temperature-independent references, negative-TC voltage, positive TC voltage, Bandgap reference, PTAT current generation.

Suggested Reading:

1.	Behzad Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw Hill. 2002
2.	Jacob Baker.R.et.al., CMOS Circuit Design, IEEE Press, Prentice Hall, India, 2000
3.	David Johns, Ken Martin, Analog Integrated Circuit Design, John Wiley & sons. 2004
4.	Philip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, International Second Edition/Indian Edition, 2010.
5.	Paul.R. Gray & Robert G. Major, Analysis and Design of Analog Integrated Circuits, John Wiley & sons. 2004

IoT SYSTEM DESIGN AND APPLICATIONS

PE508EC

Instruction: 3periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3
Prerequisites:MicroProcessor and MicroController(PC409EC)

Course Objectives:

1. To discuss fundamentals of IoT and its applications and requisite infrastructure.
2. To describe Internet principles and architecture and applications relevant to IoT.
3. To discuss private and security aspects of IoT system.

Course Outcomes: On successful completion of the course, the students will be able to

1. understand IoT technology and research directions.
2. comprehend various protocols and architecture of IoT
3. design simple IoT systems with IoT reference model
4. understand the various applications of IoT
5. comprehend the different privacy and security approaches at IoT.

UNIT – I
IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.
UNIT – II
M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
UNIT – III
IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
UNIT – IV
IoT Applications: Introduction, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi - Controlling LED and LDR using Pi, Opinions on IoT Application and Value for Industry, Home Management, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and eHealth.
UNIT – V
Internet of Things Privacy: Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Suggested Reading:

1	Vijay Madisetti and ArshdeepBahga, 'Internet of Things (A Hands-on-Approach)',1st edition, VPT, 2014.
2	Francis daCosta, 'Rethinking the Internet of Things: A Scalable Approach to Connecting Everything', 1st edition, Apress Publications, 2013.
3	Cuno Pfister, 'Getting Started with the Internet of Things', O‟Reilly Media, 2011.
4	Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley India Publishers,2014.
5	Vermesan, Ovidiu and Peter Friess, eds. Internet of things: converging technologies for smart environments and integrated ecosystems. River publishers, 2013.

OPEN ELECTIVE-1

PRINCIPLESOFELECTRONICCOMMUNICATION

OE601EC

Instruction:3periodsperweek *Duration of SEE:3 hours*
CIE:30marksSEE:70 marks
Credits: 3

Course Objectives:

1. To provide an introduction to fundamental concepts in the understanding of communications systems.
2.To describe the networkmodel andsome ofthenetworklayers includingphysicallayer,datalinklayer,networklayerandtransportlayer.
3.To discuss the evolution of wireless systems and current wireless technologies.

Course Outcomes: Onsuccessfulcompletionofthecourse,the studentswillbeableto

1.understandthe workingofanalogand digital communicationsystems.
2.explain the OSInetwork model and theworkingof data transmission.
3.describe the evolutionof communicationtechnologiesfromtraditional telephony systemstomodernwirelesscommunicationsystems.
4.differentiate between analog and digital modulation techniques
5.understand the optical fiber communication link, structure, propagation and transmission properties.

UNIT– I
Introduction to Communication systems: Electromagnetic Frequency Spectrum, Signal and itsrepresentation,ElementsofElectronicCommunicationsSystem,TypesofCommunicationChannels. Signal Transmission Concepts: Baseband transmission and Broadband transmission,CommunicationParameters:Transmittedpower,ChannelbandwidthandNoise,NeedformodulationSignalRadiationandPropagation:Principleofelectromagneticradiation,TypesofAntennas,AntennaParametersandMechanismsofPropagation.
UNIT– II
AnalogandDigitalCommunications:Amplitudemodulationanddemodulation,FMmodulationand demodulation,Digitalconverters,Digitalmodulationschemes–ASK,FSK,PSK,QPSK, Digitaldemodulation.
UNIT– III
DataCommunicationandNetworking:NetworkModels,OSIModel,DataLinkLayer–MediaAccesscontrol,Ethernet,NetworkLayer–InternetProtocol(IPv4/IPv6),TransportLayer–TCP,UDP.
UNIT-IV
Telecommunication Systems: Telephones, Telephone system, Paging systems, InternetTelephony. OpticalCommunications:OpticalPrinciples,OpticalCommunicationSystems,Fiber–OpticCables,Optical Transmitters&Receivers, WavelengthDivision Multiplexing.
UNIT-V
WirelessCommunications:EvolutionofWirelessSystems:AMPS,GSM,CDMA,WCDMA,OFDM.CurrentWirelessTechnologies:WirelessLAN,Bluetooth,PANandZigBee,Infrared wireless,RFID communication,UWB,Wirelessmeshnetworks,Vehicularadhocnetworks.

SuggestedReading:

1	LouisE.Frenzel, "PrinciplesofElectronicCommunicationSystems",3rd edition,McGrawHill,2008.
2	BehrouzA. Forouzan, "DataCommunicationsandNetworking",5th edition,TMH,2012.
3	George Kennedy, Bernard Davis, "ElectronicCommunicationsystems",4th edition,McGrawHill,1999.
4	RappaportT.S.,"Wirelesscommunications",2nd edition,PearsonEducation,2010.
5	Wayne Tomasi, "Advanced Electronic Communications Systems", 6th edition, Pearson Education.

DIGITALSYSTEMDESIGNUSINGVERILOGHDL

OE602EC

Instruction:3periods perweek *Duration of SEE: 3 hoursCIE:30 marks* *SEE:70marks*
Credits:3

Course Objectives:

1.To familiarize with various modeling styles: structural, dataflow and behavioral ofVerilog HDL.
2.Todevelopcombinationalandsequentialcircuitsusingvariousmodelingstylesof VerilogHDL.
3.ToreviewtheimplementationofVerilogHDLModelingusingrealtimeexamples.

Course Outcomes: Onsuccessfulcompletionofthecourse,the students will beableto

1.implementanddistinguishdifferentVerilogHDLmodelingstyles
2.constructandanalyzeVerilogHDLmodelsofcombinationalandsequentialcircuits.
3.designanddevelopVerilogHDLmodelingandtestbenchfordigitalsystemsforthegivenspecifications.
4.outline FPGAdesignflowandtiminganalysis.
5.understandtherealworlddesignexamples suchasUART,timers,andCPUs.

UNIT-I
Structuralmodeling:OverviewofDigitalDesignwithVerilogHDL,Basicconcepts,modulesandports, gate-levelmodeling,hazardsand design examples.
UNIT-II
DataflowandSwitchlevelmodeling:dataflowmodeling,operandsandoperators.SwitchLevelModeling:CMOSswitches and bidirectionalswitches and design examples.
UNIT-III
BehavioralModeling:StructuredProcedures,ProceduralAssignments,TimingControls,ConditionalStatements,multi-waybranching,Loops,SequentialandParallelblocks,Generate blocks.Combinational,sequentiallogic modulesanddesignexamples.
UNIT-IV
Synthesis and Verification: Tasks and Functions: Differences between Tasks and Functions.Verilog HDL synthesis, Application Specific IC (ASIC) and Field Programmable Gate Array(FPGA)designflow.Verification:TiminganalysisandTestbenchdesign.Designexamples.
UNIT-V
Realtimeimplementations:Fixed-PointArithmeticmodules:Addition,Multiplication,Division,Arithmetic and Logic Unit (ALU), Timer, Universal Asynchronous Receiver and Transmitter(UART),CPUdesign:Datapath andcontrolunits.

SuggestedReading:

1.	SameerPalnitkar, “Verilog HDL AGuide to Digital Design and Synthesis”, 2nd edition,Pearson Education,2006.
2.	Ming-BoLin,“DigitalSystemDesignsandPractices:UsingVerilogHDLandFPGA”,WileyIndiaeditio

	n,2008.
3.	J. Bhasker, AVerilogHDLPrimer,2nd edition, BSPublications, 2001.
4.	CharlesRoth,Lizy.K.John,ByeongKilLee,-Digital SystemsDesignUsingVerilog,1st edition,CengageLearning, 2015.
5.	T.R.Padmanabhan,B.BalaTripuraSundari, "DesignthroughVerilogHDL" ,Studentedition,Wiley Publishers,2008.

COMMUNICATION SYSTEMS LAB

PC458EC

Instruction:2periodsperweek *Duration of SEE:3 hours*
CIE:25marks *SEE:50 marks*
Credits:1

Course Objectives:

1.To demonstrate AM, FM, Mixer, PAM, PWM, PPM and multiplexing techniques.
2.To understand and simulate digital modulation (i.e., ASK, FSK, BPSK, QPSK) generation.
3.To model analog, pulse modulation, PCM, Delta and Digital modulation techniques using CAD tools.

Course Outcomes: Onsuccessful completionofthe course,the studentswillbeableto

1.understand and simulate modulation and demodulation of AM and FM.
2.construct and understand the need for pre-emphasis and de-emphasis at the transmitter and receiver respectively.
3.simulate the PAM, PWM & PPM circuits.
4.understand generation and detection of baseband transmission (i.e., PCM, DM, and ADM) and bandpass transmission (i.e., ASK,FSK,PSK, MSK and QPSK)
5.understand the error control coding.

List of Experiments

PART-A

Analog Communication

1. Amplitude Modulation and Demodulation.
2. Frequency Modulation and Demodulation.
3. Pre-emphasis and De-emphasis and plot the frequency response.
4. Multiplexing Techniques (FDM and TDM).
5. Mixer Characteristics and plot the frequency response.
6. Verification of Sampling Theorem.
7. PWM, PPM generation and detection.
8. Generation and Detection of AM, FM, PAM, PWM, PPM modulation techniques usingMATLAB/Simulink/Lab-view.

PART-B

Digital Communication

1. PCM modulation and demodulation.
2. Channel encoding and decoding.
3. Linear and Adaptive Delta Modulation and Demodulation.
4. ASK generation and Detection.
5. FSK and Minimum Shift Keying generation and Detection.
6. ASK generation and Detection.
7. Generation and Detection of PCM, Delta modulation and Digital modulation schemes (ASK, FSK, BPSK, QPSK) by using MATLAB/Simulink/Lab-view.

NOTE:

1. At least ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and 5 from Part B is compulsory.

DIGITAL INTEGRATED CIRCUITS DESIGN LAB

PC459EC

Instruction: 2 periods per week *Duration of SEE:- 3hours*
CIE: 25 marks *SEE:- 50 Marks*
Credits: 1

Course Objectives:

1.	To develop verilog HDL code for digital circuits using gate level, data flow and behavioral, modeling and Verify the design block using stimulus.
2.	To study the VLSI CAD tools.
3.	To implement transistor level circuits.

Course Outcomes: On successful completion of the course, the students will be able to

1.write the Verilog HDL programs in gate level and data flow modeling.
2.implement combinational and sequential circuits using Verilog.
3.analyse digital circuits using VLSI CAD tools like Mentor Graphics / Cadence
4.design CMOS circuits like basic gates, adders at the transistor level
5. implement the layout of simple CMOS circuits like inverter and basic gates.

List of Experiments:
Part-A

Write the Code using Verilog and simulate the following:

1. Write structural and dataflow Verilog HDL models for
a) 4-bit ripple carry adder.
b) 4-bit carry Adder – cum Subtractor.
c) 2-digit BCD adder / subtractor.
d) 4-bit carry look ahead adder
e) 4-bit comparator

2. Write a Verilog HDL program in behavioral model for
a) 8:1 multiplexer
b) 3:8 decoder
c) 8:3 encoder
d) 8 bit parity generator and checker

3. Write a Verilog HDL program in Hierarchical structural model for
a) 16:1 multiplexer realization using 4:1 multiplexer
b) 3:8 decoder realization through 2:4 decoder
c) 8-bit comparator using 4-bit comparators and additional logic

4. Write a Verilog HDL program in behavioral model for D,T and JK flip flops, shift registers and counters.

5. Write a Verilog HDL program in structural and behavioral models for
a) 8 bit asynchronous up-down counter b) 8 bit synchronous up-down counter

6.Write a Verilog HDL program for 4 bit sequence detector through Moore state machines

7.Write a Verilog HDL program for 4 bit sequence detector through Mealy state machines

PART-B

Transistor Level implementation of CMOS circuits using VLSI CAD tool
1. Basic Logic Gates: Inverter, NAND and NOR
2. Half Adder and Full Adder
3. 2:1 Multiplexer and 4:1 Multiplexer using 2:1 Multiplexer
4.one bit comparator and four-bit magnitude comparator using one bit comparator
5. Implement the Layout of CMOS Inverter.
6. Implement the Layout of CMOS NAND.

Note:
2. A total of 10 experiments must be completed in the semester.
3. Minimum of 5 experiments from Part-A and 5 from Part-B is compulsory.

DATA COMMUNICATION AND COMPUTER NETWORKSLAB

PC460EC
Instruction:2periodsperweek *Duration ofSEE: 3hours*
CIE:25marks *SEE:50marks*
Credits: 1

Objectives:

1. To understand a conceptual foundation for the study of data communications using theopen Systems interconnect (OSI) model for layeredarchitecture.
2. To understand the performance of data link layer protocol HDLC.
3. To understand network layer routing protocols and algorithms.

Outcomes: Onsuccessfulcompletionofthecourse,thestudentswill beableto

1.understand the working of various network topologies in circuit and packetswitching.
2. implement HDLC protocol and significance of MAC protocols.
3. understand the network routing protocols and the associated algorithms.
4. understand the transport layer working with TCP, and UDP.
5. implement network scenario and obtain its performance evaluation.

ListofExperiments:

PART-A

Design and implement the following experiments using C Compiler and packet tracer software

1. Study of network devices in detail.
2. A HDLC frame to perform thefollowing.
   i. Bitstuffing
   ii. Characterstuffing.
3. Distance vector algorithm and find path fortransmission.
4. Dijkstra's algorithm to compute the shortest routingpath.
5. Simulation of networktopologies.
6. Configuration of a network using different routingprotocols.

PARTB

Simulation using NS2/ NS3/ NCTUNS/ NetSim or any other equivalent tool in Linux OS.

1. Point to point network with four nodes and duplex links between them. Analyse the networkperformance by setting the queue size and varying thebandwidth.
2. Four node point to point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent byTCP/UDP.
3. Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and datarate.
4. Implement Ethernet LAN using n nodes and assignment of multiple traffic to obtain congestion window for different sources/destinations.
5. ESS with transmission nodes in Wireless LAN and study of performanceparameters.
6. Implementation of Link state routingalgorithm.

NOTE:

1. At least ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and 5 from Part B is compulsory.

SUMMER INTERNSHIP

PW702EC

Instruction: NA *Duration of SEE: NA*
CIE: 50 marks *SEE: NA*
Credits : 2

Course Objectives:

1.	To enhance practical and professional skills.
2.	To provide training in soft skills and also train them in presenting seminars and technical report writing.
3.	To expose the students to industry practices and team work

Course Outcomes: On successful completion of the course, the students will be able to

1.	acquirepractical experience of software design and development, and coding practices within Industrial/R&D Environments.
2.	understand working practices within Industrial/R&D Environments
3.	prepare reports and deliver effective presentation.
4.	demonstrate effective written and oral communication skills
5.	innovate in various engineering disciplines and nurture their entrepreneurial ideas.

Summer Internship is introduced as part of the curriculum for encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organisations/Computer Industry/Software Companies/R&D Organization for a period of 4 to 6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).
The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship
- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:
1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Award of internal marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note: Students have to undergo summer internship of 4 to 6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.