FACULTY OF ENGINEERING
Scheme of Instruction & Examination
(AICTE Model Curriculum)

and

Syllabi

B.E. V and VI Semesters

of

Four Year Degree Programme

in

ELECTRONICS & COMMUNICATION ENGINEERING

(With effect from the Academic Year 2020 - 2021)
(As approved in the Faculty Meeting held on 17-02-2020)

Issued by

Dean, Faculty of Engineering
Osmania University, Hyderabad – 500 007
2020

SCHEME OF INSTRUCTION & EXAMINATION
B.E. V- Semester
(ELECTRONICS AND COMMUNICATION ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Course										
1	PC501EC	Analog Communication	3	-	-	3	30	70	3	3
2	PC502EC	Digital Signal Processing	3	1	-	4	30	70	3	4
3	PC503EC	Automatic Control Systems	3	1	-	4	30	70	3	4
4	PC504EC	Antenna and wave Propagation	3	-	-	3	30	70	3	3
5	PC505EC	Microprocessors & Microcontrollers	3	1	-	4	30	70	3	4
6	MC506EG	Gender Sensitization	3	-	-	3	30	70	3	0
Practical/Laboratory Course										
8	PC551EC	Systems and Signal Processing Lab	-	-	2	2	25	50	2	1
9	PC552EC	Microprocessor and Microcontroller Lab	-	-	2	2	25	50	2	1
10	PC553EC	Mini Project	-	-	2	2	50	-	2	1
Total			**18**	**3**	**6**	**27**	**280**	**520**	**24**	**21**

PC: Professional Course **MC**: Mandatory Course
L: Lecture **T:** Tutorial **P**: Practical **D**: Drawing **G**: Grade (E/VG/G/S/U)
CIE: Continuous Internal Evaluation **SEE**: Semester End Examination (Univ. Exam)

Note-1:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Note-2:

*The students have to undergo a Summer Internship of four weeks duration after VI semester and credits will be awarded in VII semester after evaluation.

****** Subject is not offered to the students of Electronics and Communication Engineering Department

Course Code	Course Title						Core/Elective
PC501EC	**ANALOG COMMUNICATION**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
SATT	3	-	-	-	30	70	3

Course Objectives:

1. To analyze the analog communication system requirements
2. To understand the generation & detection of various analog modulation techniques
3. To analyze the noise performance of analog modulation techniques
4. To understand AM and FM receivers
5. To understand the pulse modulation techniques

Course Outcome:

1. Understand analog communication system
2. Compare and analyze analog modulation techniques
3. Calculate noise performance of analog modulation techniques
4. Design AM and FM receivers
5. Differentiate between pulse modulation techniques & continuous modulation techniques.

UNIT - I

Amplitude Modulation: Need for modulation, Amplitude Modulation (AM). Double side band suppressed carrier (DSB –SC) modulation, Hilbert transform, properties of Hilbert transform. Pre-envelop. Complex envelope representation of band pass signals, In-phase and Quadrature component representation of band pass signals. Low pass representation of band pass systems. Single side band (SSB) modulation and Vestigial-sideband (VSB) modulation Modulation and demodulation of all the modulation schemes, COSTAS Receiver.

UNIT - II

Angle modulation: Frequency Modulation (FM) and Phase modulation (PM), Concept of instantaneous phase and frequency. Types of FM modulation: Narrow band FM and wide band FM. FM spectrum in terms of Bessel functions. Direct and Indirect (Armstrong's) methods of FM Generation Balanced discriminator, Foster–Seeley Discriminator, Zero crossing detector and Ratio detector for FM demodulation Amplitude Limiter in FM

UNIT - III

Transmitters and Receivers: Classification of transmitters. High level and low level AM transmitters FM transmitters Principle of operation of Tuned radio frequency (TRF) and super heterodyne receivers Selection of RF amplifier Choice of Intermediate frequency Image frequency and its rejection ratio Receiver characteristics: Sensitivity, Selectivity, Fidelity, Double spotting, Automatic Gain Control.

UNIT - IV

Analog pulse modulation: Sampling of continuous time signals. Sampling of low pass and band pass signals Types of sampling Pulse Amplitude Modulation (PAM) generation and demodulation. Pulse time modulation schemes: PWM and PPM generation and detection. Time Division Multiplexing.

UNIT - V

Noise: Atmospheric noise, Shot noise and thermal noise. Noise temperature Noise in two-port network: noise figure, equivalent noise temperature and noise bandwidth. Noise figure and equivalent noise temperature of cascade stages. Narrow band noise representation S/N ratio and Figure of merit calculations in AM, DSB-SC, SSB and FM systems, Pre-Emphasis and De-Emphasis.

Suggested Reading:

1. Simon Haykin, "Communication Systems," 2/e, Wiley India, 2011.
2. B.P. Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems", 4/e, Oxford University Press, 2016
3. P. Ramakrishna Rao, "Analog Communication," 1/e, TMH, 2011.
4. T G Thomas and S Chandra Shekar, Communication theory, 2/e, McGraw-Hill Education
5. R. P. Singh, S. D. Sapre, Communication Systems,2/e McGraw-Hill Education, 2008.

Course Code	Course Title						Core / Elective
PC502EC	**DIGITAL SIGNAL PROCESSING**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
SATT	3	1	-		30	70	4

Course Objectives:

1. Describe the necessity and efficiency of digital signal processing.
2. Design and implementation of FIR and IIR digital filters.
3. Describe the basics of Multirate digital signal processing and its application.
4. Describe the DSP processor architecture for the efficient implementation of digital filters.

Course Outcomes:

1. Necessity and use of digital signal processing and its application.
2. Analyze FIR and IIR digital filters.
3. Applications of Multirate digital signal processing.
4. Acquaintance of DSP processor and its architecture.

UNIT – I

Discrete Fourier Transform and Fast Fourier Transform: Discrete Fourier Transform (DFT), Computation of DFT- Linear and Circular Convolution, FFT algorithms: Radix-2 case, Decimation in Time and Decimation in Frequency algorithms- in place computation- bit reversal.

UNIT - II

Infinite Impulse- response Filters (IIR): Introduction to filters, comparison between practical and theoretical filters, Butterworth and ChebyShev approximation, IIR digital filter design techniques- Impulse Invariant technique- Bilinear transformation technique, Digital Butterworth & Chebyshev filters. Implementation

UNIT - III

Finite impulse-response Filters (FIR) : Linear phase filters, Windowing techniques for design of Linear phase FIR filters- Rectangular, triangular, Bartlett, Hamming, Hanning, Kaiser windows, Realization of filters, Finite word length effects, Comparison between FIR and IIR.

UNIT - IV

Multirate Digital Signal Processing: Introduction- Decimation by factor D and interpolation by a factor I- Sampling Rate conversion by a Rational factor I/D- **Implementation of Sampling Rate conversion-** Multistage implementation of Sampling Rate conversion- Sampling conversion by a Arbitrary factor, Application of Multirate Signal Processing.

UNIT - V

Introduction to DSP Processors: Difference between DSP and other microprocessors architecture- their comparison and need for ASP, RISC and CPU- General Purpose DSP processors: TMS 320C54XX processors, architecture, addressing modes- instruction set.

Suggested Reading:

1. Alan V. Oppenheim and Ronald W. Schafer, "Digital Signal Processing", 2/e, PHI, 2010.
2. John G. Praokis and Dimtris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Application", 4/e, PHI, 2007.
3. Avathar Singh and S. Srinivasan, "Digital Signal Processing using DSP Micrprocessor", 2/e, Thomson Books, 2004.
4. John G Proakis and Vinay K Ingle, " Digital Signal Processing using MATLAB" 3/e, Cengage Learning, 1997.
5. Richard G Lyons, "Understanding Digital Signal Processing", 3/e, Prentice Hall.

Course Code	Course Title						Core/Elective
PC503EC	**AUTOMATIC CONTROL SYSTEMS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
SATT	3	1	-	-	30	70	4

Course Objectives:

1. To Analyze the stability and performance of dynamic systems in both time and frequency domain.
2. To design feedback controllers, such as PID, lead and lag compensators, to meet desired system performance specifications.
3. To provide knowledge of state variable models and fundamental notions of state model design.
4. To understand the classical methods of control engineering and physical system modeling by linear differential equations.
5. To understand state space representation of control systems.

Course Outcomes:

1. Convert a given control system into equivalent block diagram and transfer function
2. Analyze system stability using time domain techniques
3. Analyze system stability using frequency domain techniques
4. Design a digital control system in the discrete time domain
5. Analyze a control system in the state space representation.

UNIT - I

Control System fundamentals and Components: Classification of control systems including Open and Closed loop systems, Transfer function representation, Mathematical modeling of Mechanical systems and their conversion into electrical systems, Block diagram representation, Block diagram algebra and reduction and Signal flow graphs and Mason's gain formula.

UNIT - II

Time Response: Transfer function and types of input. Transient response of second order system for step input. Time domain specifications Characteristic Equation of Feedback control systems Types of 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 plots: Bode plots, frequency domain specifications Gain and Phase margin. Principle of argument Nyquist plot and Nyquist criterion for stability

Compensation Techniques: Cascade and feedback compensation. Phase lag, lead and lag-lead compensators PID controller.

UNIT - IV

Discrete Control Systems: Digital control, advantages and disadvantages, Digital control system architecture. The discrete transfer function sampled data system Transfer function of sample data systems. Analysis of Discrete data systems

UNIT - V

State space representation: Concept of state and state variables. State models of linear time invariant systems, State transition matrix, Solution of state equations. Controllability and Observability

Suggested Reading:

1. Nagrath, I.J, and Gopal, M., "*Control System Engineering*", 5/e, New Age Publishers, 2009
2. NagoorKani*.," Control systems*", Second Edition, RBA Publications.
3. Ogata, K., "*Modern Control Engineering*", 5/e, PHI.
4. Ramesh Babu, "Digital Signal Processing", 2/e,
5. K.Deergha Rao, Swamy MNS, "Digital Signal Processing, Theory and Applications", 1/e, Springer Publications, 2018

Course Code	Course Title						Core/Elective
PC504EC	**ANTENNAS AND WAVE PROPAGATION**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
EMTL	3	-	-	-	30	70	3

Course Objectives:

1. To familiarize the students with the basic principles of antennas and introduce the antenna terminology.
2. To introduce different types of wire antennas and make proficient in analytical skills for understanding practical antennas.
3. To familiarize with the design of different types of antennas for various frequency ranges and latest developments in the practical antennas.
4. To introduce need for antenna arrays and the concepts of measurements of antennas.
5. To introduce the various modes of Radio Wave propagation used.

Course Outcomes:

1. To illustrate the basic principles of antennas and learn the antenna terminology.
2. To design different types of wire antennas and make proficient in analytical skills for understanding practical antennas.
3. To design different types of antennas for various frequency ranges and get updated with latest developments in the practical antennas.
4. To apply the principles of antennas, to design antenna arrays and measure various parameters of antennas.
5. To Identify and understand the suitable modes of Radio Wave propagation used in current practice

UNIT - I

Antenna Fundamentals:

Introduction, Fundamental Concepts- Physical concept of radiation, Retarded potential. Radiation pattern, Isotropic Radiator, Front–to-back ratio, Antenna Field Regions, Radiation Intensity, Beam Area, Beam Efficiency, Reciprocity, Directivity and Gain, Antenna Apertures, Antenna Polarization, Antenna impedance, Antenna temperature, Friis transmission equation,

UNIT – II

Thin Linear wire Antennas:

Current Distributions, Radiation from Infinitesimal Dipole, Half wave Dipole and Quarter wave Monopole, Loop Antennas - Introduction, Small Loop, Far field pattern of circular loop with uniform current, Comparison of far fields of small loop and short dipole, Slot Antennas, Helical

Antennas-Helical Geometry, Helix modes, Practical Design considerations for Monofilar Helical Antenna in Axial and Normal Modes, wideband characteristics, radiation efficiency.

UNIT – III

Non-Resonant Antennas:

V- antenna, Rhombic Antenna, Yagi - Uda Antenna, Folded Dipoles & their Characteristics, Log-

periodic Antenna, Aperture Antennas- Huygens' principle, Radiation from apertures, 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 Beam Forming basics 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. Antenna Measurements: Introduction, Antenna Test Site and sources of errors, Radiation Hazards, Patterns to be Measured, Radiation, Gain and Impedance Measurement Techniques.

UNIT – V

Wave Propagation

Ground wave propagation, 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& Ahmad S. Khan, "Antennas and wave Propagation", McGraw-Hill, 4rth Edition, 2010.
2. Constantine A. Balanis, & quot;Antenna Theory: Analysis and Design" Wiley, 3rd edition,
   Faculty of Engineering O.U. With effect from Academic Year 2020 – 2137 2005
3. Edward C. Jordan and Kenneth G. Balmain, “Electromagnetic Waves and Radiating Systems,” 2/e, PHI, 2001
4. R.E.Collins, Antennas and Radio Propagation, Singapore: McGraw Hill, 1985.
5. R Harish and M. Sachidananda, Antennas and Wave Propagation, Oxford University Press,2011.

Course Code	Course Title						Core/Elective
PC505EC	**MICROPROCESSOR AND MICROCONTROLLER**						core
Prerequisite	Contact Hours per Week:4				CIE	SEE	Credits
	L	T	D	P			
COA STLD	3	1	-	-	30	70	4

Course Objectives:

1. Understand architecture & programming of 8086 microprocessor and 8051 microcontrollers.
2. Design Interfacing of memory , 8255,8257 and 8251 to 8086 processor
3. Differentiation of 8086 and 8051 in terms of internal architecture, memory, programming.
4. Design Interfacing & Programming of I/O ports, timers and UART using 8051.
5. Design Interfacing of real time devices like ADC, DAC and stepper motor with 8051.

Course Outcomes:

1. Explain the architecture of 8086 microprocessor and recognize different types of addressing modes.
2. Write assembly language programming using 8086 microprocessor instruction set.
3. Interface different peripherals to 8086 microprocessor.
4. Explain the architecture of 8051 architecture and write Assembly/C language programming using 8051 microcontroller.
5. Interface different peripherals to 8051 microcontroller.

UNIT - I

8086 Microprocessor:

Intel 8086/8088 architecture, Segmented memory, Minimum and Maximum modes of operation, Timing diagram, addressing modes, Instruction set, assembly language programming using data transfer, arithmetic, logical and branching instructions

UNIT - II

8086 Programming and Interfacing:

Assembler directives, macros, procedures, assembly language programming using string manipulation instructions, 8086 Interrupt structure, IO and Memory Interfacing concepts using 8086, IC Chip Peripherals-8255 PPI, 8257 DMA controller, 8251 USART

UNIT - III

8051 Microcontroller – Internal architecture and pin configuration, 8051 addressing modes, instruction set, Bit addressable features. I/O Port structures, assembly language programming using data transfer, arithmetic, logical and branch instructions.

UNIT - IV

8051 Timers and Interrupts:

8051 Timers/Counters, Serial data communication and its programming, 8051 interrupts, Interrupt vector table, Interrupt programming.

UNIT – V

8051 Interfacing:

Interfacing of 8051 with LCD, ADC, DAC, external memory, Stepper Motor interfacing.

Suggested Reading:

1. Ray A.K & Bhurchandhi K.M, "Advanced Microprocessor and Peripherals," 2/e, TMH, 2007.
2. Mazidi M.A, Mazidi J.G &Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C," 2/e, Pearson Education, 2007
3. Ayala K.J, "The 8051 Micro Controller Architecture, programming and Application," Penram International, 2007.
4. Scott MacKenzie and Raphael C.W.Phan. The 8051 Microcontroller.(4/e), Pearson education, 2008.
5. Douglas V.Hall, "Microprocessors and Interfacing Programming and Hardware", 2nd Edition, Tata McGraw- Hill publishing company Limited, New Delhi, 1994.

Course Code	Course Title						Core / Elective
MC506EG	**GENDER SENSITIZATION**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
-	L	T	D	P			
	3	-	-	-	30	70	0

Course Objectives:

1 To develop students' sensibility with regard to issues of gender in contemporary India.
2 To provide a critical perspective on the socialization of men and women.
3 To introduce students to information about some key biological aspects of genders.
4 To help students reflect critically on gender violence.
5 To expose students to more egalitarian interactions between men and women.

Course Outcomes:

1. Students will have developed a better understanding of important issues related to gender in contemporary India.
2. Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
3. Students will attain a finer grasp of how gender discrimination works in our society and How to counter it.
4. Students and professionals will be better equipped to work and live together as equals.
5. Students will develop a sense of appreciation of women in all walks of life.

UNIT - I

Understanding Gender: Why Should We Study It? Socialization: Making Women, Making Men: Introduction-Preparing for Womanhood-Growing up male-First lessons in caste-Different Masculinities; **Just Relationships: Being Together as Equals:** Mary Kom and Onler-Love and acid just do not mix-Love Letters-Mothers and Fathers-Further reading: Rosa Parks-The brave heart.

UNIT - II

Gender And Biology: Missing Women: Sex selection and Its Consequences – Declining sex ratio. Demographic Consequences; **Gender Spectrum: Beyond the Binary –** Two or many – Struggles with discrimination; **Our Bodies, Our Health.**

UNIT - III

Gender And Labour: Housework: the Invisible Labour: "My mother doesn't work"- Share the Load"; **Women's Work; Its Politics and Economics:** Fact and fiction-Unrecognized and unaccounted work- Wages and conditions of work.

UNIT - IV

Issues of Violence: Sexual Harassment: Say No! : Sexual harassment – not eve-teasing-Coping with everyday harassment-"Chupulu"; **Domestic Violence: Speaking Out:** Is home a safe place? When women unite-Rebuilding lives-New forums for justice; **thinking about Sexual Violence:** Blaming the victim – "I fought for my life". The caste face of violence

UNIT - V

Gender Studies: Knowledge - Through the Lens of Gender - Point of view - Gender and the structure of knowledge – Unacknowledged women artists of Telangana: **Who's History? Questions for Historians and Others:** Reclaiming a past-Writing other histories-Missing pages from modern Telangana history.

Suggested Readings:

1. A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, VasudhaNagarajAsma Rasheed, GoguShyamala, DeepaSreenivas and Susie Tharu, *"Towards a World of Equals: A Bilingual Text book on Gender"* Telugu Akademi, Hyderabad, 1st Edition, 2015.
2. www.halfthesky.cgg.gov.in

Course Code	Course Title						Core / Elective
PC551EC	**SYSTEMS AND SIGNAL PROCESSING LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
SATT PC304EC DSP PC503EC	-	-	-	2	25	50	1

Course Objectives:

1. Implement the basic algorithms of DFT, IDFT, FFT and IFFT.
2. Design FIR Filter with specific magnitude and phase requirements.
3. Design IIR Filter with specific magnitude and phase requirements.
4. Describe the basics of Multirate signal processing.
5. Design and implement digital filters on DSP processors.

Course Outcomes:

1. Illustrate various signal processing algorithms.
2. Analyze FIR Filter with specific magnitude and phase requirements.
3. Analyze IIR Filter with specific magnitude and phase requirements.
4. Illustrate the basics of Multirate signal processing.
5. Analyze digital filters on DSP processors.

PART-A

List of Signal Processing Experiments

Perform the following programs using MATLAB Simulator

1. Introduction to MATLAB and signal generation.
2. Perform DFT and FFT algorithm.
3. Perform Linear convolution.
4. Perform Circular Convolutions.
5. Perform FIR filters design using different window functions.
6. Perform IIR filters design: Butterworth and Chebyshev.
7. Perform Interpolation and Decimation.
8. Perform Implementation of multi-rate systems.
9. Perform Time response of non –linear systems.
10. Design of P, PI, PD and PID controllers (any two)

PART-B
List of DSP Processor Experiments

Implement the following experiments using DSK

1. Introduction to DSP processors.
2. Implement Solution of difference equations
3. Implement Impulse Response.
4. Implement Linear Convolution.
5. Implement Circular Convolution.
6. Perform Study of procedure to work in real-time.
7. Implement Fast Fourier Transform Algorithms.
8. Design of FIR (LP/HP) USING windows: (a) Rectangular (b) Triangular (c) Hamming windows.
9. Design of IIR (HP/LP) filters.

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. For Section 'A' MATLAB with different toolboxes like signal processing.
4. Block set and SIMULINK / MATHEMATICA / any popular software can be used.

Suggested Reading:

1. Jaydeep Chakravorthy, ''Introduction to MATLAB Programming: Toolbox and Simulink",1/e, University Press,2014.

Course Code	Course Title						Core / Elective
PC552EC	**Microprocessor and Microcontroller Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
SATT DSP	L	T	D	P			
	-	-	-	2	25	50	1

Course Objectives:

1. Apply Assembly language programs on 8086 trainer kit in standalone/serial mode
2. Classify interface modules into input /output and Memory interfaces with 8086
3. Develop and execute the embedded C programming concepts of 8051 microcontroller
4. Design and develop 8051embedded C programs for various interface modules.
5. Develop interface with Serial and I2C bus

Course Outcomes:

1. Apply different addressing modes & Model programs using 8086 Instruction set
2. Explain the usage of string instructions of 8086 for string manipulation, Comparison
3. Develop interfacing applications using 8086 processor
4. Design different programs using C cross compilers for 8051 controller
5. Develop interfacing applications using 8051 controller

List of Experiments

PART- A

1. Use of 8086 trainer kit and execution of programs. (Instruction set for simple Programs using 4 to 5 lines of instruction code under different addressing modes for data transfer, manipulation, Arithmetic operations)
2. Branching operations and logical operations in a given data.
   i) transfer byte and word data from source to destination memory.
   ii) Count even and odd numbers from given Array of ten bytes.
   iii) Find Largest and Smallest number from given array of words
   iv) sort the Given array in ascending order ,Descending order
3. Multiplication and division
   i) use MUL and IMUL for Unsigned and signed multiplication on 8 bit and 16bit data sets
   ii) use DIV and IDIV for Unsigned and signed division on 8 bit and 16bit data sets
   iii) obtain given decimal number to unpacked BCD ex:1234_{10} as 01,02,03,04 and store in memory using DIV
   iv)Find Factorial of a given number using multiplication instructions
4. Single byte, multi byte Binary and BCD addition and subtraction
5. Code conversions.
   i) BCD Unpacked to Packed BCD

ii) Ascii code to BCD code
iii) BCD to Ascii

6. String Searching and Sorting.(Useing string instructions)
   i) Find number of repetitions of a character in a string
   ii) Find and replace a character in the given string
   iii) Convert Case of a given string
   iv) find whether given string is palindrome or not

Part B

[Experiments for 8051 using any C- Cross Compiler & appropriate hardware]

1. Familiarity and use of 8051/8031 Microcontroller trainer, and execution of programs.
2. Instruction set for simple Programs (using 4 to 5 lines of instruction code).
3. Timer and counter operations & programming using 8051.
4. Serial communications using UART
5. Programming using interrupts
6. Interfacing 8051 with DAC to generate waveforms.
7. Interfacing traffic signal control using 8051.
8. Program to control stepper motor using 8051.
9. ADC interfacing with 8051
10. Serial RTC interfacing with 8051
11. LCD interfacing with 8051

NOTE: PART-B Perform using assembler simulators like edsim51/keil software

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VI - Semester
(ELECTRONICS AND COMMUNICATION ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC601EC	Digital Communication	3	-	-	3	30	70	3	3
2	PC602EC	Digital system Design with Verilog	3	-	-	3	30	70	3	3
3	PC603EC	Data Communication and computer networking	3	1	-	4	30	70	3	4
4	PC604EC	Electronic Measurements and Instrumentation	3	-	-	3	30	70	3	3
5	PE – I	Professional Elective-I	3	-	-	3	30	70	3	3
6	OE – I	Open Elective-I	3	-	-	3	30	70	3	3
Practical/Laboratory Courses										
7	PC651EC	Communication Lab	-	-	2	2	25	50	3	1
8	PC652EC	DCCN Lab	-	-	2	2	25	50	3	1
9	PC653EC	Digital system Design with Verilog Lab	-	-	2	2	25	50	3	1
10	PC654EC	Summer Internship*	-	-	-	-	50	-	-	2
Total			**18**	**1**	**6**	**24**	**305**	**570**	**27**	**24**

PC: Professional Course **PE**: Professional Elective **OE**: Open Elective
MC: Mandatory Course **SI**: Summer Internship **HS**: Humanities and Social Sciences
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE**: Semester End Examination (Univ. Exam)

Note-1:

1. Each contact hour is a Clock Hour
2. The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment

Note-2:

*The students have to undergo a Summer Internship of four weeks duration after VI semester and credits will be awarded in VII semester after evaluation.

****** Subject is not offered to the students of Electronics and Communication Engineering Department.

Open Elective-I:				**Professional Elective – I**		
S.No	**Course Code**	**Course Title**		**S.No.**	**Course Code**	**Course Title**
1	OE601EC	Principles of Electronic Communications		1	PE671EC	Image and Video Processing
2	OE602EC	Fundamental Digital design using Verilog HDL		2	PE672EC	Advanced Microcontrollers
				3	PE673EC	Optical Communications
				4	PE674EC	IOT Sensors

Course Code	Course Title				Core/Elective		
PC601EC	**DIGITAL COMMUNICATION**				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PTSP AC	3	-	-	-	30	70	3

Course Objectives:

1. Familiarize the students with elements of digital communication system and waveform coding techniques like PCM, DPCM, DM and ADM.
2. Introduce the concepts of information theory and source coding
3. Familiarize the students with channel coding techniques such as LBC, BCC and convolution codes
4. Introduce the concepts of baseband digital data transmission and analyze the error performance of different digital carrier modulation schemes like ASK, FSK, PSK etc.
5. Familiarize the students with the concepts of spread spectrum communication with emphasis on DSSS and FHSS

Course Outcomes:

1. Classify the different types of digital modulation techniques PCM, DPCM, DM and ADM and compare their performance by SNR.
2. Illustrate the classification of channels and Source coding methods.
3. Distinguish different types of Error control codes along with their encoding/decoding algorithms.
4. Examine the Performance of different Digital Carrier Modulation schemes of Coherent and Non-coherent type based on Probability of error.
5. Generation of PN sequence using Spread Spectrum and characterize the Acquisition Schemes for Receivers to track the signals.

UNIT - I

Elements of Digital Communication System: Check with autonomous Comparison of Digital and Analog Communication Systems, Analog to Digital Conversion, Quantization and Encoding techniques, PCM. Companding in PCM systems - u law and a law, Applications of PCM: Introduction to Linear Prediction Theory. Modulation and demodulation of DPCM, DM and ADM. Comparison of PCM, DPCM, DM and ADM. SNR_Q of PCM and DM

UNIT - II

Information Theory and Source Coding: Uncertainty, Information and entropy. Source-coding, Shannon – Fano and Huffman coding Discrete memory less channel – Probability relations in a channel, priori & posteriori entropies, mutual information, Channel capacity - Binary Symmetric Channel, Binary Erasure Channel, , cascaded channels, information rate. Shannon-Hartley Theorem – Shannon Bound.

UNIT - III

Channel Coding: Types of transmission errors, need for error control coding, Linear Block Codes (LBC): description of LBC, generation, Syndrome and error detection, Minimum distance of Linear block code, error correction and error detection capabilities, Standard array and syndrome decoding, Hamming codes. Binary cyclic codes (BCC): Description of cyclic codes, encoding, decoding and error correction using shift registers. Convolution codes: description, encoding – code tree, state diagram.

UNIT - IV

Introduction to Base band digital data transmission –block diagram, ISI, eye pattern Digital Carrier Modulation Schemes — Description and generation of ASK, FSK, PSK optimum receiver – matched filter, correlation receiver. Gaussian error probability -Coherent detection of Binary ASK, FSK, PSK DPSK Comparison of digital carrier modulation schemes M-ary signaling schemes – Introduction, QPSK,Synchronization methods

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 and their applications. Acquisition and Tracking of DSSS and FHSS signals

Suggested Reading:

1. Simon Haykin, “Communication systems” 4/e, Wiley India 2011
2. Sam Shanmugam K, “Digital and Analog Communication systems”, Wiley 1979.
3. B.P.Lathi, “Modern digital and analog communication systems” 3/e, Oxford University Press. 1998
4. Leon W.Couch II., Digital and Analog Communication Systems, 6th Edn, Pearson Education inc., New Delhi, 2001.
5. R.E.Zimer&R.L.Peterson : Introduction to Digital Communication, PHI, 2001.

Course Code	Course Title						Core/ Elective
PC602EC	**DIGITAL SYSTEM DESIGN THROUGH VERILOG HDL**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
STLD	L	T	D	P			
	3	-	-	-	30	70	3

Course Objectives:

1. Describe verilog HDL and develop digital circuits using gate level and data flow modeling
2. Develop verilog HDL code for digital circuits using switch level and behavioral modeling
3. Design and develop of digital circuits using Finite State Machines(FSM)
4. Prepare Algorithmic State Machines(ASM) of Digital design
5. Describes designing with Programmable Logic Devices (PLD's).

Course Outcomes:

1. Appreciate the constructs and conventions of the verilog HDL programming in gate level and data flow modeling.
2. Generalize combinational circuits in behavioral modeling and concepts of switch level modeling
3. Design and analyze digital systems and finite state machines.
4. Comprehend advanced features of verilog HDL and apply them to design complex real time digital system using ASMs
5. Design various circuits for memory devices and annotate the ASIC/FPGA design flow

UNIT - I

Introduction to HDLs: Overview of Digital Design with Verilog HDL, Basic Concepts, Data types, System tasks and Compiler Directives. Hierarchical modeling, concepts of modules and ports Gate level Modeling, Dataflow modeling-Continuous Assignments, Timing and Delays. Programming Language Interface

Design of Arithmetic Circuits using Gate level/ Data flow modeling –Adders, Subtractors**,** 4-bit Binary and BCD adders and 8-bit Comparators.

Verification: Functional verification, simulation types, Design of stimulus block.

UNIT - II

Switch Level Modeling and examples. Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls, and Conditional Statements, multi-way branching, Loops, Sequential and Parallel blocks, Generate blocks. Tasks and Functions **Behavioral/dataflow modeling of basic MSI combinational logic modules:** ALUs, Encoders, Decoders, Multiplexers, Demultiplexers, Parity generator/checker circuits, Bus Structure.
Basic concepts of Static timing analysis, Logic synthesis

UNIT - III

Behavioral modeling of sequential logic modules: Latches, Flip Flops, counters and shift registers applications

Synchronous Sequential Circuits: Analysis and synthesis of synchronous sequential circuits: Mealy and Moore FSM models for completely and incompletely specified circuits, State Minimization-Partitioning Minimization Procedure, sequence detector with verilog HDL modeling Design of a Modulo-8 Counter using the Sequential Circuit Approach and its verilog implementation. One-Hot Encoding

UNIT - IV

Algorithmic State Machines (ASMs): ASM chart, ASM block, simplifications and timing considerations with design example. ASMD chart for binary multiplier and Verilog HDL code, one hot state controller.

Asynchronous Sequential logic: Analysis procedure-Transition table, flow table, race conditions. Hazards with design example of Vending-Machine Controller

UNIT - V

Introduction to ASIC's: Full-custom, standard-cell and Gate array based ASICs. SPLDs: PROM, PAL, GAL, PLA. FPGA and CPLD simplified architecture and applications. ASIC/FPGA Design flow, CAD tools Combinational circuit Design with Programmable logic Devices (PLDs).

Suggested Reading:

1. Samir Palnitkar, "Verilog HDL A Guide to Digital Design and Synthesis," 2nd Edition, Pearson Education, 2006.
2. M. Morris Mano, Michael D. Ciletti, "Digital Design", 4th edition, Pearson Education.
3. Michael John Sebastian Smith, Application Specific Integrated Circuits, Pearson Education Asia, 3rd edition 2001.
4. Stephen Brown and ZvonkoVranesic,"Fundamentals of Digital Logic with Verilog Design",McGraw Hill.
5. Advanced Digital Design with the Verilog HDL Second Edition Michael D. Ciletti Pearson

Course Code	Course Title						Core/Elective
PC603EC	**DATA COMMUNICATION AND COMPUTER NETWORKING**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AC	3	-	-	-	30	70	3

Course Objectives:

- To provide a conceptual foundation for the study of data communications using the open Systems interconnect (OSI) model for layered architecture.
- To study the principles of network protocols and internetworking
- To understand the Network security and Internet applications.
- To understand the concepts of switched communication networks.
- To understand the performance of data link layer protocols for error and flow control.
- To understand various routing protocols and network security.

Course Outcomes:

1. Understand the working of various network topologies and circuit and packet switching
2. Comprehend the role of data link layers and significance of MAC protocols
3. Understand the networking protocols and Internet protocols
4. Understand the transport layer working with TCP, UDP and ATM protocols
5. Comprehend the functionality of application layer and importance of network security.

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.Circuit Switching Principles and concepts,Virtual circuit and Datagram subnets, X.25.

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, Wireless LAN. IEEE 802.2, 802.3, 802.4, 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, ATM Networks.

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. Andrew S Tanenbaum, "Computer Networks," 5/e, Pearson Education, 2011.
2. Behrouz A. Forouzan, "Data Communication and Networking,"3/e, TMH, 2008.
3. William Stallings, "Data and Computer Communications," 8/e, PHI, 2004.
4. Douglas EComer, "Computer Networks and Internet", Pearson Education Asia, 2000.
5. PrakashC. Gupta, "Data Communications and Computer Networks", PHI learning, 2013

Course Code	Course Title						Core/Elective
PC604EC	**Electronic Measurements and Instrumentation**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AC	3	-	-	-	30	70	3

Course Objectives:

1. Understand the different standards of measurements.
2. Study different types of transducers.
3. List various types of measurements and thermometers
4. Learn the design of digital voltmeters
5. Study various types of bio-medical instruments

Course Outcomes:

1. Describe characteristic of an instrument and state different Standards of measurements
2. Identify and explain different types of Transducers.
3. Draw and Interpret types of transducers.
4. Design and analyse the digital voltmeters and Prioritize the instruments.
5. Identify and classify types of Biomedical instruments.

UNIT - I

Electronic Measurement fundamentals

Accuracy, Precision, Resolution and Sensitivity. Errors and their types. Standards of measurement, classification of standards, IEEE standards.

UNIT - II

Transducers: Classification, factors for selection of a transducer, transducers for measurement of velocity, acceleration. Passive electrical transducers- Strain gauges and strain measurement, LVDT and displacement measurement, capacitive transducer and thickness measurement. Active electrical transducers: Piezo electric, photo conductive, photo voltaic and photo emissive transducers.

UNIT - III

Electronic Sensors

Characteristics of sound, pressure, power and loudness measurement. Microphones and their types. Temperature measurement, resistance wire thermometers, semiconductor thermometers and thermo couples.

UNIT - IV

Measuring instruments

Block diagram, specification and design considerations of different types of DVMs. Spectrum analysers. The IEEE488 or GPIB Interface and protocol. Delayed time base oscilloscope and Digital storage oscilloscope. Introduction to virtual instrumentation, SCADA. Data acquisition system block diagram.

UNIT - V

Biomedical Instrumentation:

Human physiological systems and related concepts. Bio-potential electrodes Bio-potential recorders – ECG, EEG, EMG, X- ray machines and CT scanners, magnetic resonance and imaging systems, Ultrasonic Imaging systems.

Suggested Reading:

1. Albert D. Helfric, and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 2010.
2. H S Kalsi, "Electronic Instrumentation", 3/e, TMH, 2011.
3. Robert A Witte, "Electronic Test Instruments: Analog and Digital Measurements", 2/e, 2002
4. Nakra B.C, and Chaudhry K.K., "Instrumentation, Measurement and Analysis", TMH, 2004
5. Khandpur. R.S., "Handbook of Bio-Medical Instrumentation", TMH, 2003

Course Code	Course Title						Core/Elective
PC621EC	**COMMUNICATION LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AC DC	-	-	-	2	25	50	1

Course Objectives:

1. Demonstrate AM, FM, Mixer, PAM, PWM and PPM techniques.
2. Understand multiplexing techniques.
3. Understand and simulate digital modulation (i.e., ASK, FSK, BPSK, QPSK) generation and detection.
4. Model analog, pulse modulation, PCM, Delta and Digital modulation techniques using CAD tools
5. Obtain data formats.

Course Outcomes:

1. Understand and simulate modulation and demodulation of AM and FM.
2. Construct pre-emphasis and de-emphasis at the transmitter and receiver respectively
3. Understand and simulate the PAM,PWM&PPM circuits
4. Understand baseband transmission (i.e., PCM, DPCM, DM, and ADM) generation and detection.
5. Understand error detection and correction.

PART-A

List of Analog Communication Experiments

1. Perform AM modulation and demodulation
2. Perform FM modulation and demodulation
3. Perform Pre emphasis and De-emphasis
4. Perform Multiplexing Techniques (FDM and TDM)
5. Perform Mixer Characteristics
6. Perform Sampling , PAM, PWM, PPM generation and detection

PART-B

List of Digital Communication Experiments

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

Note: At least ten experiments should be conducted in the semester, of which five should be from PART - B.

Course Code	Course Title						Core/Elective
PC652EC	**DATA COMMUNICATION & COMPUTER NETWORKS LAB**						Elective
Prerequisite	Contact Hours per Week:				CIE	SEE	Credits
	L	T	D	P			
-				2	25	50	1

Course Objectives:

- To provide a conceptual foundation for the study of data communications using the open Systems interconnect (OSI) model for layered architecture.
- To study the principles of network protocols and internetworking
- To understand the Network security and Internet applications.
- To understand the concepts of switched communication networks.
- To understand the performance of data link layer protocols for error and flowcontrol.
- To understand various routing protocols and network security.

Course Outcomes:

1. Understand the working of various network topologies and circuit and packet switching.
2. Comprehend the role of data link layers and significance of MAC protocols.
3. Understand the networking protocols and the internet protocols.
4. Understand the transport layer working with TCP, UDP and ATM protocols.
5. Comprehend the functionality of application layer and the importance of network security.

List of Experiments
PART-A

1. Study of network devices in detail.

Design and implement the following experiments using C compiler or and packet tracer software

2. A HLDC frame to perform the following.

   i) Bit stuffing
   ii) Character stuffing.
3. Distance vector algorithm and find path for transmission.
4. Dijkstra's algorithm to compute the shortest routing path.
5. Simulation of network topologies.
6. Configuration of a network using different routing protocols.

PART-B

Simulate experiments using NS2/ NS3/ NCTUNS/ NetSim/ or any other equivalent tool.

7. Implement a point to point network with four nodes and duplex links between them. Analyse the network performance by setting the queue size and varying the bandwidth.
8. Implement a 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 by TCP/UDP.
9. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.
10. Implement Ethernet LAN using n nodes and assign multiple traffic to the nodes and obtain congestion window for different sources/ destinations.
11. Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.
12. Implementation of Link state routing algorithm.

Note: **Do any 5 experiments from each part.**

Course Code	Course Title						Core/Elective
PC653EC	**DIGITAL SYSTEM DESIGN THROUGH VERILOG HDL LAB**						Elective
Prerequisite	Contact Hours per Week:				CIE	SEE	Credits
	L	T	D	P			
-				2	25	50	1

Course Objectives:

1. Describe verilog HDL and develop digital circuits using gate level and data flow modeling
2. Develop verilog HDL code for digital circuits using switch level and behavioral modeling
3. Design and develop of digital circuits using Finite State Machines(FSM)
4. Perform functional verification of above designs using Test Benches.
5. Implementation of experiments on FPGA/CPLD boards.

Course Outcomes: The students able to

1. Appreciate the constructs and conventions of the verilog HDL programming in gate level and data flow modeling.
2. Generalize combinational circuits in behavioral modeling and concepts of switch level modeling
3. Design and analyze digital systems and finite state machines.
4. Perform functional verification by writing appropriate test benches.
5. Implement designs on FPGA/CPLD boards.

List of Experiments:

Write the Code using VERILOG, Simulate and synthesize 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 Hierarchical structural model for
   a) 16:1 mux realization using 4:1 mux
   b) 3:8 decoder realization through 2:4 decoder

c) 8-bit comparator using 4-bit comparators and additional logic

3. Write a Verilog HDL program in behavioral model for
   a) 8:1 mux
   b) 3:8 decoder
   c) 8:3 encoder
   d) 8 bit parity generator and checker
4. 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
5. Write a Verilog HDL program for 4 bit sequence detector through Mealy and Moore state machines.
6. Write a Verilog HDL program for traffic light controller realization through state machine.
7. Write a Verilog HDL program for vending machine controller through state machine.
8. Write a Verilog HDL program in behavioral model for 8 bit shift and add multiplier.
9. Write a Verilog HDL program in structural model for 8 bit Universal Shift Register.
10. Write a Verilog HDL program for implementation of data path and controller units
    a) Serial Adder b) ALU

Note:

1. All the programs should be simulated using test benches.
2. Minimum of two experiments to be implemented on FPGA/CPLD boards.

Course Code	Course Title						Core/Elective
PC671EC	**IMAGE AND VIDEO PROCESSING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DSP	3	-	-	-	30	70	3

Course Objectives:

- To provide an introduction to the basic concepts and methodologies for Digital Image processing.
- To familiar with spatial and transform domain techniques used in Image Enhancement, Restoration and Segmentation of Images.
- To gain knowledge about various Image transforms used in Image processing and Image compression problems.
- To understand various methods employed for edge, line and isolated points detection in an image.

Course Outcomes:

1. Able to develop a foundation that can be used as the basis for higher study and research in the Image processing area.
2. Able to design various filters for processing and deblurring of images without destroying fine details like edges and lines.
3. Able to apply image processing techniques for processing and analysis of remotely sensed, Microscope, Radar and Medical images.
4. Able to understand the need for Digital Image processing techniques for Machine vision applications and concept of image compression.

UNIT - I

Digital Image Fundamentals: Image sensing, acquisition, Image formation model, sampling and Quantization, Basic relationships between pixels; neighbors of a pixel, adjacency, connectivity, regions and boundaries. Image formation, brightness, adaptation and discrimination Categorization of images according to their source of EM radiation

UNIT - II

Image Transforms: 2D Fourier transform, Properties of 2D Fourier transform, Walsh, Hadamard,Slant, Haar, Discrete cosine transform and Hotelling transform.

UNIT - III

Image Enhancement: Spatial domain techniques: Contrast stretching, histogram equalization and histogram specification method, Neighborhood averaging and adaptive Median filter. Frequency domain methods: Ideal Low pass, Butterworth and Gaussian Low pass filters. Ideal High pass, Butterworth and Gaussian High pass filters. Homomorphic filtering

UNIT - IV

Image Restoration: Mathematical expression for degraded image,

Estimation of degradation functions: image observation, experimentation and by modeling, Inverse filter, Wiener filter, Geometric transformation, periodic noise reduction method.

UNIT - V

Image segmentation and Compression: Detection of discontinuities, point lineAnd Edge detection methods: Gradient operation, Laplacian, Prewitt, Sobel, Laplacian of a Gaussian and Canny edge detectors. Image compression: Functional block diagram of a general image compression system various types of redundancies, Huffman coding, Arithmetic coding.

Suggested Readings:

1. RafealC.Gonzalez, RicharsE.Woods, Digital Image Processing ", Pearsons Education, 2009, 3rd Edition.
2. Anil K Jain, Fundamentals of Digital Image Processing, Prentice-Hall of India Private Limited, New Delhi, 1995.
3. Milan Sonka, Vaclav Havel and Roger Boyle, Digital Image Processing and Computer vision, Cengage Learning India Pvt. Limited, 2008.
4. Vipul Singh, Digital Image Processing with Matlab and Lab view" Elsevier 2013.
5. Qidwai, "Digital Image Processing," First Indian Reprint 2013, (Taylor & Francis), Yesdee Publications.

Course Code	Course Title						Core/Elective
PC672EC	**ADVANCED MICROCONTROLLER**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
MPMC	3	-	-	-	30	70	3

Course objectives:

1. To gain the knowledge of ARM cortex
2. To gain the knowledge on LPC 21xx microcontroller
3. To understand basic features of programmable DSP processor
4. To study instruction set and addressing modes of TMS 320C54XX.

Course Outcomes:

1. Understand the architecture of a ARM Processor
2. Compare and select ARM processor core based SoC with several features/peripherals based on requirements of embedded applications.
3. Develop simple applications using LPC 21xx microcontroller.
4. Characterize architecture by utilizing the ARM processor core and DSP Processor based platform.

UNIT I:

ARM Embedded Systems: The RISC design philosophy, The ARM design philosophy, ARM Processor fundamentals, registers, current program status register, pipeline exceptions, interrupts and vector table, core extensions, architecture revisions.

UNIT II:

LPC 2148 **microcontroller-** Internal memory, GPIOs, Timers, ADC,UART and other serial Interfaces, PWM,RTC,WDT

UNIT III:

Programmable DSP Processors: Basic Architectural features, DSP Computational Building blocks, Bus Architecture and memory, Data Addressing Capabilities, Address Generation unit, Programmability and program execution, Speed Issues.

UNIT-IV:

Commercial Digital Signal –Processing Devices:

Data addressing modes of TMS320C54xx Digital signal processors, Data addressing modes of TMS320C54xx processors, Memory space of TMS320C54xx processors, Program control TMS320C54xx instructions and programming,

UNIT V:

On-chip Peripherals, Interrupts of TMS320C54xx processors, pipeline operation of TMS320C54xx processors.

Suggested Reading:

1. Sloss Andrew N, symes dominic, wright Chris,"ARM System Developers Guide:Designing and optimizing",Morgan kaufman publication
2. Joseph yiu,"The definitive guide to ARM Cortex-M3", Elsevier, 2nd edition
3. Avatar singh and srinivasan.S, Digital signal processing Implementations, Thomson Book, Singapore, 2004.

Course Code	Course Title						Core/Elective
PC673EC	**IoT Sensors**						Elective
Fundamentals of Communication and Computer Network.	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
COA,MPMC	3	-	-	-	30	70	3

Course Objectives:

1. To understand what is Internet of things.
2. Describe architecture, Design, underlying technologies, platforms and cloud interface.
3. To introduce the concept of implementation of a design of sensor.
4. To introduce different hardware and software components utilising for IoT
5. To introduce different applications with case studies.

Course Outcomes:

1. Explain architecture and design of IoT.
2. Describe the Different Sensors connected in IoT.
3. Understand the underlying Technologies.
4. Understand the platforms in IoT.
5. Understand cloud interface to IoT

UNIT I

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT.

UNIT II

Sensors: Working principles, Different types of sensors such as capacitive, Resistive,MEMS, Surface Acoustic wave for Temperature.Equivalent circuite of a smart sensors. Importance and adavntages of smart sensors.

UNIT-III

IoT Platforms: What is an IoT Device, Exemplary Devices: Raspberry Pi, Raspberry Pi Interfaces, Other IoT Devices: pcDuino, Beagle Bone Black,LoRa,RFID-Tags, CubieBoard, ARDUINO.

UNIT-IV

Interfacing: Design procedure, Serial, SPI, I2C Interfaces, Interfacing Microcontroller sensor interface,Interfacing with communication module, Cloud Interface, ThingSpeak IoT Platform.

UNIT-V

Domain specific IoTs and Case studies: Home Automation, Smartcities, Environment Applications, Energy, Agriculture, Industry, Health and Lifestyle, Logistics.

Suggested Readings:

1. Internet of Things: A Hands-On Approach Arshdeep Bahga, Vijay Madisetti VPT – Paperback 2015 978- 0996025515 628/- 2.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things David Hanes, Gonzalo Salgueiro, Patrick Grossetete Cisco Press – Paperback – 16 Aug 2017 978-1- 58714-456- 1 599.

3.Smart Internet of things projects Agus Kurniawan Packt - Sep 2016 978-1- 78646- 651-8 2 The Internet of Things Key Olivier Willy Publication 2nd Edition 978

Course Code	Course Title				Core/Elective		
PC674EC	**OPTICAL COMMUNICATION**				Elective		
Prerequisite	Contact Hours per Week:				CIE	SEE	Credits
	L	T	D	P			
DC	3	-	-	-	30	70	3

Course Objectives:

- Learn concepts of propagation through optical fibermodes and configurations, Losses and dispersion through optical fiber.
- Understand operating principles of light sources and detectors used in optical transmitters and Receivers.
- Design an optical link in view of loss and dispersion.

Course Outcomes:

1. Study of modes of optical communication through optical waveguides
2. Analyze the losses inserted in an optical fibre
3. Study of material used and underlying principles of optical signal generation
4. Design of optical detection systems
5. Design an optical link in view of loss and dispersion.

UNIT – I

Optical fibers: structureswave guides

Evolution of fiber optic system, Elements of Optical Fiber Transmission link, Ray Optics, Optical Fiber Modes and Configurations, Mode theory of Circular Waveguides, Overview Low frequency data transportation of Modes and Key concepts, Linearly Polarized Modes, Single Mode Fibers and Graded Index fiber structure.

UNIT – II

Attenuation and Dispersion:

Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides-Information Capacity determination, Group Delay, Material Dispersion, Waveguide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in Guided Index fibers, Mode Coupling, Types of OFC Connectors and issues involved Design Optimization of Single and cut-off wavelength.

UNIT – III

Optical Sources,Amplifiers and Coupling:

Direct and indirect Band gap materials, LED structures, Light source materials, Quantum efficiency, LED power, Modulation of LED, laser Diodes, Modes and Threshold condition,

Rate equations, External Quantum efficiency, Resonant frequencies, Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers, Power Launching and coupling, Lensing schemes, Fiber-to-Fiber joints, Fiber splicing.

UNIT – IV

Photodetectors & Receivers:

PIN and APD diodes, Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources, Receiver Configuration, Probability of Error, Quantum Limit.

UNIT – V:

Digital Links ,Optical Networks:

Point-to-Point link system considerations -Link Power budget, Rise - time budget, Noise Effects on System Performance, Operational Principles of WDM and Applications. Erbium-doped Amplifiers Introductory concepts of SONET/SDH Network Multiple signal interface in fibers, Bandwidth utilization, Interface with nano-electronic devices.

Suggested Reading:

1. Gourd Keiser, "Optical Fiber Communication," 4/e, TMH, 2000.
2. J.Senior, "Optical Communication, Principles and Practice," PHI, 1994.
3. J.Gower, "Optical Communication System," PHI, 2001.
4. Binh, "Digital Optical Communications," First Indian Reprint 2013, (Taylor & Francis), Yesdee Publications.
5. MMK.Liu, Principles and Applications of Optical Communications, TMH, 2010.

Course Code	Course Title						Core / Elective
OE601EC	**Principles of Electronic Communications**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	**Credits**
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

1. Provide an introduction to fundamental concepts in the understanding of communications systems.
2. Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
3. Provide an introduction to the evolution of wireless systems and current wireless technologies.

Course Outcomes

1. Understand the working of analog and digital communication systems
2. Understand the OSI network model and the working of data transmission
3. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.

UNIT – I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.
Signal Transmission Concepts: Baseband transmission and Broadband transmission,
Communication Parameters: Transmitted power, Channel bandwidth and Noise, Need for modulation **Signal Radiation and Propagation:** Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT – II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT – III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT – IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.
Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT – V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

1. *Principles of Electronic Communication Systems*, Louis E. Frenzel, 3e, McGraw Hill, 2008.
2. *Data Communications and Networking*, Behrouz A. Forouzan, 5e TMH, 2012.
3. Kennady, Davis, *Electronic Communications systems*, 4e, McGraw Hill, 1999.

Course Code	Course Title						Open Elective
OE 602 EC	**Fundamental Digital design using Verilog HDL**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
STLD or DELD	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Describe Verilog hardware description languages (HDL).
- Develop Verilog HDL code for combinational digital circuits.
- Develop Verilog HDL code for sequential digital circuits..
- Develop Verilog HDL code for digital circuits using switch level modeling and describes system tasks, functions and compiler directives

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Course Outcomes : The students able to

1. Describe Verilog hardware description languages (HDL).
2. Develop Verilog HDL code for combinational digital circuits.
3. Develop Verilog HDL code for sequential digital circuits..
4. Develop Verilog HDL code for digital circuits using switch level modeling and
5. describes system tasks, functions and compiler directives

Unit I

Introduction to Verilog HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, System Tasks, Programming Language Interface, Module, Simulation and Synthesis Tools

Verilog Data types and Operators, Binary data manipulation, Combinational and Sequential logic design, Structural Models of Combinational Logic, Logic Simulation, Design Verification and Test Methodology, Propagation Delay, Truth Table models using Verilog.

Unit II

Combinational Logic Circuit Design using Verilog: Combinational circuits building blocks: Multiplexers, Decoders , Encoders , Code converters, Arithmetic comparison circuits , Verilog for combinational circuits , Adders-Half Adder, Full Adder, Ripple-Carry Adder, Carry Lookahead Adder, Subtraction, Multiplication.

Unit III

Sequential Logic Circuit Design using Verilog: Flip-flops, registers & counters, synchronous sequential circuits: Basic design steps, Mealy State model, Design of FSM using CAD tools, Serial Adder Example, State Minimization, Design of Counter using sequential Circuit approach.

Unit IV

Switch Level Modeling:
Basic Transistor Switches, CMOS Switches, Bidirectional Gates, Time Delays with Switch Primitives, Instantiation with Strengths and Delays, Strength Contention with Trireg Nets.

UNIT V:
Functions and Compiler Directives:
Parameters, Path Delays, Module Parameters. System Tasks and Functions, File Based Tasks and Functions, Computer Directives, Hierarchical Access, User Defined Primitives.

Suggested Reading:

1. T.R. Padmanabhan, B Bala Tripura Sundari, *Design Through Verilog HDL*, Wiley 2009.
2. Samir Palnitkar, *Verilog HDL*, 2nd Edition, Pearson Education, 2009.
3. Stephen Brown, Zvonko Vranesic , *Fundamentals of Digital Logic with Verilog Design* -, TMH, 2nd Edition 2003.

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Course Code	Course Title						Core/Elective
SI 671 EC	**SUMMER INTERNSHIP**						**Core**
Prerequisite	**L**	**T**	**D**	**P**	**CIE**	**SEE**	**Credits**
-	**0**	**0**	**0**	**2**	**50**	**0**	**2***

Course Objectives: To prepare the students

1. To give an experience to the students in solving real life practical problems with all its constraints.
2. To give an opportunity to integrate different aspects of learning with reference to real life problems.
3. To enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes: On successful completion of this course student will be

1. Able to design/develop a small and simple product in hardware or software.
2. Able to complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
3. Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
4. Able to implement the selected solution and document the same.

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Industry / R & D Organization / National Laboratory for a period of 4 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.

After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessional marks are based on the performance of the student at the work place 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 coordinate the overall activity of Summer Internship.

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