List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Electronics and Communication Engineering*

Programme Name : *B.Tech.*

Academic Year : 2016-17

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	ENATHS01	Professional Communication English
02.	CHATBS01	Engineering Chemistry
03.	MEATES01	Engineering Mechanics
04.	CSATES02	Fundamental of Computers
05.	EMATBS02	Engineering Mathematics-I
06.	CHALBS01	Engineering Chemistry Lab
07.	MEALES01	Engineering Mechanics Lab
08.	MEALES03	Engineering Drawing
09.	CHBTHS02	Environmental Studies
10.	MEBTES04	Engineering Thermodynamics
11	EEBTES05	Basic Electrical & Electronics Engineering
12	PHBTBS03	Engineering Physics
13	EMBTHS04	Engineering Mathematics-II
14	EEBLES05	Basic Electrical & Electronics Engineering Lab
15	PHBLBS03	Engineering Physics Lab
16	MEBLES06	Workshop Practices
17	EC3THS03	Engineering Economics
18	EC3TPC01	Signals and Systems
19	EC3TBS01	Engineering Mathematics-III
20	EC3TES01	Network Analysis And Synthesis
21	EC3TES02	Electronic Devices
22	EC3TPC02	Digital Logic Circuits
23	EC3PES02	Electronics Devices Lab
24	EC3PPC02	Digital Logic Circuits Lab
25	EC4TBS02	Numerical Analysis
26	EC4TPC03	Automatic Control Systems

27	EC4TPC04	Analog Circuits
28	EC4TPC05	Communication System-I
29	EC4TPC06	Electronics Measurements & Instrumentation
30	EC4PPC04	Analog Circuits Lab
31	EC4PPC05	Communication System-I Lab
32	EC4PPC06	Electronic Measurements & Instrumentation Lab
33	ECETh3101	Lic & Its Application
34	ECETh3102	Electromagnetic Field Theory
35	ECETh3103	Microprocessor & Its Application
36	ECETh3104	Automatic Control System
37	ECETh3104	Communication System- II
38	ECEPr3101	Lic & Its Application Lab
39	ECEPr3102	Microprocessor & Its Application Lab
40	ECEPr3103	Communication System Lab
41	ECETh3201	Digital Signal Processing
42	ECETh3202	Data Communication
43	ECETh3203	Digital Hardware Design
44	ECETh3204	Antenna & Wave Propagation
45	ECETh3205	VLSI Fabrication Technology
46	ECEPr3201	Digital Signal Processing Lab
47	ECEPr3202	Advance Communication Lab
48	ECEPr3203	Digital Hardware Design Lab
49	ECETh4101	Wireless and Mobile Communication
50	ECETh4102	VLSI Design & VHDL
51	ECETh4103	Power Electronics
52	ECETh4104	Microwave Engineering
53	ECETh4105	Embedded System
54	ECETh4106	Multirate Systems and Filter Banks
55	ECETh4107	Speech Signal Processing
56	ECETh4108	Wireless Sensor Network
57	ECETh4109	Artificial Intelligence & Expert Systems
58	ECETh4110	Neural Network & Fuzzy Logic System
59	ECETh4111	Biomedical Instrumentation
60	ECETh4112	Semiconductor Devices Modeling & Simulation
61	ECEPr4101	Project-I

62	ECEPr4102	Seminar
63	ECEPr4103	VLSI Design & VHDL Lab
64	ECEPr4104	Microwave Engineering Lab
65	ECETh4201	Radar & Satellite Communication
66	ECETh4202	Principle of Management
67	ECETh4203	Optical Fiber Communication
68	ECETh4204	Digital Image Processing
69	ECETh4205	Cryptography & Network Security
70	ECETh4206	Radar Engineering
71	ECETh4207	Mobile Computing
72	ECETh4208	Nano Technology
73	ECETh4209	Vacuum Technology
74	ECETh4210	Optimization Techniques
75	ECETh4211	Stochastic Process
76	ECEPr4201	Project-II
77	ECEPr4202	Comprehensive Viva-voce
78	ECEPr4203	Circuit Simulation Lab
79	ECEPr4204	Optical Fiber Communication Lab
80	IT7100	Research Methodology in engineering
81	ECE7102	Vaccume Technology
82	ECE7103	Finite Element Method
83	ECE7104	Sensors Measurement Science & Technology
84	ECE7105	Artificial Intelligence

विभागाध्यक्ष (इले. एवं संचार अभियांत्रिकी)
H.O.D. (Elect. & Comm. Engineering)
प्रौद्योगिकी संस्थान
Institute of Technology
गु. घा. वि., बिलासपुर (छ.ग.)
G. G. V. Bilaspur (C.G.)

Sub Code	L	T	P	Duration	IA	ESE	Credits
EC4TPC05	3	1		3 hours	40	60	4

COMMUNICATION SYSTEM – I

UNIT – 1

Random Variables & Processes: Probability, Random Variables, Cumulative Distribution Function, Probability density function, average value & Variance of Random Variable, co relation between random variables, Random process, auto correlation and Power spectral density of random process, classification of random process.

UNIT – II

Amplitude Modulation: Review of Signal Analysis, Introduction to communication system, Frequency Translation ,A Method of Frequency Translation, Recovery of Baseband Signal, Amplitude Modulation, Maximum Allowable Modulation, The Square-Law Demodulation, Spectrum Of An AM Signal, Modulators & Balanced Modulators, Single Sideband Modulation, Method Of Generating A DSB signal, An SSB Signal, VSB, Multiplexing, Block Diagram of AM Transmitter & super heterodyne receiver.

UNIT – III

Exponential Modulation: Phase & Frequency Modulation: Mathematical representation of FM & PM signals, Relationship Between Phase & Frequency Modulation, Phase & Frequency Deviation, Spectrum Of An FM Signal, Transmission BW of FM waves, Phasor Diagram For FM waves, WBFM & NBFM , Generation of FM waves: Indirect FM (Armstrong Method), Direct FM, Demodulation of FM waves, Balanced frequency discriminator – Zero-crossing detector, comparison of AM and FM systems. Block Diagram of FM Transmitter & Receiver.

UNIT – IV

Mathematical Representation of Noise: Sources of noise, Frequency domain Representation of Noise, spectral component of noise, effect of filter on PSD of noise , superposition of noise, quadrature component of noise, resistor noise, available power , noise temperature, noise figure, two port cascaded systems, noise bandwidth, effective input noise temperature, White noise.

UNIT – V

Noise in CW Modulation: AM Receiver model, Signal to noise ratios for coherent reception, DSB-SC receiver, SSC-SC receiver, Noise in AM receivers using envelope detection, AM threshold effect, FM receiver model, Noise in FM reception, Capture effect in FM, Threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM.

SUGGESTED TEXT BOOKS:-

1. *"Principles of Communication System", Taub & Schilling, TMH*
2. *"Electronic Communication System", George Kennedy, TM*
3. *"Principles of Communication Systems", Simon Haykin, John Wiley, 2nd Ed.*

REFERENCE BOOKS:-

1. *Communication System", R P Singh & S D Sapre , TMH*
2. *" Modern Analog and Digital Communication",B.P Lathi 3rd edition, Oxford Press*

Sub Code	L	T	P	Duration	IA	ESE	Credits
EC4TPC06	3	0	0	3 hours	40	60	3

ELECTRONIC MEASUREMENTS & INSTRUMENTATION

UNIT – I

Measurements, Significance of measurement, Methods of measurement, Instruments and measurement system, Classification of Instruments, Mode of Operation, Application of measurement system, Characteristics of instrument and measurement system; Elements of a Generalized Measurement System, Accuracy and precision, Significant figure, types of error, Probability of error.

UNIT –II

Electromechanical Indicating Instruments: Operating forces, Constructional Details, Types of Support, Torque/Weight Ratio, Control system, Damping- Air friction and Eddy current damping, D'Arsonaval Galvanometer- construction, Torque Equation, Dynamic Behavior, Response of Galvanometer, Ballistic Galvanometer, PMMC- Construction, Torque Equation, Voltage/Current Measurement: Ammeter, Voltmeter, Ohmmeter, Multimeter (V.O.M.), Ratiometer, Megger, High frequency Measurement: Q-meter

UNIT – III

AC Bridge: Introduction, Sources and Dectectors, General equation for ,bridge balance, General form of AC Bridge. Maxwell's Bridge, Hay's bridge, Anderson's bridge, De-Sauty's bridge, Schering bridge, Wien's bridge, Electronic Instruments: Introduction, Advantage of Electronic voltmeter, VTVM, Differential voltmeter, Electronic voltmeter using rectifier, True RMS reading voltmeter, Calorimeter power meter.

UNIT – IV

Transducers: Classification of transducer, Primary & Secondary, Passive & Active, Analog & Digital, Potentiometer, loading effect, Strain Gauge, Thermistor, Construction of thermistor, Thennocouple, LVDT, Advantage & Disadvantage of LVDT, RVDT, Capacitive Transducer, Piezo-electric transducer. Hall-effect Transducer, Capacitive Transducer, Pressure Transducer.

UNIT – V

Display devices: Digital display method, Segmental display- 7segment & 14 segment display, dot matrix, LED, LCD, TFT, Plasma display, DLP, Digital voltmeter (DVM): Types of DVM, Ramp type DVM, Integrating type DVM, Potentiometer type (non-integration type), Recorders: Analog Recorder, Null type Recorder, Single point Recorder, Graphical strip chart, X-Y recorders, Magnetic tape recorder, FM recorder, CRO: Introduction, Block diagram, CRT, Functional block diagram of sampling, Storage, Dual trace and dual beam oscilloscope.

SUGGESTED TEXT BOOKS:-

1. *Modern Electronic Instrumentation and Measurement Technique, W D Cooper & A D Helfrick, PHI 2000*
2. *A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney Dhanpat Rai & Sons, 2010*

Note : Unit - III → Power factor Meter & Frequency measurement Topics are deleted.

Sub Code	L	T	P	Duration	IA	ESE	Credits
[illegible]Th310U	3	1		3 hours	40	60	4

LIC & ITS APPLICATIONS

UNIT – I

Basic Building Blocks for ICs & OPAMP: Basic Differential Amplifiers & Analysis. Introduction to OPAMP, Ideal OPAMP Characteristics. OPAMP ICs 741Pin Diagram and Pin Function, Inverting Amplifier Non Inverting Amplifier, Definition of OPAMP Parameters. Frequency Response of OPAMP. Open Loop & Closed Loop Configuration of OPAMP and its Comparisons, Voltage Comparator, Zero Crossing Detector, Level Detector.

UNIT – II

Applications of OPAMP: Introduction, Adder, Substracter/Difference Amplifier. Voltage Follower, Integrator, Differentiator, Comparator IC such as LM339, Window detector, Current to Voltage and Voltage to Current Converter, Instrumentation Amplifier, Precision Half Wave Rectifier, Precision Full Wave Rectifier, Log & antilog amplifier, Schmitt Trigger, Bridge Amplifier, Peak Detectors/Peak follower, Sample- and- Hold Amplifiers, Square wave generator, Saw-tooth wave generator, Triangular wave generator. Astable multivibrator, Monostable multivibrator, Dead Zone circuit- with positive output, with negative output. Precision clipper circuit. Generalized Impedance Converter (GIC) and its application.

Frequency response of OPAMP: Open loop voltage gain as a function of frequency, Unity gain Bandwidth, Close loop frequency response, Slew Rate.

UNIT – III

Active filters & PLL - Introduction to Filters, Merits & Demerits of active filters of over Passive Filter. Classification of filters, Response characteristics of Filter, First Order and Second Order active high pass, Low pass. Band pass and band reject Butterworth filters.

Phase Lock Loop: Operating Principle of the PLL, Linear Model of Phase Lock Loop, Lock Range and Capture Range, Application of the PLL. Voltage Controlled Oscillator(VCO)

UNIT – IV

D/A and A/D converters & Analog Multiplier: D/A converter - Ladder, R-2R. A/D converters-Ramp, Continuous conversion, Flash ADC, Dual slope ADC, Successive Approximation, Voltage to Time converters. Timing and circuits comparisons, DAC/ADC specifications.

Analog Multiplier: Basic Analog Multiplication Techniques, Applications of Multiplier- Frequency doubling, Phase-angle difference detection, Voltage dividing action, Square root of a signal, Function realization by Multiplier, Amplitude Modulator, Standard Modulator Circuit, Demodulation of AM signal.

UNIT – V

Timer & Regulators: Monolithic 555 Timer: Functional Diagram: Monostable and Astable operation using 555 Timer. Voltage Regulators: Basic Configurations Parameters for Voltage Regulators, Basic blocks of linear IC voltage regulators, Positive and negative voltage regulators, Positive and negative voltage regulators, General Purpose IC Regulator (723): Important features and Internal Structure, Switching regulators.

SUGGESTED BOOKS & REFERENCE:-

1. *"Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, PHI*
2. *"Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin & Fred.F. Driscoll, PHI/Pearson*
3. *"Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, New Age International*
4. *"Integrated Circuits" by K. R. Botkar, Khanna Publications*
5. *"Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH*

Sub Code	L	T	P	Duration	IA	ESE	Credits
ECETh3102	3	1		3 hours	40	60	4

ELECTROMAGNETIC FIELD THEORY

UNIT-I

INTRODUCTION: Review of vector analysis. Scalar & vector products. Coordinate systems and Transformation amongst rectangular, cylindrical and spherical co-ordinate system. Line, Surface and Volume Integral, Gradient of a Scalar, Divergent and Curl of a vector, Divergence Theorem, Stoke's Theorem, Laplacian of a Scalar.

UNIT-II

Electrostatics: Coulomb's law, electric field intensity from point charges, field due to continuous distribution of charges, Electric Flux density, Gauss's law, Electric displacement and displacement density. Electric Potential, Potential field of a point charge, Laplace and Poison's equation.

Magnetostatics: Biot-Savart's law, Ampere's circuital law and its Application, Magnetic flux density, Magnetic Scalar and Vector potential, Magnetic Energy stored.

UNIT-III

Time Dependent Field: Ampere's work law in differential work form, continuity of currents, Conduction and displacement currents, Maxwell's equation and their interpretations, Boundary conditions.

Energy Flow And Poynting Vector: Pointing theorem, interpretation of ExH.Simple application, complex pointing vector.

UNIT-IV

Wave equations, Sinusoidal time varying fields, uniform plane wave in dielectric and conductor media, Skin effect and depth of penetration. Reflection and refraction of plane waves at boundaries for normal and oblique incidence surface impedence.

UNIT-V

Transmission Lines: Transmission line theory from the circuit concept, Properties, Constants, Transmission line equations, Infinite line, Reflections in Transmission lines, Voltage Current and Impedance relations- Open and short circuit lines, Experimental determination of line constants, Standing wave ratio, Impedance matching, Quarter and half wave lines, Single stub and double stub matching, Circle diagram, Smith chart.

SUGGESTED BOOKS & REFERENCE:-

1. *"Elements of Electromagnetics", Matthew N.O. Sadiku, OXFORD Press*
2. *"Elements of Electromagnetics", Hayt and Buck, TMH*
3. *"Electromagnetic waves and radio system", Jorden R.F.*
4. *"Principle and applications of Electromagnetic fields", Ptonsey R and Collin R.P.*

Sub Code	L	T	P	Duration	IA	ESE	Credits
CETh3103	3	1		3 hours	40	60	4

MICROPROCESSOR & ITS APPLICATIONS

UNIT – I

Microprocessor architecture and Microcomputer systems: History And Evolution, Types Of Microprocessors, Functions of Microprocessor, Architecture of 8085, Pin configuration and Function, Tristate Bus concept, Generation of Timing Signals, Bus Timing, Demultiplexing, Instruction execution, Instruction cycle, Machine cycles, T states, Fetch executes cycle, Instruction Timing and Operation [illegible]

UNIT – II

Memory map & addresses, I/P devices ,I/P Addressing, The 8085 Programming model, Instruction Classification, Instruction & Data Formats, Addressing Modes, Instruction for data transfer, Arithmetic and Logical operation, Branching operation, Addressing mode, Writing Assembly Language Programs

Counters, Time Delays And interrupts: Memory interfacing, Absolute, Partial Decoding, Multiple Address Range, Interfacing memory with wait states, Interfacing I/O devices, Peripheral I/O, Memory Mapped I/O, 8085 Single Board Microcomputer System. Interfacing Of 8085 with 8155/8156(RAM), 8355/8755(ROM)

UNIT – III

Programming Techniques with additional instructions, Looping, counting and indexing, Data transfer from/to memory to/from microprocessor, 16-bit arithmetic instructions, Logic Operations like rotate, compare, Time delays, Counters, Stacks, Subroutine, Call and return instructions. Interrupts, The 8085 interrupt process, multiple interrupt and priorities, Vectored interrupts. Restart as software instruction

UNIT – IV

Programmable Interfacing devices: Basic Concept, 8279 programmable Keyboard/Display interface,8255A Programmable Parallel interface, Interfacing keyboard and display using 8255A, 8254 Programmable Interval Timer, 8259A Programmable Interrupt Controller, Direct Memory Access(DMA), 8237 DMA Controller. Basic Concept in Serial I/O, Data Communication over Telephone Lines, 8085-serial I/O lines, 8251A Programmable Communication interface, Interfacing a matrix keyboard, Interfacing LED and seven segment displays.

UNIT –V

Introduction of 16-bit Microprocessor: Internal organization of 8086, Signal descriptions, Physical memory organization, Minimum & Maximum mode, Bus Organization and timing. Addressing modes, Instruction set, Assembler directives, Interrupts and Interrupt service routine.

SUGGESTED BOOKS & REFERENCE:-

1. *"Microprocessor Architecture, Programming & Applications with the 8085",R S.Gaonkar, Pearson Publication.*
2. *"Microprocessor System, Architecture Programming & Design", Yu-Cheng Liu & Glenn A Gibson,*
3. *"Microprocessors & Interfacing. Programming & Hardware ",D.V.HALL, McGraw Hill*
4. *"Advance Microprocessor & Peripherals", A K Rai , K M Bhurchandi, TMH*
5. *"The Intel Microprocessor", Barray B. Brey, PHI*
6. *"The 8051 Micro Controller Architecture, Programming and Application", K J Ayala, Thomson Publishers.*
7. *"Micro Controller Theory and Application", A V Deshmukh, TMH, 2005*
8. *"The 8051 Micro Controller and Embedded System", M A Mazidi, J G Mazidi, R D McKinlay, Pearson Education, 2008.*

Code	L	T	P	Duration	IA	ESE	Credits
BEETh310-4	3	1		3 hours	40	60	4

AUTOMATIC CONTROL SYSTEM

UNIT-I

Control System Component & Transfer Function: Control System Component & Transfer Function: System component, open loop and closed loop system, Introduction to feedback concept. Mathematical modeling of electrical & mechanical system. Transfer function of Linear system, Block diagram and its reduction procedure, Signal flow graph, Mason gain formula, System Components, potentiometer, AC&DC servomotor.

UNIT-II

Time Response Analysis: Time response of first and second order system, Types of systems, Steady State Error and Error Constants, Basic control action and automatic controllers, effects of proportional, integral, derivative and PID controller on system performance.

UNIT-III

Stability: Concept of stability, Necessary Condition for Stability, absolute and relative stability, Hurwitz Stability Criterion, Routh Stability Criterion, Relative stability Analysis.

Root Locus Technique: Concept, Root locus techniques, Construction of Root Loci, Breakaway points, Determination of Roots from Root Locus, Root contours, Sensitivity of the Roots of the Characteristic Equation.

UNIT-IV

Frequency Domain analysis & Compensation Techniques: Correlation between time and frequency response, Polar Plots, Inverse Polar Plots, Bode Plots- details, Pole and Zero on real axis, Complex conjugate pole, Construction of Bode Plots, Compensation Network - phase lead, phase lag, lag-lead compensation, Feedback Compensation.

Stability in Frequency Domain: Nyquist stability criteria- Nyquist contour, Mapping, Nyquist criteria, Assessment of relative stability using Nyquist criteria, Gain margin and Phase margin,

UNIT-V

State Variable Analysis and Design: Concept of State, State Variables and State Model for linear continuous time systems, State space representation using Phase varinbles, Phase variable formulations, State space representation using Canonical variables, State Variables and discrete time system, Diagonalization, Solution of State Equations, Controllability and Observability.

SUGGESTED BOOKS & REFERENCE:-

1. *"Modern Control Engineering", Ogata, Pearson Education.*
2. *"Control System Engineering", Nagrath & Gopal, New Age International*
3. *"Automatic Control System" B.C. Kuo, PHI*
4. *"Linear Control System", B.S.Manke, Khanna Pub.*
5. *"Modern Control System", R.C.Dorf & R.N.Bishop, AWL Low price edition.*
6. *"Introduction to Control Engineering", Ajit K.Mandal, New Age International.*

Sub. Code	L	T	P	Duration	IA	ESE	Credits
ECETA3105	3	1		3 hours	40	60	4

COMMUNICATION SYSTEM – II

UNIT – I

Pulse Modulation: Sampling theorem, Basic principles of PAM, PWM and PPM. TDM, comparison of TDM with FDM; Typical multiplexed systems.

Pulse Code Modulation: Pulse code modulation, generation and detection of PCM, quantization, companding, A-Law and μ-Law, differential PCM; Delta modulation, Adaptive delta modulation, delta sigma modulation.

UNIT – II

Digital Modulation Techniques: Introduction – Pass band Transmission model- Generation, Detection of BPSK, DPSK, DEPSK, QPSK, M-Ary PSK, QASK, BFSK, MSK, Duo- Binary Encoding, QAM

UNIT – III

Optimal reception of digital signal: Performance of Digital Modulation Systems, S/N ratio of PCM and DM, Comparison of PCM and DM, pulse shaping of baseband signal, Equalization principles. ISI, Optimum Filter, Matched Filter, Error Probability of Various digital modulation Technique.

UNIT – IV

Information Theory: The concept of Information, average information, Entropy; Marginal, Conditional and Joint Entropies, Information rate , Shannon's theorm, Channel capacity, Bandwidth S/N tradeoff, Discrete communication channels, Shannon's limit, mutual information and channel capacity, Continuous communication channels, Channel with finite memory, Discrete memory less channels.

UNIT – V

Coding: General principles of coding, necessary and sufficient condition for noiseless coding, Coding efficiency, Shannon-Fano and Huffman coding; Error control, Hamming codes, Linear block codes, Cyclic codes, Convolutional codes - Viterbi Algorithm, Trellis coded Modulation.

SUGGESTED BOOKS & REFERENCE:-

1. Principles of Communication Systems –Taub and Shilling, Tata Mc Graw Hill.
2. Communication Systems –Simon Haykins. Tata McGraw Hill
3. Principles of Digital Communication Systems, B.P. Lathi, PHI
4. A Text Book of Analog & Digital Communication – P. Chakrabarti, Dhanpat Rai & Co.
5. Principles of Digital Communications, Das, Mullick and Chatterjee, Wiley Eastern Publications
6. Advanced Digital Communication Systems, NIIT, PHI
7. Digital Communication, Bernard Sklar, Pearson Education Asia.
Digital and Analog Communication Systems: K.Sam Shanmugam, John Wiley

Code	L	T	P	Duration	IA	ESE	Credits
[illegible]	3	1		3 hours	40	60	4

DIGITAL SIGNAL PROCESSING

UNIT - I

Realization of Systems: Realization of digital linear system, Signal flow graph. Structures for realization of discrete time systems, Structures for IIR and FIR systems, State space system analysis and structures. Representation of numbers, Quantization of filter coefficients, Round off effects in digital filters, Introduction to digital signal processors.

UNIT - II

Infinite Impulse Response Filter design (IIR): Features of IIR filters, Design stages, Filter design by Approximation of Derivatives, Impulse invariance method, Bilinear transformation method, Butterworth and Chebyshev Design Method, Frequency Transformations in Analog and Digital domain.

UNIT – III

Finite Impulse Response (FIR) Filter Design: Linear phase response- Symmetric and Antisymmetric, Design by Window method, Optimal method, Rectangular, Triangular, Hamming, Blackman & Kaiser Window, Frequency sampling method, Design of FIR differentiators, Design of Hilbert transformer, Comparison of various design methods.

UNIT – IV

Multirate DSP: Introduction, Sampling Rate Conversion by rational factor, Decimation of Sampling rate by an Integer factor, Interpolation of sampling rate by an Integer Factor, Sampling rate alteration or conversion by a rational factor, Filter design and implementation for sampling rate alteration or conversion: Direct form FIR digital filter structures, Polyphase filter structure, Time varying digital filter structures, Sampling rate conversion by an arbitrary factor: First order approximation & Second order approximation method. Applications of Multirate Digital Signal Processing (MDSP).

UNIT – V

Applications of Digital Signal Processing: Introduction, Applications of DSP: Digital Sinusoidal Oscillators, Digital Time Control Circuits, Digital Comb Filters, Applications in broader sense: Removal of noise from pictures, Applications of DSP to Radar, Applications of DSP in Image Processing, Applications of DSP in speech processing.

SUGGESTED BOOKS & REFERENCE:-

1. "Digital Signal Processing", J. Johnson, Pearson - PHI
2. "Digital Signal Processing", Proakis, Manolakis & Sharma, Pearson Education
3. "Digital Signal Processing", Nair, PHI
4. "Discrete Time Signal Processing", Oppenheim & Schafer, Pearson - PHI
5. "Digital Signal Processing", Vallavuraj, Srilvahanan, Gnanapriya, TMH
6. "Digital Signal Processing", Hussain, Umesh Publications.

Code	L	T	P	Duration	IA	ESE	Credits
CTCT202	3	1		3 hours	40	60	4

DATA COMMUNICATION

UNIT- I

Model of digital communication system, OSI Reference, TCP/IP, ATM Reference Model, Characteristics of signals, basic concepts, Analog and digital transmission, parallel and serial transmission, Multi formats, T1/E1, SONET, SDH, QC, Asynchronous and Synchronous transmission, simplex, half duplex and duplex, different guided and unguided media, Wireless & Mobile, channel capacity.

UNIT-II

Review of different types of Encoding.

MAC Protocols, Network topologies, error detection techniques like parity check, LRC and CRC (Cyclic Redundancy Check) Implementations using shift register method, Interfacing standard: RS232, RS423A, Data link control, Flow control using stop and wait ,DRQ, go back to N ARQ and selective Reject ARC, Data link Control protocol :DLC,SDLC.

UNIT- III

Circuit Switching, Circuit Switched Networks, Switching concept, space, division switching, Time division switching, Packet Switching, principle, Switching techniques, Comparison with circuit switching, Routing and congestion control algorithm, Application of spread spectrum.

UNIT- IV

Layered network model, OSI layer standard, medium access control, Network protocol, internet working, TCP-IP, IPV-4, IPV-6, Ethernet, ISDN, B-ISDN, ATM, binary synchronous character in BSC frame.

UNIT- V

Application Layer: DNS, Telnet, TFP, SMTP, World Wide Web, HTML, URL, HTTP.
IEEE-802.2 LLC, IEEE 802.3 Ethernet, IEEE 802.5 MAC Frame format, IEEE 802.11 Wireless Local Area Network: Layered Architecture, DCF, PCF, MAC Frame of IEEE 802.11, Physical layer of IEEE 802.11.

SUGGESTED BOOKS & REFERENCE:-

1. *Computer Network by Tanenbaum pearson edition.*
2. *Data communication and Computer network by Frojon; TM.*
3. *Data Networks, Dimitri P. Bertsekas, Robert G. Gallager, Prentice-Hall*

	L	T	P	Duration	IA	ESE	Credits
M.ETh.3203	3	1		3 hours	40	60	4

DIGITAL HARDWARE DESIGN

UNIT – I

Microprocessor Applications: Interfacing [illegible] multiplexed display and keyboard, Interfacing matrix keyboard, Stepper motor interfacing, [illegible] microprocessor based system.

Serial I/O & Data communication RS 232C, Modem etc., Various BUS Standards, Introduction to PCI, EISA (82350 chip set), MCA and local bus structure.

UNIT –II

Review of Evolution of Advanced Microprocessors 8086, 8088, 186/286/386/486 Pentium. Familiarization with IBM Compatible Pentium based PC's with advantage of coprocessors, RISC & CISC processor.

Brief Introduction to Processor such as Power PC MIPS, CYRIX, AMD's, Motorola series.

UNIT –III

Microcontroller: Introduction to 8051 microcontroller, Architecture, Memory Organization, Port Operation, Memory Interfacing, Introductory Programming, Assembler Directives.

UNIT –IV

Interrupt and Timer/Counter: Interrupts, Timers/Counters, Programming Timer Interrupt, Programming external Hardware Interrupt, Interrupt priority in 8051.

Application: Interface to LED and LCD, Keyboard, 7 Segment display, ADC and DAC Interfacing, Stepper motor Interfacing and DC motor Interfacing, GSM module Interfacing.

UNIT –V

Design Methodology, Life Cycle, and Modelling of Embedded Systems: Software Life Cycle, Embedded Life Cycle, Modeling of Embedded Systems, Simulation & Emulation.

Networks for Embedded Systems: Serial Communication Basics, RS-232model, I^2C model, CAN and CAN Open, SPI, SCI, Introduction to Device Drivers.

SUGGESTED BOOKS & REFERENCE:-

1. *Microprocessor and Interfacing Programming & Hardware, Douglas V Hall, TMH.*
2. *Advanced Microprocessor and Peripherals, A K Rai, K M Burchandi, TMH.*
3. *The Intel Microprocessor, Barray B Brey, Pearson Education.*
4. *The 8051 Microcontroller & Embedded System, 2nd Edition, M Ali Mazidi, J G Mazidi, Pearson Education.*

Code	L	T	P	Duration Hours	IA	ESE	Credits
EE3204	3	1		3	40	60	4

ANTENNA AND WAVE PROPAGATION

UNIT – I

Fundamental Parameters of Antenna: Introduction, Radiation Pattern, Radiation Power Density, Beam-width, Directivity, Antenna Efficiency, Gain, Bandwidth, Polarization, Antenna Radiation Efficiency, Friss Transmission Equation.

UNIT – II

Electromagnetic Radiation: Short electric dipole, Half wave dipole, Radiation from a small current element, power radiated, Radiation from a half wave dipole, Power radiated, Radiation resistance, Isotropic radiators and radiation pattern, Effective length, Antenna top loading and tuning effect of earth.

UNIT – III

Antenna Arrays and Their Design: Broadside and End fired arrays Collinear array, Array of point source, Non isotropic but similar point sources, Pattern Multiplication, Linear array with n Isotropic point sources of equal amplitude and spacing, Binomial, Dolph Tchebyscheff arrays.

UNIT – IV

Practical Antennas: Resonant and Non resonant antennas, Tower radiator, Long wire antenna, V antenna, Rhombic antenna, Loop antenna, Folded Dipole Antenna, Yagi -Uda Antenna, Reflector Antenna, Helical Antenna, Turnstile Antenna, Babinet's Principle, Horn Antenna, Micro-strip Antenna, Dielectric Resonator Antenna, Smart Antenna

UNIT – V

Wave Propagation : Modes of propagation of EM waves, UHF and Microwave Propagation, sky wave, Surface wave, Space wave range and fields calculations, Ionosphere characteristics, Earth's magnetic field, Ionospheric propagation, Refractive index at high frequencies, Mechanism of radio wave bending, critical frequency, Effect of earth's magnetic fields, Effective dielectric constant and conductivity, MUF, Skip distance, Optimum working frequency, Multi hop propagation, Ionosphere abnormalities, Troposheric propagation, Effect of earth's curvature and dielectric constant, Tropospheric scatter and Duct propagation.

SUGGESTED BOOKS & REFERENCE:-

1. *Antenna and Wave Propagation – K.D. Prasad, Satya Pub.*
2. *Electromagnetic Waves and Radiating Systems - E.C.Jordan and K.G.Balmain, Prentice Hall India*
3. *Antennas- John D. Kraus, McGraw Hill.*
4. *Antenna & Wave Propagation- Robert E.Collin, McGraw Hill*
5. *Antenna Theory : Analysis and Design- C.A. Balanis, Wiley*

Code	L	T	P	Duration	IA	ESE	Credits
[illegible]3205	3	1		3 hours	40	60	4

VLSI FABRICATION TECHNOLOGY

UNIT-1

Crystal growth, wafer preparation. Epitaxy: Electronic Grade Silicon, Czochralski crystal Growth, Silicon Shaping, Processing considerations.

Epitaxy: Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation, Growth Mechanism and kinetics.

UNIT-2

Oxidation: Kinetics of Silicon dioxide growth for thick, thin and ultrathin films. Oxidation technologies in VLSI and ULSI. Characterization of oxide films. High k and low k dielectrics for ULSI.

UNIT-3

Impurity Incorporation: Solid State Diffusion – Fick's equation, Atomic Diffusion Mechanisms, Measurement Techniques, Diffusion in polysilicon and silicon di-oxide diffusion systems

Ion Implantation – Range theory, Equipments, Annealing, Shallow Junction, High Energy Implementation

UNIT-4

Lithography: Optical Lithography, Optical Resists, Contact & Proximity Printing, Projection Printing, Electron Beam Lithography: Resists, Mask Generation, Electron Optics: Roster Scans & Vector Scans, X-ray lithography, Ion Beam lithography.

UNIT-5

Chemical Vapour Deposition Techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films.

Metal Film deposition: Evaporation and sputtering techniques. Failure mechanisms in metal interconnects: Multi-level metallisation schemes

SUGGESTED BOOKS & REFERENCE:-

1. S. M. Sze, " VLSI Technology", McGraw Hill Book Co.
2. S.K.Gandhi, "VLSI Fabrication Principles", John Wiley and Sons, NY.
3. Chen, "VLSI Technology" Wiley, March.
4. D.Nagchoudhary, "Principles of Microelectronics Technology", Wheeler (India).
5. Plummer, Deal, Griffin "Silicon VLSI Technology: Fundamentals, Practice & Modeling" PH, 2001.
6. P. VanZant, "Microchip Fabrication", 5th Edition, MH, 2000.

Sub Code	L	T	P	Duration	IA	ESE	Credits
[illegible]	3	1		3 hours	40	60	4

WIRELESS & MOBILE COMMUNICATION

VI

UNIT - I

Introduction to Wireless Communication System Evolution mobile communications. Mobile radio around the world. Types of Wireless communication system, comparison of Common wireless system. Trend in Cellular radio and personal Communication Second generation Cellular Networks. Third Generation (3G) Wireless Networks, Wireless Local Loop(WLL), Bluetooth and Personal Area Networks

The Cellular Concept-System design Fundamentals:

Cellular System, Hexagonal geometry cell and frequency reuse concept, channel assignment strategies, Distance to frequency reuse ratio, channel & Co-channel interference reduction factor, S/I ratio consideration and calculation for minimum Co-channel and adjacent interference, Handoff strategies, Umbrella Cell Concept, Trunking and Grade Of Service(GOS),Improving Coverage & Capacity in cellular System-splitting, cell sectorization, Repeaters, Micro cell zone concept

UNIT – II

Mobile Radio Propagation: Large Scale Path Loss : Free space propagation model. The three basic propagation Mechanism: reflection, diffraction, scattering, Practical link budget design. Outdoor Propagation models, Indoor propagation models. Small scale Multipath propagation. Impulse response model of a Multipath Channel, Small scale Multipath measurements, parameters of Mobile multipath channels, types of small scale fading. Rayleigh and Ricean Distributions, Statistical for models multipath fading channels and diversity techniques in brief.

UNIT-III

Modulation Techniques: Orthogonal Frequency Division Multiplexing. Performance of Digital Modulation in Slow-Flat Fading Channels and Frequency Selective Mobile Channels. Equalization: Survey of Equalization Techniques. Linear Equalization. Non-linear Equalization. Algorithms for Adaptive Equalization

UNIT – IV

Multiple Access Techniques for Wireless Communication: Introduction, FDMA, TDMA, CDMA:DS-SS,FH-SS, space division multiple access, packet radio, capacity of a cellular systems.

UNIT – V

GSM: System architecture, GSM subsystems, GSM communication frame, 3G system. GSM: Services: Mobile services, Bearer Services, Tele Services, Supplementary Services, Components & Working of WLAN, Transmission Media for WLAN. Modulation Techniques for WLAN (DSSS, FHSS), IEEE 802.11 Standards, & Protocol for WLAN.

The future of mobile communications. 3G, 4G, 802.11a/b/g, 802.16 concepts of adhoc network and mobile computing.

SUGGESTED BOOKS & REFERENCES:-

1. *Kamilo Feher. "Wireless Digital Communications", PHI*
2. *Rapport T.S., "Wireless Communications, Principles and Practice", PHI*
3. *Lee W.C.Y., "Mobile Cellular Telecommunication", MGH*
4. *Pandya R, Mobile & Personal Communication System, PHI*
5. *Haykins S & Moher M, Modern Mobile Wireless Communication, Pearson Ed.*

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Sub. Code	L	T	P	Duration	IA	ESE	Credits
ECETin4102	3	1		3 hours	40	60	4

VLSI DESIGN & VHDL

UNIT I

Evolution of VLSI, VLSI Design Methodology. VLSI Design Flow. Full Custom & Semicustom Design Approach, FPGA Design, CAD Technology, MOS structure, MOS system under external bias condition, Structure and operation of MOSFET, N-MOS and P-MOS technology, Accumulation, Depletion, Inversion, I-V characteristics, Threshold voltage, Body Effect, MOSFET Capacitance, Latch-up , Second order Effects.

UNIT II

CMOS Fabrication process flow, CMOS N-well process, Layout design rules, stick diagram, CMOS design rules, Diagram for N-MOS and CMOS inverter & Gates, P-well process, Twin-Tub process, Fabrication of bipolar Transistor.

UNIT III

MOS Inverter static characteristics, CMOS inverter, Voltage transfer characteristics, Noise margin, CMOS inverter circuit operation, Switching characteristics, Delay time definitions, Power dissipation- static and dynamic power, BiCMOS Inverter.

UNIT IV

Combinational MOS logic circuit, CMOS logic circuits, Complex logic circuit, CMOS Transmission Gate. Pseudo NMOS logic. Sequential MOS logic circuits, Latches and Flip Flop circuits. Dynamic CMOS logic circuits, Domino CMOS logic, NORA, ZIPPER logic

UNIT V

Introduction to VHDL, EDA tools. Entity and Architecture declaration, Data Objects, Data Types, Operators, Concurrent and Sequential Statements, Various Architecture Styles of Modeling, Design of Combinational and Sequential Circuits.

SUGGESTED BOOKS & REFERENCE:-

1. *S.M. kang & Y. Leblebici, CMOS digital integrated circuits: analysis and design, MH*
2. *S.M. Sze, VLSI Technology. MH*
3. *Neil Waste & Kamran Eshraghian, CMOS VLSI design, Pearson*
4. *W. Wolf, Modern VLSI Design, Pearson Edu.*
5. *J Bhaskar, A VHDL Primer, Pearson Edu.*
6. *Fundamental of Digital Logic Design with VHDL, Brown & Vranesic, MGH Pub.*

Sub Code	L	T	P	Duration	IA	ESE	Credits
ECETh4103	3	1		3 hours	40	60	4

POWER ELECTRONICS

UNIT – I

Thyristor characteristics, Two transistor model of Thyristor, Thyristor Turn-On di/dt protection, dv/dt protection, Thyristor Turn-On , Series operation of Thyristor, Parallel operation of thyristor, Thyristor Commutation Technique, Natural Commutation, Forced Commutation, Self Commutation, External pulse Commutation, Load side Commutation, Line side Commutation.

UNIT – II

Inverters:- Classification of Inverters, Depending upon the various types of Commutation, Series and Parallel inverters, Self Commutation inverters, Single and three phase bridge inverters, Voltage Control of three phase inverters, Harmonic reductions.

UNIT – III

DC Choppers:- Introduction, Principle of Step-Down operation, Step Down chopper with RL load, Principle of Step-Up operation, Performance parameters, Switch mode regulators, Thyristor based chopper circuit, Impulse commutated choppers, Effects of Source and Load inductance, Impulse commutated three thyristor chopper, Resonant pulse choppers.

UNIT – IV

Controlled Rectifiers:- Introduction, Principle of Phase controlled converter operation, Single Phase semi converter with RL load, Single Phase full converter with RL load, Single phase dual converters, Single phase series converters, Three phase half wave converters, Three phase semi converters with RL load, Three phase full converter with RL load, Three phase Dual converters, Power factor improvements, Excitation angle control, PWM control, Sinusoidal Pulse Width Modulation, Design of converter circuits.

UNIT – V

AC Voltage Controllers:- Introduction, Principle of On-Off control, Principle of Phase control, Single Phase Bidirectional controller with resistive loads, Single Phase controller with inductive loads, Three phase half wave controller, Three phase full wave Controller, Three phase bidirectional delta connected controllers, Cycloconverters, Single phase to single phase, Single phase to three phase & Three phase to three phase cycloconverter, Reduction of output harmonics, AC Voltage controller with PWM control, Design of AC voltage controller circuits, Effect of Source and Load inductances.

SUGGESTED BOOKS & REFERENCE:-

1. *P.S.Bhimbra, "Power Electronics",*
2. *Rashid, "Power Electronics", Pearson Publication.*
3. *H.C.Rai, "Power Electronics", Galgotia Publication.*

Sub. Code	L	T	P	Duration	IA	ESE	Credits
ECETh-4104	3	1		3 hours	40	60	4

MICROWAVE ENGINEERING

UNIT – I

Microwave Waveguides: Introduction, Types of waveguides, TE and TM modes in Rectangular wave guide, Dominant mode, Various field components of TE and TM modes, Cut off frequency of a wave guide, Phase velocity, Group velocity, Guide wave length, Wave impedance, Power transmission in rectangular wave guide, TE and TM modes for Circular wave guide.

UNIT –II

Microwave tubes and Measurements: Introduction, High frequency limitation of conventional tubes, Two cavity Klystron amplifier, Bunching process, Applegate diagram, Analysis of two cavity Klystron, Reflex Klystron: Performance characteristics, Travelling Wave Tube (TWT): Constructional features and operating principle of TWT, Magnetron: Construction and operating principle of cavity magnetron, Analysis of Cylindrical Magnetron, Mode jumping.

UNIT –III

Solid State Microwave Devices: Introduction to Microwave Transistors, MESFETs Varactor Diode, Parametric Amplifiers, Masers, PID diode: Equivalent circuit, Operation and Application: Schottky Barrier Diodes, Tunnel Diode, Transferred Electron Devices: Gunn Effect, Gunn diode as an amplifier & Oscillator, Avalanche transit time devices: IMPATT diode, TRAPATT diode, BARITT diode.

UNIT –IV

Microwave Network Analysis: Scattering Matrix, Properties of Scattering Matrix, Microwave T junctions: H-plane Tee, E-plane Tee, Magic Tee junction and its applications, Directional Couplers: Introduction and Scattering Matrix of a Directional Coupler, Wave guide Joints, Bends, Corners, Twists, Posts and Tuning Screws, Rate Race Junction, Isolator, Circulator, Attenuator, Phase Shifters, Ferrite Devices, Faradays rotation in ferrites.

UNIT –V

Microwave measurements & MMIC: Microwave Bench, Measurement of Power, Wavelength, Frequency, Impedance, SWR, Attenuation, Q and Phase Shift, Microwave Integrated Circuits: MMIC's, Strip Lines, Micro strip Lines.

SUGGESTED BOOKS & REFERENCE:-

1. *Microwave Circuits and Devices, S Y Lio, PHI*
2. *Foundation of Microwave Engineering, R E Collin, McGraw Hill*
3. *Microwave Engineering, Annapurna Das & Sisir K Das, TMH*
4. *Microwave Engineering, d m Pozar, John Wiley & Sons*
5. *Microwave and Radar Engineering, M Kulkarni, Umesh Publication*

LIST OF ELECTIVE SUBJECTS

Sub Code	L	T	P	Duration	IA	ESE	Credits
ECETh410-	3	1		3 hours	40	60	4

1. EMBEDDED SYSTEMS

UNIT-I Introduction to embedded systems: Classification, Characteristics and requirements

UNIT-II Timing and clocks in Embedded systems, Task Modeling and management, Real time operating system issues

UNIT-III Signals, frequency spectrum and sampling, digitization (ADC, DAC), Signal Conditioning and Processing.
Modeling and Characterization of Embedded Computation System

UNIT-IV Embedded Control and Control Hierarchy, Communication strategies for embedded systems, Encoding and Flow control.

UNIT-V Fault-Tolerance, Formal Verification.

SUGGESTED BOOKS & REFERENCE:-

1. H.Kopetz, *"Real-Time Systems"*, Kluwer, 1997.
2. R.Gupta, *"Co-synthesis of Hardware and Software for Embedded Systems"* Kluwer 1995.

2. MULTIRATE SYSTEM & FILTER BANKS

UNIT-I

Fundamentals of Multi-rate Systems: Basic multi-rate operations, interconnection of building blocks, poly-phase representation, multistage implementation, applications of multi-rate systems, special filters and filter banks.

UNIT-II

Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, trans-multiplexers.

UNIT-III

Para-unitary Perfect Reconstruction Filter Banks: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Para-unitary lattices, M-channel FIR Para-unitary QMF banks, transform coding.

UNIT-IV

Linear Phase Perfect Reconstruction QMF Banks: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice.

UNIT- V

Cosine Modulated Filter Banks: Pseudo-QMF bank and its design, efficient poly-phase structures, properties c cosine matrices, cosine modulated perfect reconstruction systems.

SUGGESTED BOOKS & REFERENCE:-

1 P.P. Vaidyanathan, *"Multirate Systems and Filter Banks"* Pearson Education (Asia) Pte. Ltd. 2004
2 Gilbert Strang and Truong Nguyen, *"Wavelets and Filter Banks"* Wellesley-Cambridge Press, 1996
3 N. J. Fliege, *"Multirate Digital Signal Processing"* John Wiley & Sons, U.S.A, 2000

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SPEECH SIGNAL PROCESSING

UNIT – I

Speech: Production, Perception and Acoustic-Phonetic Characterization: Introduction to Speechproduction process, Time and frequency domain representation of speech, Speech sounds and features: The vowels, Diphthongs, Semivowels, Nasal Consonants, Unvoiced Fricatives, Voiced Fricatives, Voiced & Unvoiced Stops, Acoustic-Phonetic Approach to Speech Recognition, Statistical Pattern-Recognition Approach to Speech Recognition, AI Approaches to Speech Recognition, Neural Networks and their Application to Speech Recognition.

UNIT – II

Spectral Analysis of Speech: Short time Fourier analysis, filter bank design, speech coding, subband coding of speech, transform coding, channel vocoder, formant vocoder, cepstral vocoder, vector quantizer coder.

UNIT – III

Speech Synthesis: Pitch extraction algorithms, Gold Rabiner pitch trackers, autocorrelation pitch trackers,voice/unvoicedunvoiced detection, homomorphic speech processing, homomorphic systems for convolution, complex cepstrums, pitch extraction using homomorphic speech processing.

UNIT – IV

Automatic speech recognition systems: Isolated word recognition, connected word recognition, large vocabulary word recognition systems, pattern classification, DTW, HMM, speaker recognition systems, speaker verification systems, speaker identification systems.

UNIT – V

Hidden Markov Models: Discrete-Time Markov Processes, Extensions to HMMs, Coin-toss Models, The Urnand- Ball Model, Elements of an HMM, HMM generator of observations, Three Basic problems for HMMs and their solutions, Probability Evaluation, 'Optimal' State sequence, Parameter estimation, Re-estimation procedure, HMM types, continuous observation densities in HMMs, Autoregressive HMMs, Variants on HMM structures, Inclusion of Explicit State Duration Density in HMMs, Optimization Criterion – ML, MMI and MDI, Comparisons of HMMs.

SUGGESTED BOOKS & REFERENCE:-

1. Fundamentals of Speech Recognition, Rabiner L. and Juang B., Pearson Education
2. Owens F.J., "Signal Processing of Speech", Macmillan New Electronics

4. WIRELESS SENSOR NETWORK

UNIT- I

Wireless Sensor Network: Introduction, Architecture, Hardware and Software used in Wireless Sensor Network.

UNIT- II

Sensor network application: Motion monitoring, Environmental monitoring, Generic Architecture, Sensor network Evolution.

UNIT- III

Wireless Sensor Network : Design , Goals and Issues , Sensor deployment, Scheduling and coverage issues, self configuration and topology control, Querying, data collection and processing. Collaborative information processing and group connectivity.

UNIT- IV

Wireless Sensor Routing Protocols. Data Centric, Hierarchical, Location based, Energy efficient routing,

UNIT- V