IV Year- I Semester	LOW POWER VLSI DESIGN (PE-IV)	L	T	P	C
		3	0	0	3

Course Outcomes:

Uponcompletingthis course,the studentwill beable to

- UnderstandtheneedofLowpower circuitdesign.
- Attaintheknowledgeofarchitecturalapproaches.
- AnalyzeanddesignLow-VoltageLow-Powercombinational circuits.
- KnownthedesignofLow-VoltageLow-PowerMemories

UNIT–I:

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching PowerDissipation,ShortCircuitPowerDissipation,LeakagePowerDissipation,GlitchingPower Dissipation,ShortChannelEffects–DrainInducedBarrierLoweringandPunchThrough,Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT–II:

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches.

Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, and Mask level Measures.

UNIT–III:

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures–RippleCarryAdders,CarryLook-AheadAdders,CarrySelectAdders,CarrySave Adders, Low-Voltage Low-Power DesignTechniques –Trendsof TechnologyandPowerSupply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT–IV:

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT–V:

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, MemoryCell, Pre-charge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TEXT BOOKS:

1. CMOSDigitalIntegratedCircuits–AnalysisandDesign–Sung-MoKang,Yusuf Leblebici, TMH,2011.
2. Low-Voltage,Low-PowerVLSISubsystems–Kiat-SengYeo,KaushikRoy,TMH Professional Engineering.

REFERENCEBOOKS:

1. IntroductiontoVLSISystems:ALogic,CircuitandSystemPerspective–Ming-BOLin, CRC Press,2011
2. Low Power CMOS VLSICircuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
3. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press,2002.

IV Year- I Semester	CODING THEORY AND APPLICATIONS (PE-IV)	L	T	P	C
		3	0	0	3

Course Outcomes:

Oncompletionofthiscoursestudent willbeableto

- Performthemeasurementofinformationandcomputeerrors.
- DesignLinearBlockCodesandCyclic codes.
- Constructtreeandtrelliesdiagramsfor convolutioncodes
- DesigntheTurbo codesand Spacetime codesandalsocarryouttheirapplications

UNIT–I:

CodingforReliableDigitalTransmissionandStorage: MathematicalmodelofInformation,A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies

Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, MinimumDistanceofaBlockcode,Error-DetectingandError-correctingCapabilitiesofaBlock code,StandardarrayandSyndromeDecoding,ProbabilityofanundetectederrorforLinearCodes overaBSC,HammingCodes.ApplicationsofBlockcodesforErrorcontrolindatastoragesystem **UNIT –II:**

Cyclic Codes: Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT–III:

Convolutional Codes: Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decodingand Sequential Decoding, Applications of Convolutional codes in ARQ system.

UNIT–IV:

Burst –Error-Correcting Codes: Decoding of Single-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolutional Codes, Phased-Burst –Error-Correcting Cyclic and Convolutional codes.

UNIT-V:

BCH–Codes:BCHcode-Definition,MinimumdistanceandBCHBounds,DecodingProcedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

TEXT BOOKS:

1. Error Control Coding- Fundamentals andApplications–ShuLin,DanielJ.Costello, Jr, Prentice Hall, Inc.
2. ErrorCorrectingCodingTheory-ManYoungRhee-1989,McGraw-Hill Publishing.

REFERENCEBOOKS:

1. DigitalCommunications-FundamentalandApplication-BernardSklar,PE.
2. DigitalCommunications-JohnG.Proakis,5thEd.,2008,TMH.
3. IntroductiontoErrorControlCodes-SalvatoreGravano-oxford
4. ErrorCorrectionCoding–MathematicalMethodsandAlgorithms–ToddK.Moon,2006, Wiley India.
5. InformationTheory,CodingandCryptography–RanjanBose,2ndEd,2009, TMH.

IV Year- I Semester	DSPPROCESSORSAND ARCHITECTURES (PE-IV)	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understandthebasicsof DigitalSignalProcessingandtransforms.
- Able to distinguish between the architectural features of general purpose processors and DSP processors.
- UnderstandthearchitecturesofTMS320C54xx devicesandADSP2100DSPdevices.
- Abletowritesimpleassemblylanguageprogramsusinginstructionset ofTMS320C54xx.
- CaninterfacevariousdevicestoDSPProcessors.

Unit – I: Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. ComputationalAccuracyin DSPImplementations: Numberformats forsignals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Unit – II: Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

Unit-III: ProgrammableDigitalSignalProcessors:Commercialdigitalsignalprocessingdevices, Data Addressing modes of TMS320C54XX DSPs, data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX processors, program control, TMS320C54XX instructions and programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, pipeline Operation of TMS320C54XX Processors.

Unit–IV: AnalogDevicesFamilyofDSPDevices:AnalogDevicesFamilyofDSPDevicesALU and MAC block diagram, Shifter Instruction, BaseArchitecture ofADSP2100,ADSP2181 high performanceprocessor. Introductionto BlackfinProcessor-The BlackfinProcessor, Introduction toMicrosignalArchitecture,OverviewofHardwareProcessingUnitsandRegisterfiles,Address Arithmetic Unit, Control Unit, BusArchitecture and Memory, Basic Peripherals.

Unit–V: InterfacingMemoryandI/OPeripheralstoProgrammableDSPDevices:Memoryspace organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TextBooks:

1. DigitalSignalProcessing–AvtarSinghandS.Srinivasan,ThomsonPublications, 2004.
2. APracticalApproachTo DigitalSignalProcessing -KPadmanabhan,R.Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009.
3. EmbeddedSignalProcessingwiththeMicroSignalArchitecturePublisher:Woon-SengGan, Sen M. Kuo, Wiley-IEEE Press, 2007.

ReferenceBooks:

1. DigitalSignalProcessors,Architecture,ProgrammingandApplications–B.Venkataramani and M. Bhaskar, 2002, TMH.
2. DSPProcessorFundamentals:Architectures&Features–Lapsleyetal.,S.Chand&Co. DigitalSignalProcessingApplicationsUsingtheADSP-2100Family,Prentice-Hall,Inc.
3. TheScientistandEngineer'sGuidetoDigitalSignalProcessingbyStevenW.Smith, Digital Signal Processing, California Technical Publishing, San, Diego, CA.
4. EmbeddedMediaProcessing,DavidJ.KatzandRickGentile,Elsevier, 2005.

IV Year- I Semester	SOFT COMPUTING TECHNIQUES (PE-IV)	L	T	P	C
		3	0	0	3

UNIT–I:

Introductiontosoftcomputing:

Introduction, Artificial Intelligence, Artificial Neural Networks, Fuzzy systems, Genetic Algorithm and Evolutionary programming, Swarm Intelligent systems, Expert systems, Comparison among Intelligent systems.

UNIT–II:

ArtificialNeuralNetworks:

Introduction to Artificial Neural Networks, Classification of ANNS, First generation neural networks, Perceptron network, Adaline, Madaline, Second generation neural networks, Back propagation neural networks, Hopfield Neural Network, Kohonen neural network, Hamming neural network, Radial basis function neural networks, spike neuron models.

UNIT–III:

FuzzyLogic System:

Introduction to fuzzy logic, classical sets and fuzzy sets, fuzzy set operations, fuzzy relations, fuzzy composition, natural language and fuzzy interpretations, fuzzy inference system, fuzzy controllers

UNIT–IV:

GeneticAlgorithm:

Introduction to Genetic algorithms, Genetic algorithms, procedures of Gas, working of Gas, Travelling sales man problem, Evolutionary programming, working principle of GA Machine learning classifier system

UNIT–V:

SwarmIntelligentsystem

Introduction to swarm intelligence, back ground, Ant colony system, working of ant colony optimization, Particle swarm intelligent systems, Artificial bee colony system, cuckoo search algorithm..

TEXT BOOKS:

1. 1.SoftcomputingwithMATLABprogramming—N.P.Padhy,S.P.Simon,Oxforduniversity press,2015
2. NeuralNetworksandFuzzySystems-Kosko,B.,Prentice-HallofIndiaPvt.Ltd.,1994.
3. IntroductiontoArtificial NeuralSystems-Jacek.M.Zurada,JaicoPublishingHouse,1999

REFERENCEBOOKS:

1. FuzzySets,UncertaintyandInformation-KlirG.J.&FolgerT.A.,Prentice-Hallof IndiaPvt. Ltd., 1993.
2. FuzzySetTheoryandItsApplications-ZimmermanH.J.KluwerAcademic Publishers,1994.
3. IntroductiontoFuzzyControl-Driankov,Hellendroon,NarosaPublishers.
4. ArtificialNeuralNetworks -Dr.B. Yagananarayana,1999,PHI,New Delhi.

IV Year- I Semester	DESIGN FOR TESTABILITY (PE-V)	L	T	P	C
		3	0	0	3

Course Outcomes:

UNIT-I

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSITechnologyTrendsaffectingTesting,TypesofTesting,FaultModeling:Defects,Errorsand Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT-II

Logic and Fault Simulation: Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation, ATPG.

UNIT-III

TestabilityMeasures:SCOAPControllabilityandObservability,HighLevelTestabilityMeasures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of
Scan.

UNIT-IV

Built-InSelf-Test:TheEconomicCaseforBIST,RandomLogicBIST:Definitions,BISTProcess, PatternGeneration,ResponseCompaction,Built-InLogicBlockObservers,Test-Per-Clock,Test-Per-Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST. **UNIT - V**

BoundaryScanStandard:Motivation,SystemConfigurationwithBoundaryScan:TAPController and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

TEXT BOOK:

1. M.L. Bushnell, V. D. Agrawal, "Essential of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Publishers

REFERENCEBOOKS:

1. M. Abramovici, M. A. Breuer and A.D Friedman, Digital Systems and Testable Design", JaicoPublishing House
2. P.K. Lala,"DigitalCircuitsTestingandTestability",Academic Press

IVYearI Semester	RADARENGINEERING (PE-V)	L	T	P	C
		3	0	0	3

Course Outcomes:

Aftergoingthroughthiscoursethestudentwillbe able to:

- Derivethe radarrangeequationandtosolvesomeanalytical problems.
- Understandthedifferenttypesofradarsanditsapplications.
- Understandthe conceptoftrackinganddifferenttrackingtechniques.
- Understandthevariouscomponentsofradarreceiverandits performance

UNIT–I:

Basics of Radar: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Illustrative Problems

RadarEquation: ModifiedRadarRangeEquation,SNR,probabilityofdetection,probabilityof FalseAlarm,IntegrationofRadarPulses,RadarCrossSectionofTargets(simpletargets-sphere, cone-sphere), Creeping Wave, Transmitter Power, PRF and RangeAmbiguities, System Losses (qualitative treatment), Illustrative Problems.

UNIT–II:

CWandFrequencyModulatedRadar: DopplerEffect,CWRadar–BlockDiagram,Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. Illustrative Problems

FM-CWRadar: RangeandDopplerMeasurement,BlockDiagramandCharacteristics,FM-CW altimeter, Multiple Frequency CW Radar.

UNIT-III:

MTI and Pulse Doppler Radar: Introduction, Principle, MTI Radar with - Power Amplifier TransmitterandPowerOscillatorTransmitter,DelayLineCancellers –FilterCharacteristics,Blind Speeds, Double Cancellation, Nth Cancellation Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

UNIT–IV:

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar–AmplitudeComparisonMonopulse(one-andtwo-coordinates),PhaseComparisonMono pulse, Tracking in Range,Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT–V:

Detection of Radar Signals in Noise : Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation detection and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise, Noise Figure and Noise Temperature.

Rad

arTransmitters&Receivers–Displays–types.Duplexers–BranchtypeandBalancedtype, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Series versus parallel feeds, Applications, Advantages and Limitations. Radomes Modulators, solid state

TEXT BOOKS:

1. IntroductiontoRadarSystems–MerrillI.Skolnik,TMHSpecialIndianEdition,2ndEd., 2007.

REFERENCEBOOKS:

1. Radar:Principles,Technology,Applications–ByronEdde,PearsonEducation,2004.
2. RadarPrinciples –Peebles,Jr.,P.Z.,Wiley,New York,1998.
3. PrinciplesofModernRadar:BasicPrinciples–MarkA.Richards,JamesA.Scheer, William A. Holm, Yesdee, 2013
4. RadarEngineering–GSNRaju,IK International

IVYearI Semester	DIGITALIMAGEPROCESSING (PE-V)	L	T	P	C
		3	0	0	3

CourseOutcomes:At theend ofthe course, studentwill beable to

- Describe the Image Processing system, scope ofdigital image processing and comparevarious image transforms.
- Applyfilteringoperations on images both in spatial and frequencydomain.
- DescribeImagedegradationmodelandExplaintherestorationtechniques onimages.
- AnalyzethedigitalImagesusingwaveletsandmultiresolutionprocessingandusevarious coding techniques for various image compression methods.
- Explainvarioussegmentationtechniquesondigitalimages;ExplainvariousColourmodels and Colour Image Processing.

Unit I:

Introduction: Introduction to Image Processing, Examples of fields that use Digital Image Processing, Fundamental steps in digital image processing, components of an image processing system,ElementsofVisualPerception,LightandtheElectromagneticSpectrum,Examplesofthe fields that use Digital Image Processing. Image sensing and acquisition, image sampling and quantization, Some basicrelationships between pixels, An introduction tothe mathematical tools used in digital image processing.

Image Transforms: Need for image transforms, Image transforms, Fourier Transform, 2D Discrete Fourier Transform and its properties, Walsh Transform, Hadamard transform, Haar Transform, Discrete Cosine transform, KL Transform, Singular Value Decomposition.

Unit II:

Intensity Transformations and Spatial Filtering: Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, and sharpening spatial filters.

Filtering in the Frequency Domain: The Basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering

Unit III:

ImageRestorationandReconstruction: Amodeloftheimagedegradation/Restorationprocess, Noisemodels,restorationinthepresenceofnoiseonly-SpatialFiltering,PeriodicNoiseReduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering.

Unit IV:

Wavelets and Multi resolution Processing: Imagepyramids, sub band coding, Multi resolution expansions, wavelet transforms in one dimensions& two dimensions, Wavelet packets.

Image compression: Fundamentals, Basic compression methods: Huffman coding, Golomb coding,Arithmeticcoding,LZWcoding,Run-Lengthcoding,BlockTransformcoding,Predictive coding

Unit V:

Imagesegmentation: Fundamentals,point,line,edgedetection,thresholding,andRegion–based segmentation.

Color image processing: Color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression.

TextBooks

1. R.C.GonzalezandR.E.Woods,"DigitalImageProcessing,3rdedition,Pearson,2008.

ReferenceBooks

1. Anil K.Jain, "Fundamentals ofDigitalImage Processing", PrenticeHallofIndia, 9th Edition, Indian Reprint, 2002.
2. Jayaraman,S.Esakkirajan,andT.Veerakumar,"DigitalImageProcessing",Tata McGraw-Hill Education, 2009.

IVYearI Semester	INTERNETOFTHINGS (PE-V)	L	T	P	C
		3	0	0	3

Course Outcomes:

- UnderstandinternetofThingsanditshardwareandsoftware components.
- InterfaceI/Odevices,sensors&communication modules.
- Remotelymonitordata andcontrol devices.
- DesignrealtimeIoTbasedapplications

UNITI:

Introduction to IoT Introduction to IoT, Architectural Overview, Design principles and needed capabilities, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways,Datamanagement,Businessprocesses in IoT,Everythingas a Service(XaaS),Roleof Cloud in IoT, Security aspects in IoT.

UNITII:

Elements of IoT Hardware Components- Computing- Arduino, Raspberry Pi, ARM Cortex-A classprocessor,EmbeddedDevices–ARMCortex-Mclassprocessor,ArmCortex-M0Processor Architecture,BlockDiagram,Cortex-M0ProcessorInstructionSet,ARMandThumbInstruction Set.

UNITIII:

IoT Application Development Communication, IoT Applications, Sensing, Actuation, I/O interfaces. Software Components- Programming API‟s (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, CoAP, UDP, TCP, Bluetooth. Bluetooth Smart Connectivity Bluetooth overview, Bluetooth Key Versions, Bluetooth Low Energy (BLE) Protocol, Bluetooth, Low Energy Architecture, PSoC4 BLE architecture and Component Overview.

UNITIV:

Solution framework for IoT applications Implementation of Device integration, Data acquisition and integration, Device data storage Unstructured data storage on cloud/local server, Authentication, authorization of devices.

UNITV:

IoT Case Studies IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

CloudAnalyticsforIoTApplication:Introductiontocloudcomputing,DifferencebetweenCloud Computing and Fog Computing: The Next Evolution of Cloud Computing, Role of Cloud ComputinginIoT,ConnectingIoTtocloud,CloudStorageforIoTChallengeinintegrationofIoT with Cloud.

TextBooks:

1. RajKamal,“InternetofThings:ArchitectureandDesignPrinciples”,1stEdition, McGraw Hill Education, 2017.
2. TheDefinitive GuidetotheARMCortex-M0 byJosephYiu,2011.
3. VijayMadisetti,ArshdeepBahga,InternetofThings,“AHandsonApproach”, University Press, 2015.

References:

1. CypressSemiconductor/PSoC4BLE(Bluetooth LowEnergy)ProductTrainingModules.
2. PethuruRajandAnupamaC.Raman,“TheInternetofThings:EnablingTechnologies, Platforms, and Use Cases”, CRC Press, 2017.

IVYearI Semester	PRINCIPLESOFCELLULAR& MOBILE COMMUNICATIONS (OE-IV)	L	T	P	C
		3	0	0	3

OUTCOMES:

- Thestudent will beable to understandimpairments duetomultipath fading channel
- Thestudentwillbeabletounderstandthefundamentaltechniquestoovercomethe different fading effects
- Thestudent willbe ableto understandco-channel andnon co-channel interferences.
- Thestudentwillbeabletounderstandthefrequencymanagement,channelassignmentand types of handoff
- ThestudentwillbeabletounderstandtheMultipleaccessschemesinmobilecommunications

UNIT I CELLULAR SYSTEMS: Limitations of Conventional System, Basic Cellular Mobile System, First, second, third and fourth andGeneration cellular wireless systems. Operation of Cellular System. Uniqueness of Mobile Radio Environment –Fading, coherence bandwidth, Doppler Spread. Fundamentals of cellular Radio System Design: concept of frequency reuse channels, Co-channel Interference,Co-channel InterferenceReductionFactor,desiredC/Ifrom a normal case in a Omni directional Antenna system. Trunking and grade of service

UNITIICO-CHANNEL&NON-CO-CHANNELINTERFERENCE: MeasurementofReal Time Co-Channel Interference, design of Antenna system, Antenna parameters and their effects, diversity techniques: Space Diversity, Polarization diversity, frequency diversity and time diversity. Non-co channel interference-adjacent channel interference.

UNITIIIFrequencyManagementAndChannelAssignment: Numberingandgrouping,setup access and paging channels ,channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non fixed channel assignment

UNIT IV HANDOFFS: Handoff Initiation, types of handoff, delaying handoff, advantages of Handoff, power difference handoff, forced handoff, mobile assisted and soft and Hard handoffs. Intersystem and Intrasystem handoffs, Concept of Call drop rates.

UNIT V Multiple access schemes in mobile communications: TDMA, FDMA, CDMA. IntroductiontoMIMOsystemsPrinciplesofCDMAcellularsystems,PrinciplesofOFDMbased broadbandwirelesssystems,4GLTEbasics–OFDM,andOFDMA,Generalisedframeworkfor Filtered OFDM and FBMC .Introduction of 5G

TEXT BOOKS:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006. 2. Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.
2. T.S.Rappaport,“WirelessCommunications–PrinciplesandPractice”(2ndedition)Pearson, 2010, ISBN 9788131731864

REFERENCES:

1. PrinciplesofMobileCommunications–GordonL.Stuber,SpringerInternational2ndEdition, 2001.
2. ModernWirelessCommunication –SimonHaykinMichaelMoher,PersonsEduction,2005.
3. WirelessCommunicationtheoryandTechniques,AsrarU.H.Sheikh ,Springer,2004.
4. A.Goldsmith,“WirelessCommunications,”CambridgeUnivPress,2005
5. D. Tse and P. Viswanath, “Fundamentals of Wireless Communications,” Cambridge UnivPress, 2005

IVYearI Semester	FUNDAMENTALSOFSATELLITE COMMUNICATIONS (OE-IV)	L	T	P	C
		3	0	0	3

UNITI

INTRODUCTION: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications. Orbital Mechanics, launches and launch vehicles, Orbital effects in communication systems performance

UNITII

SATELLITESUBSYSTEMS: Attitudeandorbitcontrolsystem,telemetry,tracking,Command and monitoringsystem, power systems, communication subsystems, Satellite antennas, Equipment reliability and Space qualification

UNITIII

SATELLITELINKDESIGN: Basictransmissiontheory,linkequation,C/Nratio,systemnoise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

UNITIV

MULTIPLE ACCESS: Frequency division multiple access (FDMA): Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA); Frame structure, Examples. Code Division Multiple access (CDMA): Spread spectrum transmission and reception.

UNITV

GLOBALNAVIGATIONSATELLITE SYSTEM(GNSS):

Introduction,variousGNSS:GPS,GLONASS,GALILEO,BeiDou,QZSS,IRNSS.GPS-location principle,GPSnavigationmessage,GPSreceiveroperation,differentialGPS;IRNSS-introduction, IRNSS satellites, IRNSS constellation, IRNSS configuration, IRNSS services, navigation data, applications of IRNSS; multi GNSS.

TEXT BOOKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 3RD Edition, 2020.
2. SatelliteCommunicationsEngineering–WilburL.Pritchard,RobertANelsonandHenri G.Suyderhoud, 2nd Edition, Pearson Publications, 2003.

REFERENCES:

1. Satellite Communications: Design Principles– M. Richharia, BS Publications, 2nd Edition,2003.
2. SatelliteCommunication-D.CAgarwal,KhannaPublications,5thEd.
3. SatelliteCommunications –DennisRoddy,McGrawHill,2ndEdition

IVYearI Semester	EMBEDDEDSYSTEMS (OE-IV)	L	T	P	C
		3	0	0	3

COURSEOUTCOMES:

- Understandthebasicconceptsofanembeddedsystemandabletoknowanembeddedsystem design approach to perform a specific function.
- Thehardwarecomponentsrequiredforanembeddedsystemandthedesignapproachofan embedded hardware.
- Thevariousembedded firmwaredesignapproaches onembeddedenvironment.
- Understandhowtointegratehardwareandfirmwareofanembeddedsystemusingrealtime operating system.

UNIT-I

INTRODUCTION: Embeddedsystem-Definition,historyofembeddedsystems,classificationof embeddedsystems,majorapplicationareasofembeddedsystems,purposeofembeddedsystems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT-II

EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

UNIT-III

EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmwaredevelopmentlanguages,ISRconcept,Interruptsources,Interruptservicingmechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT-IV

REAL TIME OPERATING SYSTEM: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

HARDWARE SOFTWARE CO-DESIGN: Fundamental Issues in Hardware Software Co-Design,Computationalmodelsinembeddeddesign,HardwaresoftwareTrade-offs,Integrationof Hardware and Firmware.

UNIT-V:

EMBEDDEDSYSTEMDEVELOPMENT,IMPLEMENTATIONANDTESTING:The integrateddevelopmentenvironment,Typesoffilesgeneratedoncross-compilation,Deassembler/ De-compiler, Simulators, Emulators and Debugging, Target hardware debugging,
Embedded Software development process and tools, Interpreters, Compilers and Linkers, debuggingtools,Qualityassuranceandtestingofthedesign,Testingonhostmachine,Simulators, Laboratory Tools.

TextBooks:

1. Embedded Systems Architecture-ByTammyNoergaard, Elsevier Publications, 2013.
2. EmbeddedSystems-ByShibu.K.V-TataMcGrawHillEducationPrivateLimited,2013.

References:

1. EmbeddedSystem Design,Frank Vahid,TonyGivargis, JohnWileyPublications, 2013.
2. EmbeddedSystems-LylaB.Das-PearsonPublications,2013.

IVYearI Semester	TRANSDUCERSANDSIGNAL CONDITIONING (OE-IV)	L	T	P	C
		3	0	0	3

CourseOutcomes:At theend ofthe course, studentwill beable to

- ChooseSuitablesensor/transducerforagivenphysicalvariableandunderstandits principle, characteristics and determine order of the sensor.
- Measuredisplacement,pressure,flow,temperature variables.
- Designsuitablesignal conditioningcircuitforsensor/transducers.
- Analyzethebridgecircuits forcalculatingL,C, R.
- Understandnoisereductionusinggroundingandshieldingtechniquesanddesignhigh input impedance instrumentation amplifiers

UNIT– I

GeneralizedPerformancecharacteristicsof Instruments:

Functional elements of an instrument, generalized performance characteristics of instruments-static characteristics, dynamic characteristics, Experimental determination of measurement system parameters, loading effects under dynamic conditions.

UNIT– II

SignalConditioningCircuits:

Signal Generator- fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse,sweep, Arbitrary waveform. Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.
SignalConditioningCircuits:
INTRODUCTION: Need for pre-processing, identification of signal conditioning blocks and their characteristics. BRIDGE CIRCUITS: Analysis of DC and AC bridges with applications

UNIT– III

Transducers:MotionandDimensionalMeasurements:Relativedisplacement,translationand rotational resistive potentiometers, resistance strain gauges, LVDT, capacitance pickups. Piezo-electrictransducers.
ForceMeasurement:Bondedstraingaugetransducers,variablereluctancepickup,torque measurement dynamometers.
PressureMeasurement:Manometers,elastictransducers,veryhigh-pressuretransducers, thermal conductivity gauges.
Temperature Measurement: Thermal expansion methods, thermometers (liquid in glass), Thermocouplesmaterials,Thermistors,JunctionsemiconductorsandSensors.Smartsensors, MEMS and Nano Sensors.

UNIT– IV

Intelligent Sensors: definition of intelligent instrumentation, types of instruments, Static Characteristics: Accuracy and Precision, Error, Correction, and Uncertainty, Repeatability, Reproducibility, and Hysteresis, Sensitivity, Offset, and Dead Band, Resolution and Linearity, StatisticalCharacteristics,ErrorModeling,DynamicCharacteristics,DynamicErrorand

DynamicSensitivity,Input-OutputImpedances.,HistoricalPerspective,Currentstatus,software based instruments.
Classification,Smartsensors,CogentSensors,SoftorVirtualsensors,Self-AdaptiveSensors, Self-Validating Sensors, Temperature Compensating Intelligent Sensors, Pressure Sensor, Indirect Sensing

UNIT– V

Instrumentation Amplifiers & Isolation Amplifiers: Specifications and use of instrumentation amplifiers for signal conditioning circuits using commercial ICs. Necessity for isolation amplifiers,industrialandmedicalapplicationsofisolationamplifiers,GroundingandShielding.

TextBooks:

1. MeasurementSystems-ApplicationandDesign,DOEBELIN,E.O.,McGrawHill, 4th Ed.1990
2. Electronic Instrumentation&Measurements-DavidA.Bell,PHI,2ndEdition, 2003.
3. ManabendraBhuyan,—IntelligentInstrumentation:PrinciplesandApplications‖CRC Press,2011.

ReferenceBooks:

1. InstrumentationSystemsandDevices,Rangan,Mani,Sarma.,TataMcGrawHill.2nded
2. TransducersandInstrumentation,Murthy,D.V.S.,PHI,NewDelhi.

IVYearISemester	QUANTUMSCIENCEAND TECHNOLOGY (OE-IV)	L	T	P	C
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Prerequisites: BasicPhysics, LinearAlgebra,andIntroductiontoModernPhysics

Course Objectives:

1. Tointroducefundamentalconceptsofquantummechanicsanditsmathematicalformalism.
2. Toexplorequantumcomputingandcommunicationprinciplesand technologies.
3. Tounderstandthephysicalimplementationandlimitationsofquantumsystems.
4. Toenablestudentstorelatequantumtheorytopracticalapplicationsincomputing,cryptography, and sensing.
5. Tofamiliarizestudentswiththe emergingtrendsinquantum technologies.

Course Outcomes:

Aftercompletingthiscourse, students willbeableto:
CO1.Explaincoreprinciplesofquantummechanicsandtheirtechnologicalimplications. CO2. Analyze quantum phenomena like superposition and entanglement.
CO3.Applymathematical tools tomodel and solvequantum systems.
CO4.Demonstrateunderstandingof quantumalgorithmsandquantum circuits.
CO5.Evaluatepotentialapplicationsandchallengesinquantumcommunicationandsensing.

Unit 1: Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions.

Unit2:QuantumInformationTheory: Classicalvs.quantuminformation;Qubitrepresentation usingBlochsphere;Quantumsuperpositionandquantumentanglement;Diracnotation(bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)

Unit3:QuantumComputing: Classicalcomputingreviewandlimitations;Quantumparallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum FourierTransform(QFT);Quantumerrorcorrection:Bit-flip,phase-flip,andShor's9-qubitcode; Introduction to quantum programming: Qiskit, Cirq, IBM Quantum Experience (overview)

Unit 4: Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); EavesdroppingandsecurityofQKD;Quantum teleportation(circuit andprotocol);Quantum dense coding; Quantum networksandentanglement swapping; Roleofquantum repeaters;Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise)

Unit 5: Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry;Quantummetrology:standardtime,atomicclocks;Quantumimagingandlithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacyand NISQ era; Global initiatives: IBM, Google, D-Wave, IonQ, India's NQM; Ethical concerns and future prospects

TextBooks:

1. **"QuantumComputationandQuantumInformation"** byMichaelA.Nielsenand Isaac L. Chuang
2. **"QuantumMechanics: Conceptsand Applications"**byNouredineZettili

OnlineLearning Resources:

1. https://nptel.ac.in/courses/104104082
2. https://nptel.ac.in/courses/115104096https: //nptel.ac.in/courses/122106034