DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS 2011-2012 AND 2018-2019

Course code	**Course name**
EC 901	Probability and Stochastic Processes
EC 902	Advanced Digital Communication
EC 903	Advanced Digital Signal Processing
EC 927	Advanced Information Theory and Coding Techniques
EC 930	Advanced Embedded Systems Design
EC 922	Wireless Sensor Networks
EC 908	Seminar
EC 904	RF Engineering
EC 905	High Performance Communication Networks
EC 906	Embedded Core Design
EC 928	Mobile Satellite Communication
EC 913	Wireless Communication Systems
EC 916	CDMA and OFDM for Wireless Communication
EC 907	Advanced Communication andEmbedded Systems Laboratory
EC 909	Project Phase-I
EC 926	Multimedia Compression Techniques
EC 910	Project Phase II
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EC 910	Project Phase II
Course code	**Course name**
ECENG 510	Communication and Embedded Systems Laboratory - I
ECENG 511	Advanced Digital Communication
ECENG 512	Advanced Engineering Mathematics
ECENG 513	Embedded Systems and VLSI Design
ECENG 514	High Speed Semiconductor Devices
ECENG	Advanced Information Theory and Coding

532	Techniques
ECENG 531	Advanced Image Processing
ECENG 520	Communication and Embedded Systems Laboratory - II
ECENG 521	Advanced Digital System Design
ECENG 522	Advanced Digital Signal Processing
ECENG 523	Advanced Wireless Communications
ECENG 524	Modern Communication Systems
ECENG 553	High Performance Communication Networks
ECENG 557	Pattern Recognition and Artificial Intelligence
EC 909	Project Phase-I
EC 928	Mobile Satellite Communication
EC 910	Project Phase II
Course code	**Course name**
ECENG 644	Vehicular Ad-hoc Networks (VANET)
ECENG 638	Internet of Every Things (IoET)
ECENG 636	Free Space Optical Networks
ECENG 610	Internship / Seminar/ Workshop / Conference / FDP / Short term course / NPTEL/GIAN/MOOC Course
ECENG 611	NPTEL/GIAN/MOOC Course

ECENG 612	Project – Literature Survey
ECENG 620	Project and Viva Voce
ECENG 621	Publication
ECENG 510	Communication and Embedded Systems Laboratory - I
ECENG 511	Advanced Digital Communication
ECENG 512	Advanced Engineering Mathematics
ECENG 513	Embedded Systems and VLSI Design
ECENG 514	High Speed Semiconductor Devices
ECENG 534	Advanced Optical Communication
ECENG 539	Mobile Communication System
ECENG 520	Communication and Embedded Systems Laboratory - II
ECENG 521	Advanced Digital System Design
ECENG 522	Advanced Digital Signal Processing
ECENG 523	Advanced Wireless Communications
ECENG 524	Modern Communication Systems
ECENG 554	Industrial Electronics
ECENG 557	Pattern Recognition and Artificial Intelligence

EC ENG511 – ADVANCED DIGITAL COMMUNICATION

CO No	Descriptions
CO1	Summarize about the Digital Modulation Techniques such as BPSK,QPSK,DPSK,MSK,GMSK,M-ary PSK, M-ary QAM.
CO2	Describe about the signals corrupted by Additive White Gaussian Noise Channel, and to outline the performance of the optimum receiver for memory less modulation;
CO3	Summarize about pulse shaping and linear equalization and its variations
CO4	Generalize about the Carrier and Symbol Parameter Estimation such as Carrier phase estimation - symbol timing estimation - joint estimation of carrier phase and symbol timing - performance characteristics of ML estimators.
CO5	Practice the Different digital modulation - AWGN channel - equalization techniques and synchronization using simulation

EC902 – ADVANCED DIGITAL COMMUNICATION

CO No	Descriptions
CO1	Summarize about the elements of a digital communication systems, digitally modulated signals and the signaling schemes memory and without memory
CO2	Describe about the signals corrupted by Additive White Gaussian Noise Channel, and its probability of error in band limited and power limited signals. Discuss about the coherent, partially coherent and non-coherent receivers and its impact on different channel characteristics
CO3	Compute the different block coded and convolution coded digital communication systems.
CO4	Summarize about pulse shaping and linear equalization and its variations
CO5	Generalize about the Carrier and Symbol Parameter Estimation such as Carrier phase estimation - symbol timing estimation - joint estimation of carrier phase and symbol timing - performance characteristics of ML estimators.

EC 929 - ADVANCED IMAGE PROCESSING

CO No	Descriptions
CO1	Explain the Elements of visual perception, Steps in Image Processing Systems, Image sensing and Acquisition Sampling and Quantization, Pixel Relationships, Colour Fundamentals and Models. And also discuss the image Basis Function of Two dimensional DFT, DCT, Discrete Sine, Walsh, Hadamard transform, Slant, Haar, KLT and SVD.
CO2	Illustrate the image enhancement of gray level Transformations, Histogram Processing, Spatial Filtering, Image Smoothing and Sharpening, Fuzzy techniques for intensity transformations and spatial filtering. Filtering in Frequency Domain, Image Smoothing and Sharpening filters, Homomorphic Filtering. Colour transformations, colour image smoothing and sharpening and explain the Image restoration techniques.
CO3	Discuss the Multi Resolution Analysis of Image Pyramids, subband coding, Multi resolution expansion, Wavelet Transforms, Fast Wavelet transforms, Wavelet Packets and also explain the need for data compression in image processing.
CO4	Describe image segmentation and description of Point and line detection, edge detection, Edge Operator, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Segmentation using morphological watersheds, use of Motion in Segmentation, Image segmentation based on colour and also discuss its representation.
CO5	Summarize the Image Recognition of Patterns and pattern classes in various theoretic methods and also explain the Fuzzy system in optimization techniques for recognition, Genetic algorithm, Simulated annealing.

ECENG 523–ADVANCED WIRELESS COMMUNICATIONS

CO No	Descriptions
CO1	Summarize the cellular concept of channel reuse, handoff strategies to improve the channel capacity and also summarize the second and third generation network standards. Summarize the Frequency division multiple access-time division multiple access-spread spectrum multiples access-space division multiple access
CO2	Discuss the - channel modeling methods - radio channelsindoor channels - outdoor channels - fading channels. Describe the concepts of small scale, large scale fading and statistical models for multipath fading channels in mobile radio propagation.
CO3	Discuss the Structure of a wireless communication link and linear, constant envelope modulation techniques for wireless communication. Analyze the error performance in fading channels and combined fast, slow fading - equalization - different detection techniques used in wireless communication.
CO4	Describe the Alamouti scheme - orthogonal and quasi orthogonal space time block codes-space time trellis codesspace time code design principles. performance analysis and comparison of space-time block and trellis codes.
CO5	computethe modulation and multiple access technique for wireless communication using related MATALB.

EC 916 CDMA AND OFDM FOR WIRELESS COMMUNICATION

CO No	Descriptions
CO1	Explain Direct sequence and frequency hopping spread spectrum communication system with the usage of PN codes and Walsh codes also explain the Rake receiver its Capacity, Effects of loading, sectorization and voice activity, Power control, Hand off and also discuss the Link structure of CDMA system.
CO2	Illustrate the Call processing, Initialization, idle, access and traffic states for CDMA system and also discuss the Calculation of Ec/I0 and Eb/N0, Traffic intensity, Grade of Service, Erlang-B and C models using Forward link and reverse link analysis.
CO3	Discuss the OFDM principles, system model, Generation of sub carrier using IFFT, guard time and cyclic extensions, windowing of an OFDM system and also discuss the Choice of OFDM parameters, OFDM signal processing.
CO4	Describe the FEC coding, Interleaving, QAM, Coded modulation, Synchronization using cyclic extension and special training symbols for an OFDM system and also discuss the Coherent detection using One and two dimensional channel estimation, Special training symbols, Decision directed channel estimation, Differential detection in the time and frequency domain.
CO5	Explain the Frequency hopping in OFDMA, OFDMA system description, Channel coding, modulation, time and frequency synchronization, Combination of OFDM and CDMA and also discuss the MC-CDMA, MT-CDMA and MC-DS CDMA systems difference between OFDMA and MC-CDMA

ECENG 644- VEHICULAR AD-HOC NETWORKS (VANET)

CO No	Descriptions
CO1	Discuss the basic theories, principles, technologies, standards and system architecture of vehicular networks.
CO2	Ability to analyze, design, and evaluate vehicular communication technologies for various kinds of safety models and infotainment applications.
CO3	Explain the working of different routing Protocols and DSRC regulations and standards.
CO4	Discuss the requirement ,challenges of Vanet supporting properties, Digital signatures and explain the detection of malicious data and secure position verification
CO5	Practice Simulation of vehicle to vehicle communication , vehicle to infrastructure and infrastructure to vehicle communication using related tool

ECENG 521-ADVANCED DIGITAL SYSTEMDESIGN

CO No	Descriptions
CO1	Analyze the clocked synchronous sequential circuits and modeling using state diagram, state table, state table assignment and reduction Designthe iterative circuits using ASM chart and realization using ASM.
CO2	Analyze the asynchronous sequential circuit, Designof asynchronous sequential circuit, static anddynamic methods, flow table reduction, races, state assignment transition table and problems intransition table, essential hazards, data synchronizers, mixed operating mode asynchronouscircuits.
CO3	Designa synchronous sequential circuit using PLA/PAL, realization of finite state machine using PLD/FPGA.
CO4	Analyze the diagnosis method, Path sensitization method, Boolean difference method, D – algorithm tolerance techniques, compact algorithm, fault in PLA/PAL, test generation,built in self-test.
CO5	Review the Simulation of synchronous/ asynchronous sequential circuits of Logic compilation, two level andmultilevel logic. Synthesize the sequential logic circuit, technologymapping, tools for mapping toPLDs and FPGAs.

ECENG 522ADVANCED DIGITAL SIGNAL PROCESSING

Expected Outcome

The students will be able to

CO No	Descriptions
CO1	Summarize the classification , advantages of digital signal Processing and the use of Multirate signal Processing using decimation and Interpolation .
CO2	Compute the PSD for a Discrete Random signal using Parametric and Non Parametric methods with the help of to Yule walker equations.
CO3	Dramatize the FIR adaptive filtering approach using SD and LMS methods and show the equalization, echo and noise cancellation. Also dramatize the IIR adaptive filtering through RLS methods.
CO4	Explain the application of Wavelet transforms in digital signal processing with the help of Haar and Daubechies wavelets.
CO5	Demonstrate the EEC/ECG signal generation, Echo cancellation, Voice recognition and speech-to-text conversion using MATLAB

EC 903 ADVANCED DIGITAL SIGNAL PROCESSING

CO No	Descriptions
CO1	Analyze the given discrete signal with Fourier transform and apply the concept for Discrete Random signals to obtain the PSD and filtering outputs of white noise.
CO2	Compute the PSD for a Discrete Random signal using Parametric and Non Parametric methods
CO3	Illustrate the Linear Prediction model and solution to Normal equations through LS, Wiener methods .
CO4	Dramatize the FIR adaptive filtering approach using SD and LMS methods and show the equalization, echo and noise cancellation. Also dramatize the IIR adaptive filtering through RLS methods.
CO5	Demonstrate the Multirate signal Processing using Decimation and Interpolation and realize FIR filters using Polyphase structures with an application to subband coding.

ECENG 535 - ADVANCED SATELLITE COMMUNICATION

CO No	Descriptions
CO1	Employ angle period, returning period, orbital spacing, delay transponder, earth stations, antennas and earth coverage, altitude and eclipses for orbits of satellites and also explain the Different Multiple Access techniques an demand assigned.
CO2	Illustrate the working of Space Segment using Power supply, altitude control, station keeping, thermal control, TT and C subsystem, transponders and Earth Segment using Receive only home TV system, outdoor unit, indoor unit, master antenna TV system and community antenna TV system.
CO3	Discover the Satellite's uplink and downlink using System noise temperature, G/T ratio, C/N ratio and error control for digital satellite link.
CO4	Discuss the system design procedure of VSAT Systems using Network architectures, access control protocols, earth station engineering, antennas and link margins.
CO5	Use a simulation tool Simulate the link budget for transponders, antenna systems and for two satellite systems.

EC 927 - AIT&CT

CO No	Descriptions	Blooms Taxonomy Level
CO1	Compute the Average information content of symbols in long dependent and independent sequences using uncertainty and information, average mutual information, Average self information, Average conditional self information, Measures and content of information. Also Illustrate the Markoff statistical model for information sources, Entropy and information rate of Markoff sources, and Information measure for continuous random variables.	**Application** Compute
CO2	Describe basics of Communication channels for Discrete communication channel, Rate of information transmission over a discrete channel, capacity of a discrete memory less channel continuous channel, Shannon and Hartley theorem and its implications. And also Classify channel capacity–BSC, BEC, cascade channels, symmetric channel, unsymmetric channel and their capacities-Information capacity theorem, Shannon limit, channel capacity for MIMO system.	**Comprehension** Describe
CO3	Describe the Purpose of source coding technique and Uniquely decipherable codes, State Shannon's I and II fundamental theorem, Source coding theorem, Huffman coding. Compute Shannon fano-Elias coding, Arithmetic coding –Lempel- Ziv algorithm-Run length encoding and PCX format-Rate distortion function-optimum quantizer design-JPEG standard for lossless and lossy compression	**Application** Compute
CO4	Discuss Error detection and correction capability perfect codes, Hamming codes, Low density parity check (LDPC) codes, Optimal linear codes, Maximum distance separable (MDS) codes-Bounds on minimum distance-space time block codes quasi cyclic codes and shortened cyclic codes and shortened cyclic codes, Fire codes, Golay codes ,CRC codes, BCH codes, RS codes. And also classify different methods of Linear block codes and cyclic codes-Galois fields, Vector spaces and matrices, Noisy channel coding theorm, extend Matrix description of linear blocks codes-Equivalent codes-parity cheek matrix Decoding of linear block codes , Method fee generating cyclic codes- Matrix description of cyclic codes, syndrome calculation,	**Comprehension** Discuss
CO5	Discuss Convolution and Trellis codes. And also classify the codes of - Tree codes and Trellis codes, polynomial description of convolutional codes-Viterbi decoding of convolutional codes distance bounds, performance bounds. And also Extend Turbo codes-Turbo decoding-Interleaver design concept of coded modulation, Ungerboecks TCM-Design rules-Decoders, TCM for AWGN channel, TCM for fading channel, Space Time Trellis Codes.	**Comprehension** Discuss

ECENG 534ADVANCED OPTICAL COMMUNICATION

CO No	Descriptions
CO1	Summarize the light generation and transmission for optical networks with reference to second and Third order nonlinear optical effects which include SFG, DFG, THG, FWM and Sf concepts
CO2	Discuss the effects of noise and channel impairments on optical transmission and describe the advanced and multilevel modulations employed in optical communication.
CO3	Dramatize the coherent , heterodyne, intradyne detection system of optical signals and DPSK, OFDM and MIMO systems employability in optical communication
CO4	Compute the channel capacities of normal optical system, OFDM optical system and MIMO optical systems with the help of Information capacity theorems
CO5	Simulate using OPTIFDTD system the two dimensional photonic crystal, ring resonator and Y-shaped waveguide and Analyze second order nonlinearity and four-wave mixing.

ECENG 631 - Bio Sensors

CO No	Descriptions
CO1	Summarize Basic principle of bio sensor- components of bio sensor- classification of biosensors - applications.
CO2	Illustrate the Semiconductor substrates for bio electronics - silicon - diamond - chemical functionalization - covalent attachment of biomolecules to silicon surfaces - DNA modified silicon and diamond surfaces.
CO3	Discuss-Anti body as bio recognition element: Types of anti-bodies and anti-body fragments; Types of immune sensors - labeled and label-free sensors - immune sensor applications.
CO4	Discuss the Piezoelectric semiconductor - impedimetric - mechanical and molecular electronics based transducers - Chemi - luminescence based bio sensors.
CO5	Synthesize-Simulation of biosensors for various applications: clinical chemistry-medicine and health care- veterinary - industrial processes - environmental monitoring using related tools.

ECENG553–HIGH PERFORMANCE COMMUNICATION NETWORKS

CO No	Descriptions
CO1	Describe the different types of communication Networks: Telephone and computer networks, cable television networks, wireless networks and its Layered architecture, network bottlenecks, network elements and mechanisms, traffic characterization and QoS.
CO2	Illustrate the Multihop wireless broadband networks, mesh networks, MANET architecture and its classification of routing protocols, routing metrics, packet scheduling algorithms, power control mechanism.
CO3	Discuss the concepts of Internet Protocol, TCP and UDP and Circuit switched networks: SONET, DWDM, fiber to the home, DSL and describe theIntelligent Network (IN) scheme, CATV and layered network, services over CATV.
CO4	Explainthe concepts of WiFi, WIMAX, UWB, LTE and LTE-A networks with their architecture and frame structure. Comparison of broadband technologies.
CO5	Apply the concepts ofWifi network, WiMAX network in mesh mode and multihop relay mode, integration of LTE - A and WiMAX network with single IP network in simulation and study the characteristics.

EC ENG514 – HIGH SPEED SEMICONDUCTOR DEVICES

CO No	Descriptions	Blooms Taxonomy Level
CO1	Recognize the structure of crystals, electrons in the periodic lattice, energy band diagram, carrier concentration, transport phenomenon and their physical properties such as electrical, optical, thermal & high field properties.	**Comprehension Recognize**
CO2	Summarize different crystal growth and wafer fabrication techniques such as epitaxy, dielectric film deposition, oxidization techniques, masking & lithography techniques, diffusion, ion implantation, metallization, bipolar & MOS integration techniques and interface passivation techniques.	**Comprehension Summarize**
CO3	Demonstrate the Structure, band diagram, operation, characteristics of M-S junction, MOS junction, MOSFET and their properties such as breakdown, punch through, sub threshold current and scaling down. Discuss about the advanced MOSFET concepts such as High k-dielectric materials, SOI MOSFET, buried channel MOSFET, charge coupled devices.	**Application Demonstrate**
CO4	Discuss the Structure, band diagram, operation, characteristics AlGaAs/ GaAs, InP & SiGe based HBT and HEMT Devices. Summarize the benefits of heterojunction and Nano devices such as Resonant tunneling diode & transistor, SET, FinFET, nanowire FET.	**Comprehension Discuss**
CO5	Compute the simulation of MOSFET, HBT /HEMT, FinFET, SET using related tools	**Application Compute**

EC 923 - MULTIMEDIA COMPRESSION TECHNIQUES

CO No	Descriptions
CO1	Extend the Fundamental Concepts of audio, video in analog and Digital formats using the components of multimedia software tools, Graphics and Image Data Representations, Data types and Storage requirements for multimedia applications and also explain the Need for Compression and Taxonomy of compression techniques
CO2	Recognize the Data Compression using Huffman coding, Arithmetic coding, Adaptive Huffman Coding, Adaptive Arithmetic Coding, Dictionary Methods and LZW algorithm.
CO3	Describe the Digital audio compression techniques using μ Law and A Law companding, ADPCM and Speech compression techniques using waveform codecs, source codecs, hybrid codec, and Shorten compressor MPEG-1 audio layers
CO4	Express the Image Compression techniques using Image and orthogonal transforms, DCT, JPEG, progressive image compression, JBIG, JBIG2 standards , Vector quantization, Differential lossless compression, DPCM Wavelet based compression, Filter banks, DWT, Multi resolution decomposition, SPIHT and EZW Coders, and JPEG 2000 standards.
CO5	Summarize the Video Compression methods using Video signal components, MPEG Video Coding, Motion Compensation, H.261, H.263 Standard , MPEG4 and H.264 codecs.

EC 904 - RF ENGINEERING

CO No	Descriptions
CO1	Summarize RF Resistors, capacitors and Inductors performance and Transmission lines performance using smith chart and also explain the use ADCD and S parameters.
CO2	Illustrate the working of PIN ,GUNN diodes and BJT , FET Transistors in RF band and apply them for designing LNA, Power applifies , Differential amplifiers, Distributed power amplifiers and Broad band amplifiers.
CO3	Employ RF circuit concepts for RF Oscillator, RF Mixers and RF filters and Resonators
CO4	Discuss the RF IC Design concepts and the parameters involved in RF IC packaging.
CO5	Use RF System design concepts in designing Spread spectrum communication, GPS, Datam, Receiver design for FM broadcast, Digital cellular, Multimeter wave point to point, Direct conversion GSM receiver also show the RF MEMS Implementation and Applications.

EC 937 VLSI SYSTEM DESIGN

COURSE INFORMATION SHEET

SYLLABUS:

Unit	Contents of the syllabus	Hours
I	**Combinational Circuit Design** Static CMOS Circuits – Mirror Circuits – Pseudo NMOS – Tristate Circuits - Clocked CMOS – Dynamic CMOS logic Circuits – Domino Logic – Dual rail logic networks – DCVSL – Complementary pass transistor logic.	12
II	VLSI System Components Multiplexers – Binary Decoders – Equality Detectors and Comparators – Priority Encoder – Shift and Rotation Operations – Latches – Flip-flops – Registers – Single bit addition – Carry – Propagate Addition – Carry Generation and Propagation – Manchester Carry Chain – Carry Skip Adder – Carry Look Ahead adder.	12
III	System Level Physical Design Large scale physical Design – Interconnect Delay Modeling – Crosstalk – Interconnect Scaling – Floor planning and Routing – Input and Output Circuits – Power Distribution and Consumption – Low Power Design Considerations.	12
IV	VLSI Clocking and System Design Clocked Flip-flops – CMOS clocking styles – Pipelined system – Clock Generation and Distribution – System Design Considerations.	12
V	Reliability and Testing Of VLSI Circuits General Concepts – CMOS Testing – Test Generation Methods	12

Text Book:

1. John.P.Uyemura, " Introduction to VLSI Circuits and System" , Wiley India , 2008.

Reference Book:

1. Neil H.E.Weste, David Harris and Ayan Banerjee, "CMOS VLSI Design," Pearson Education, 2008.

Expected Outcome

The students will be able to

CO No	Descriptions	Blooms Taxonomy Level
CO1	Use combinational circuit design concepts in designing mirror circuits, Pseudo NMOS, Tristate Circuits, Clocked CMOS, Dynamic CMOS logic Circuits, Domino Logic, Dual rail logic networks , DCVSL , Complementary pass transistor logic. .	**Application Use**
CO2	Illustrate the working of Multiplexers, Binary Decoders ,Equality Detectors and Comparators ,Priority Encoder ,Shift and Rotation Operations ,Latches ,Flip-flops , Registers and apply them for	**Application Illustrate**

	designing Single bit addition Carry Propagate Addition , Carry Generation and Propagation ,Manchester Carry Chain ,Carry Skip Adder , Carry Look Ahead adder.	
CO3	Discuss the Large scale physical Design concepts and the parameters involved in Interconnect Delay Modeling , Crosstalk , Interconnect Scaling ,Floor planning and Routing, Input and Output Circuits , Power Distribution and Consumption , Low Power Design Considerations.	**Comprehension Discuss**
CO4	Discuss the concepts of Clocked Flip-flops , CMOS clocking styles, Pipelined system, Clock Generation and Distribution, System Design Considerations..	**Comprehension Discuss**
CO5	Summarize the general concepts of CMOS testing using test generation methods	**Comprehension Summarize**

PO for PG

Post Graduate Engineering Graduates will be able to:

PO1. Identify, formulate, review research literature, and analyze complex problems in Electronics and Communication Engineering.

PO2: Design solutions for complex engineering problems in Electronics and communication and design system components or processes that meet the specified needs.

PO3. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO4: Demonstrate appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities

PO5: Express and rewrite a significant technical report/document.

PO6 : Apply ethical principles and efficiently manage Projects with financial considerations on Problems related to Electronics and Communication.

CO-PO/PSO Mapping

	PO1 K5	PO2 K5	PO3 K3	PO4 K3	PO5 K2	PO6 K3
CO1 Application	2	1	1	-	-	-
CO2 Application	2	2	1	-	-	-
CO3 Comprehension	2	2	1	-	-	-
CO4 Comprehension	2	1	1	-	-	-
CO5 Comprehension	2	2	1	-	-	-

EC 922 WIRELESS SENSOR NETWORKS

CO No	Descriptions
CO1	Explain the basic concepts of Wireless Networks and challenges of Adhoc and sensor networks
CO2	Classify the design issues and different categories of sensor Networks , Energy Consumption of Sensor Nodes and Issues in Designing a Multicast Routing Protocol
CO3	Analyze the performance issues of routing in WSN and QoS related performance measurements
CO4	Discuss the MAC Protocols for Sensor Networks and QoS related performance measurements
CO5	Illustrate the performance of Routing WSN in various applications.

EC 913–WIRELESS COMMUNICATION SYSTEMS

CO No	Descriptions
CO1	Summarize the cellular concept of channel reuse, handoff strategies to improve the channel capacity and also summarize the second and third generation network standards.
CO2	Discuss the basic reflection- ground reflection model-diffraction-scattering-practical link budget design propagation mechanisms for radio wave propagation. Describe the concepts of small scale and multipath fading in radio wave propagation.
CO3	Discuss the capacity of flat fading channels and frequency selective fading channels at the transmitter and receiver end. Analyze the Error probability of BPSK, FSK, MSK, GMSK, QPSK, M-ary PSK, M-ary QAM and M-ary FSK on AWGN channels over wireless channels.
CO4	Describe the transmitter and receiver diversity of an unknown channel.
CO5	Summarize the Frequency division multiple access-time division multiple access-spread spectrum multiples access-space division multiple access Discuss the Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain

ECENG 638 INTERNET OF EVERY THINGS (IoE)

CO No	Descriptions
CO1	Summarize the Architectural overview of IoT using the main design principles, standards and considerations, M2M and IoT technology fundamentals, devices and gateways, data managements. Also Extend the working of IoT through business processes, everything as a service, M2M, IoT analytics, and knowledge management.
CO2	Employ the energy storage module, power management module, RF Module, sensing module for Wireless sensor structure used in IoE.
CO3	Generalize the Security requirements in IoE architecture with security in enabling technologies, security concerns in IoE applications, Architectural insufficiency in authentication and authorization, insecure in access control and threats to access control, privacy, and availability. Also Classify the attacks specific to IoE.
CO4	Express the Importance of IoE Testbed Through ACOEM Eagle, EnOcean Push Button, NEST sensor, and Ninja blocks focus on wearable electronics.
CO5	Experiment the IoE applications for home and office infrastructures, security and other IoE electronic equipment, interfacing of sensor with sensor node using any embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino).

ECENG 524- MODERN COMMUNICATION SYSTEMS

CO No	Descriptions
CO1	Discuss the microwave communication system and orbits of satellite and also the explain the design of uplink and downlink satellite antennas.
CO2	Illustrate the working light source, photodiodes, fiber losses, signal dispersion, pulse propagation, multichannelpropagation, signal propagation, modulation schemes and also discuss the OFDM for optical communication in MIMO.
CO3	Explain the analog and digital cellular systems, cell coverage, frequency reuse, channel interferences, cell splitting and handoffs in cellular communication system
CO4	Outline of cognitive radio network architecture, functions of cognitive radioand also discuss the spectrum policies and regulations of spectrum sensing, spectrumanalysis, spectrum sharing/management and spectrum mobility, applications of cognitive radio.
CO5	Analyze the Performance of minimum four communication systems through simulation using related platforms

EC ENG557 – PATTERN RECOGNITION AND ARTIFICIAL INTELLIGENCE

CO No	Descriptions
CO1	Discuss about the statistical and nonparametric decision making, to analyze the patterns , features, training and learning about pattern recognition and its approaches
CO2	Conclude about the supervised and unsupervised learning and generalize about hierarchical and graph theories approach to pattern clustering and also to discuss about fuzzy pattern classifier and its application of pattern recognition medicine
CO3	Explain about artificial intelligence how the language processing, problem solving, heuristic searching is done in artificial intelligence. Explain how the artificial intelligence works in game playing and logics present in AI
CO4	Summarize about the expert system components, rules, backward, forward and statistical reasoning.
CO5	Practice using the matlab about the Range images generation, extraction of geometric elements, automatic scene generation, scene recognition, geometrical hashing

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