ECE - (4 Year B.Tech Programme) - COURSE CURRICULUM R-20												
IV Year Course structure												
Semester - I												
Course Code	**Title of the course**	**CAT**	**Periods**						**Sessional Marks**	**Semester end Exam marks**	**Total Marks**	**Credits**
			L	**T**	**P**	**E**	**O**	**Total**				
ECE411	**Open Elective- III**	**OE**	**3**	**0**	**0**	**1**	**2**	**6**	**40**	**60**	**100**	**3**
ECE412	**Engineering Economics and Management**	**HS**	**3**	**0**	**0**	**0**	**2**	**5**	**40**	**60**	**100**	**3**
ECE413	**Professional Elective –4**	**PE**	**3**	**0**	**0**	**1**	**4**	**8**	**40**	**60**	**100**	**3**
ECE414	**Professional Elective -5**	**PE**	**3**	**0**	**0**	**1**	**3**	**7**	**40**	**60**	**100**	**3**
ECE415	**Microwave and Radar Engineering**	**PC**	**3**	**0**	**0**	**1**	**5**	**9**	**40**	**60**	**100**	**3**
ECE416	**Microwave Engineering Laboratory**	**PC**	**0**	**0**	**3**	**0**	**1**	**4**	**50**	**50**	**100**	**1.5**
ECE417	**DSP Lab**	**PC**	**0**	**0**	**3**	**0**	**1**	**4**	**50**	**50**	**100**	**1.5**
ECE418	**Internship-II**	**PR**	**0**	**0**	**0**	**0**	**1**	**1**	**100**	**0**	**100**	**2**
ECE419	**Project Phase – I**	**PR**	**0**	**0**	**4**	**0**	**4**	**8**	**100**	**0**	**100**	**2**
Total			**15**	**0**	**10**	**4**	**23**	**52**	**500**	**400**	**900**	**22**
Semester - II												
Course Code	**Title of the course**	**Cate gory**	**Periods**						**Sessional Marks**	**Semester end Exam marks**	**Total Marks**	**Credits**
			L	**T**	**P**	**E**	**O**	**Total**				
ECE421	**Open Elective- IV**	**OE**	**3**	**0**	**0**	**1**	**2**	**6**	**40**	**60**	**100**	**3**
ECE422	**Project Phase – II**	**PR**	**0**	**0**	**16**	**0**	**16**	**32**	**100**	**100**	**200**	**8**
Total			**3**	**0**	**16**	**1**	**18**	**38**	**140**	**160**	**300**	**11**

Professional Elective 4
1. Cellular and Mobile Communications
2. Computer Network Engineering
3.Satellite communications & GPS

Professional Elective 5
1. Speech Processing
2. Digital Image Processing
3. Low power VLSI

ENGINEERING ECONOMICS AND MANAGEMENT

ECE 412 **Credits:3**

Instruction: 3 Periods & 1 Tut/week Sessional Marks:40

End Exam: 3 Hours End Exam Marks:60

Prerequisites: Nil

Course Objectives:

- To familiarize the students with the concepts of Economics.
- To gain basic understanding of management and manage organizations effectively and to relate the concepts of management with industrial organizations
- To help the students to understand the factors affecting plant location and to acquaint them with the major concepts of Break-Even-Analysis
- To understand the concepts of marketing management and to develop an understanding on the various aspects Advertising
- To make them to know the basics of Accounting

Course Outcomes:

At the end of the course students will be able to	
CO1	**Understand** the concepts of Economics
CO2	**Understand** the basic knowledge of management and **Develop** the understanding of the concept of human resource management and its relevance in organizations.
CO3	Select appropriate location for establishing industrial plants and **Apply** the concepts of Break-Even Analysis in **evaluating** project economically
CO4	**Identify** the scope and significance of Marketing and **Identify** the roles of advertising in promoting the business
CO5	**Understand** and **apply** the basic concepts of accounting, finance and marketing management

CO-PO –PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	3	-	2	1
CO2	-	-	-	-	-	-	-	2	3	-	2	1
CO3	-	-	-	-	-	-	-	2	3	-	2	1
CO4	-	-	-	-	-	-	-	2	3	-	2	1
CO5	-	-	-	-	-	-	-	2	3	-	2	1

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS

UNIT I **9L+3TPeriods**

Fundamentals of Economics: Wealth, Welfare and Scarce Definitions of Economics; Micro and Macro Economics; Demand- Law of Demand, Elasticity of Demand, Types and measurements of Elasticity - Utility- Law of Diminishing Marginal Utility, its limitations and exceptions.

UNIT II **9L+3T Periods**

Introduction to Management: Definition of Management-Levels of Management and Managerial Skills-Functions of Management- Taylor's Scientific Management; Henry Fayol's Principles of Management.

Human Resource Management –Basic functions of Human Resource Management (in brief).

UNIT III **9L+3T Periods**

Production Management: Plant Location-factors effecting location of plant, Break-Even Analysis- Assumptions, limitations and applications. (Simple Problems)

UNIT IV **9L+3T Periods**

Introduction to Marketing Management: Marketing Management: Functions of marketing in brief. Distribution Channels and Advertising.

UNIT V **9L+3T Periods**

Financial Management: Types of Capital: Fixed and Working Capital and Methods of Raising Finance; Final Accounts- Trading Account, Statement of Profit and Loss and Balance Sheet (simple problems)

TEXT BOOKS:

1. A.R. AryaSri, Managerial Economics and Financial Analysis, TMH Publications, new Delhi, 2014**(UNIT–I,III,V)**
2. P.C.Tripathi, P.N.Reddy, Principles of Management. **(UNIT–II)**
3. S.C. Sharma and Banga T. R., Industrial Organization & Engineering Economics, Khanna Publications, Delhi-6, 2006**(UNIT–III & IV)**
4. S.N.Maheswari, SK Maheswari, Financial Accounting Fifth Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012 **(UNIT-V)**

CELLULAR AND MOBILE COMMUNICATIONS

ECE 413(a) **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40

End Exam : 3 Hours End Exam Marks:60

Prerequisites: Analog Communication**,** Digital Communications

Course objectives:

1. To understand the cellular radio concepts such as frequency reuse, Cell splitting and affect of interference on the capacity of cellular system.
2. To interpret small scale, large scale and multipath propagation models usedin mobile environment.
3. Develop an ability to analyze Frequency management and channel assignment strategies, Handoff and dropped calls.
4. To describe various multiple access techniques, forward and reverse channels and capacity of cellular system.
5. To identify the concept behind integration of mobile satellite and terrestrial mobile systems.

Course Outcomes:

By the end of the course, students will be able to

CO1 Evaluate the performance of a cellular system in terms of Frequency reuse, interference and Cell splitting.

CO2 Analyze the Mobile radio propagation, fading, diversity concepts and the channel modeling.

CO3 Evaluate the concepts of Handoff, dropped calls, Frequency management and channel assignment strategies.

CO4 Apply cellular theory and analyze various Multiple access techniques in wireless communications.

CO5 Interpret the technical challenges in implementation of receiver circuitry with the integration of mobile satellites.

CO-PO-PSO Mapping:

CO	PO												PSO			JUSTIFICATION
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	1	1											2		PI: 1.1.2, 1.3.1.
CO2	2	2	1											2		PI: 2.1.2, 2.1.3,
CO3	3	1												2		2.3.1, 2.3.2, 2.4.1,
CO4	2	2												2		PI: 3.2.1, 3.4.1.
CO5	2	1				1								1		PI: 6.1.1

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

	CO-PO Justification
1	CO1 deals with mathematical formulation for Co-channel interference and frequency reuse distance with different path losses hence mapped high with PO1, low mapped with PO2, PO3 and moderately mapped to PSO-2. PO9 attained partially with role play.
2	CO2 helps the student in analyzing different mobile radio propagation models and multi path fading channels hence medially mapped to PO-1, PO-2, low mapped with PO-3 and medially mapped to PSO-2. PO9 attained partially with Student Seminar in class.

3	CO3 deals with problem solving on handoff, dropped calls, frequency management and channel assignment hence highly mapped with PO-1, low mapped with PO2 and medially mapped to PSO-2.
4	CO4 helps the student in analyzing and design forward and reverse channels of various multiple access techniques in wireless communications hence medially mapped to PO1, PO2 and PSO2. PO9 attained partially with Student Seminar in class.
5	CO5 emphasizes analysis and design in implementation of receiver circuitry with the integration of mobile satellites hence medially mapped to PO-1, low to PO-2, PO-6and PSO2.

SYLLABUS

UNIT I **10 Periods**

Introduction to Cellular Systems: Basic Cellular Systems, Uniqueness of mobile radio environment, Concept of Frequency reuse Channels, Cochannel interference Reduction factor, Desired C/I from a normal case in an Omnidirectional Antenna system, Non Co-channel interference, Cell splitting.

UNIT II 10 Periods

Mobile Radio Propagation: Large scale path loss - Reflection, Diffraction, Scattering, Outdoor and Indoor Propagation models, **Mobile Radio Propagation: small scale fadingand multi path** - small scale Multi path measurements, parameters of mobile multi path channels, Types of small scale fading.

UNIT III 10 Periods

Frequency Management and Channel Assignment: Frequency management, Fixed Channels assignment, Non Fixed Channel assignment, Traffic and Channel Assignment. **Hand Off, Dropped Calls:** Why Hand-Off, Types of Hand-Off and their characteristics, dropped call rates and their evaluation.

UNIT IV 10 Periods

Multiple access techniques for wireless communications: FDMA, TDMA, Spread spectrum techniques, SDMA, Packet Radio, CSMA , Capacity of cellular CDMA with multiple cells and capacity of SDMA, Details of forward and reverse CDMA channels

UNIT V 10 Periods

Personal access communication systems: personal Mobile satellite communications, Integrating GEO, LEO, MEO satellite and terrestrial mobile systems, Rake receiver and Advanced Rake receiver.

TEXT BOOKS:

1. William C.Y.Lee, Wireless & Cellular Telecommunications, Third Edition,McGraw Hill, International Edition. **[UNIT- I ,II,III]**
2. Theodore S.Rappaport, Wireless communications Principles and Practice, Second Editions, Pearson Publications. **[UNIT- IV ,V]**

REFERENCE BOOKS:

1. GottapuSasibhushanaRao, Mobile Cellular Communication, PEARSON International, 2012.
2. Wayne Tomasi, Electronic Communication system, Pearson.

COMPUTERNETWORKENGINEERING

ECE413(b) **Credits:3**

Instruction:3Periods&1Tut/week SessionalMarks:40

EndExam: 3Hours End ExamMarks:60

Prerequisites: Nil

Course Objectives:

- To develop an understanding of computer networking basics.
- To develop an understanding of different components of computer networks, various protocols, modern technologies and their applications.

Course Outcomes:

At the end of the course, students will be able to

1. Apply the concepts of Computer Networks and Networks Models for Data Communication.
2. Analyze networking architecture and infrastructure for wired and wireless link
3. Design, calculate ,and apply subnet masks and routing addresses to fulfill networking requirements
4. Analyzeissuesofroutingandcongestionmechanismforindependentandinternetworkingnetworksforwired and wireless link.
5. Analyze internal working of the Internet and of a number of common Internet applications and protocols (DNS, SMTP, FTP, HTTP, WWW, Security and Cryptography).

CO-PO–PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1													2	2	
CO2		2											1	2	
CO3		2	3										2	2	
CO4	1	2											2	2	
CO5		2	3										2	2	

Correlationlevels1: Slight (Low) 2:Moderate(Medium)3:Substantial(High)

SYLLABUS

UNITI 10 Periods

DataCommunications: Components–DirectionofDataflow–Networks–ComponentsandCategories–TypesofConnections–Topologies–ProtocolsandStandards–ISO/OSImodel–TransmissionMedia–CoaxialCable–FiberOptics–LineCoding–Modems–RS232Interfacingsequences

UNITII 10 Periods

Data Link Layer: Error – detection and correction – Parity – LRC – CRC – Hamming code – Low Control and Error control - Stop and Wait – go back-N ARQ – Selective Repeat ARQ-Slidingwindow–HDLC.-LAN-EthernetIEEE802.3-IEEE802.4-IEEE802.5-IEEE 802.11–FDDI-SONET–Bridges.

UNITIII 10 Periods

NetworkLayer: Internetworks–PacketSwitchingandDatagramapproach–IPaddressingmethods–Subnetting– Routing–DistanceVectorRouting–Link StateRouting– Routers.

UNITIV 10 Periods

Transport Layer: Duties of transport layer – Multiplexing – De-multiplexing – Sockets – UserDatagramProtocol(UDP)–TransmissionControlProtocol(TCP)–CongestionControl–Qualityof services(QOS)–Integrated Services.

UNITV 10 Periods

ApplicationLayer: DomainNameSpace(DNS)–SMTP–FTP–HTTP-WWW–Security–Cryptography.

TEXTBOOKS:

1.WilliamStallings,"DataandComputerCommunication",SixthEdition,PearsonEducation,NewDelhi, 2000. **[UNIT-I,II &III]**

2.Andrew S.Tanenbaum,"Computer Networks",Fourth Edition PHILearning,NewDelhi,2003.**[UNIT-IV &V]**

REFERENCEBOOKS:

1. BehrouzA.Forouzan,"DatacommunicationandNetworking",FourthEdition,TataMcGraw-Hill PublishingCo. Pvt., Ltd., New Delhi, 2006.
2. JamesF.KuroseandKeithW.Ross,"ComputerNetworking:ATop-DownApproachFeaturingtheInternet", PearsonEducation, NewDelhi,2003.

SATELLITE COMMUNICATIONS & GPS

ECE 413(c) **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40

End Exam : 3 Hours End Exam Marks:60

Prerequisites: Analog Communication **and** Digital Communications

Course Objectives:

- To get in depth knowledge of communication through satellite
- To understand the design criterion
- To introduce students to the principle of GPS.
- To familiarize students with GPS signal structure.

Course Outcomes:

By the end of the course, students will be able to

1.	Describe and justify communication satellite subsystem with specifications.
2.	Analyze C/N ratio for satellite single link budgets in air and rain.
3.	Classify, analyze and estimate the capacity of each multiple access technique required for satellite communication.
4.	Illustrate the working principle of GPS and determine GPS receiver position using satellites in 2D & 3D.
5.	Illustrate GPS system segments, GPS signals & signal structures using PRN codes.

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1												2	
CO2	3	2												2	
CO3	3	2												2	
CO4	3	1		1										2	
CO5	2	2		1										2	

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO Justification	
1	CO1 deals with mathematical formulations, principles & theorems of satellite system which can be described & justify the specifications, so it is mapped to PO1. Various satellite subsystems can be identified with basic knowledge of science & principles of mathematics, so mapped to PO2 & PSO2.
2	CO2 can be attained using basic knowledge of science & principles of mathematics to analyze and calculate C/N ratio for satellite system for satellite single link budgets in different mediums, so it is mapped to PO1, PO2 & PSO2.
3	CO3 deals with multiple accesses techniques, for this basic knowledge of engineering fundamentals is required to solve problems and to develop solutions related to satellite communication so it is mapped to PO1, PO2 & PSO2.
4	CO4 helps the student in gaining fundamental knowledge about various GNSS and their specifications in finding the position of an object such as segments in 2D, 3D etc hence mapped to PO1, PO2, PO4 and PSO2.
5	CO5 provides fundamental knowledge about Global Positioning System hence mapped to PO1 and able to use extract PRN codes using different frequencies so mapped to PO2, PO4 and PSO2.

SYLLABUS

UNIT I **10 Periods**

Introduction: Types of satellites, Satellite constellation, orbital mechanics, look angle determination, Orbital effects in Communication System Performance, Satellite sub systems, Communication subsystems, Overview of launching procedures and launch vehicles.

UNIT II **10 Periods**

Propagation Impairments And Space Link: Introduction, atmospheric loss, ionospheric effects, rain attenuation, other impairments.

Space link: Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR

UNIT III 10 Periods

Multiple Access: Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA),Spread spectrum transmission and reception.

UNIT IV 10 Periods

Introduction To Global Navigation Satellite Systems(GNSS): The History of GPS, The Evolution of GPS, Development of NAVSTAR GPS, Block I, Block II satellites, Block IIA, Block IIR and Block II R-M satellites. Introduction to IRNSS, GPS working principle, Trilateration, Determination of where the satellites are, Determination of how far the satellites are, Determining the receiver position in 2D or XY Plane, Determining the receiver position in 3D or X-Y-Z Plane

UNIT V 10 Periods

GPS Satellite Constellation And Signals: GPS system segments, Space segment, Control segment, User segment, GPS Signals, GPS signal generation, Generation of Codes- C/A code , P code and Navigation data.

***Note-** Additional topics that can be introduced during the course but are out of the prescribed syllabus –**The working of a satellite phone**

TEXT BOOKS:

1. T. Pratt and C.W. Boastian, "Satellite Communication", 2 nd edition, John Wiley & Sons, 2002**.(UNIT-I,II,III)**
2. G S RAO, Global Navigation Satellite Systems, McGraw-Hill Publications, New Delhi, 2010**(UNIT-IV,V)**

REFERENCE BOOKS:

1. D. Roddy, "Satellite Communications", Prentice Hall, 4 th edition, copyright, 2008.
2. K.N. Raja Rao, "Satellite Communication: Concept and Application", 2nd edition, PHI, 2013

SPEECH PROCESSING

ECE 414(a) **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40

End Exam : 3 Hours End Exam Marks:60

Prerequisites: Signal & System, Digital Signal Processing

Course Objectives:

- Understand the anatomy and Physiology of Speech Production system and perception model and to design an electrical equivalent of Acoustic model for Speech Production.
- Analyze speech signals in time and frequency domain.
- Analyze linear predictive coding techniques for speech signal

To study about the process of Man-Machine communication

Course Outcomes:

By the end of the course, students will be able to

1.	Create an electrical representation of the Speech Production system.
2.	Analyze the time domain and frequency domainrepresentation of speech signal
3.	Design the Homomorphic Vocoder
4.	Apply Linear Predictive Coding (LPC) to speech synthesissystem
5.	Build a complete speech recognition system

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2											2		
CO2	2	2											2		
CO3	2	2	2										2		
CO4	2	2											2		
CO5	2	2	2										2		

Correlation levels1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO-PO-PSO Justification	
1	CO1 deals with mathematical model of speech production hence mapped moderately with PO1 & PO2.
2	CO2 deals with representations of the speech signal in terms of timedomainmeasurements as well as its spectral properties hence mapped moderately with PO1 & PO2.
3	CO3 demonstrate the design principle of a Homomorphic decoder for analyzing and synthesizing speech signal hence mapped moderately with PO1, PO2& PO3.
4	CO4 deals with representation of speech sample as a linear combination of past speech samples hence mapped moderately with PO1 & PO2.
5	CO5 emphasize the basic building blocks of a complete Speech recognition model hence moderately with PO1, PO2& PO3.

SYLLABUS

UNIT I **10 Periods**

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals.

UNIT II **10 Periods**

Time domain methods for speech processing: Time domain parameters of Speech signal, short time energy and average magnitude, Short time average zero crossing rate, Speech Vs Silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, Short Time Auto Correlation Function, The short time average magnitude difference function, Pitch period estimation using Auto Correlation Function.

UNIT III **12 Periods**

Frequency domain method for speech processing: Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Filter bank summation method for short-time synthesis- Spectrographic displays -Pitch detection - Analysis by Synthesis - Analysis synthesis systems: Phasevocoder, Channel Vocoder.

Homomorphic speech analysis:

Homomorphic Systems for Convolution, The Complex Cepstrum of Speech, Pitch detection, Formant Estimation, Homomorphic Vocoders.

UNIT IV **8 Periods**

Linear predictive analysis of speech: Basic Principles of linear predictive analysis: Autocorrelation method, Covariance method, Solution of LPC equations: Cholesky method, Durbin's Recursive algorithm, Comparison between the Methods of Solution of the LPC Analysis Equations, Application of LPC parameters: Pitch detection using LPC parameters, Formant analysis using LPC Parameters.

UNIT V **10 Periods**

Man-Machine Communication: Speaker Recognition System: Speaker Verification Systems, Speaker Identification Systems, Speech Recognition System: Isolated Digit Recognition System, Continuous Digit Recognition System, LPC Distance Measures, Large Vocabulary Word Recognition System.

TEXT BOOKS:

1. L.R. Rabiner and R.E Schafer, "Digital Processing of Speech Signals", Pearson Education, 2008,
2. Human & Machine, Douglas O'Shaughnessy, Speech Communications, 2nd Edition., Wiley India, 2000.

REFERENCE BOOKS:

1. Discrete-TimeSpeechSignalProcessing,ThomasF,Quatieri,PrenticeHall/PearsonEducation, 2004.
2. SpeechandAudioSignalProcessing,BenGoldandNelsonMorgan,JohnWileyandSonsInc., Singapore,2004
3. FundamentalsofSpeechRecognition,L.R.RabinerandB.H.Juang,PrenticeHall,1993.

DIGITAL IMAGE PROCESSING

ECE 414(b) **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40

End Exam : 3 Hours End Exam Marks:60

Prerequisites: Signal & System (ECE 214), Digital Signal Processing (ECE 322)

Course objectives:

- Understand the fundamentals of digital image processing.
- Understand the image transforms used in digital image processing.
- Understand the image enhancement techniques used in digital image processing.
- Understand the image restoration techniques and methods used in digital image processing.
- Understand the Morphological Operations used in digital image processing.

Course Outcomes:

By the end of the course, students will be able to

1.	Describe the basic components of digital image processing system and transform techniques (FFT, DCT and Hadamard transform).
2.	Analyze image enhancement in spatial domain using smoothing and sharpening operators.
3.	Analyze image enhancement in frequency domain using High pass and low pass filters.
4.	Describe image restoration using Weiner filtering and image segmentation using thresholding and region growing techniques.
5.	Compare and contrast image compression techniques (Variable length coding, LZW coding, Bit plane coding, Lossless predictive coding, Lossy prediction, transform coding).

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2		-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO4	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
CO5	2	2		-	-	-	-	-	-	-	-	1	2	-	-

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS

UNIT I 10 Periods

Digital Image Fundamentals: Fundamental steps in digital image processing, Components of an image processing system, Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels

Image Transforms: Two-dimensional FFT properties, Discrete cosine transform &Hardmard transform

UNIT II 10 Periods

Image Enhancement (Spatial Domain): Introduction, Basic gray level transformation, Histogram processing, Enhancement using arithmetic/logic operations, Basics of spatial filtering: Smoothing and sharpening spatial filter

UNIT III 10 Periods

Image Enhancement (Frequency Domain): Introduction to Fourier transform and the frequency domain, Smoothing and sharpening frequency domain filters, Homomorphic filtering

UNIT IV 10 Periods

Image Restoration: Introduction to image degradation, Noise model, Restoration in presence of noise only, Inverse filtering, Wiener filtering,

Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding (global and adaptive), Region based segmentation

UNIT V 10 Periods

Image Compression: Redundancy, Fidelity criteria, Image compression models, Error free compression: Variable length coding, LZW coding, Bit plane coding, Lossless predictive coding, Lossy prediction, transform coding, image compression standards

Fundamentals of morphological processing - Dilation, Erosion, Opening, Closing

TEXT BOOKS:

1. TRafael C Gonzalez, Richard E Woods, "Digital Image Processing," PHI, Second edition, 2004. **(UNITS I, II, III, IV, V)**
2. Jayaraman S, Esakkirajan S, Veerakumar T, "Digital Image Processing," Tata McGraw Hill, 2010 **(UNIT-I)**

REFERENCE BOOKS:

1. Anil Kumar Jain, "Fundamentals of Digital Image Processing," PHI, 2002.

LOW POWER VLSI

ECE 414(c) **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40

End Exam : 3 Hours End Exam Marks:60

Prerequisites: Digital Electronics, VLSI design

Course objectives:

- To make students familiar with power dissipation, power optimization techniques and power estimation in VLSI circuits.
- To make student design the power efficient VLSI systems by applying low power design techniques.

Course Outcomes:

By the end of the course, students will be able to

1.	Explain the sources of power dissipation in CMOS
2.	Classify the special techniques to mitigate the power consumption in VLSI circuits
3.	Summarize the power optimization and trade-off techniques in digital circuits.
4.	Illustrate the power estimation at logic and circuit level
5.	Explain the software design for low power in various level

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1													1
CO2	3	2													1
CO3	3	3													1
CO4	3	3	1												1
CO5	2	3	3		2						2				1

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS

UNIT I **10 Periods**

Power Dissipation in CMOS : Sources of power dissipation – Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET, Submicron MOSFET, gate induced drain leakage– Power dissipation in CMOS: short circuit dissipation, dynamic dissipation, load capacitance– Low power VLSI design: Limits – principles of low power design, hierarchy of limits, fundamental limit, material limit, device limit, system limit.

UNIT II 10 Periods

Power Optimization Using Special Techniques : Power Reduction in Clock Networks: Clock Gating, Reduced Swing Clock, Oscillator Circuit for Clock Generation, Frequency Division and Multiplication, Other Clock Power Reduction Techniques - CMOS Floating Node: Tristate Keeper Circuit, Blocking Gate, Low Power Bus: Low Swing Bus, Charge Recycling Bus, Delay Balancing - Low Power Techniques for SRAM: SRAM Cell, Memory Bank Partitioning, Pulsed Word line and Reduced bit line Swing

UNIT III **10 Periods**

Design of Low Power Circuits: Transistor and Gate Sizing : Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction - Network Restructuring and Reorganization : Transistor Network Restructuring, Transistor Network Partitioning and Reorganization - Special Latches and Flip-flops : Self-gating Flip-flop, Combinational Flip-flop, Double Edge Triggered Flip-flop - Low Power Digital Cell Library : Cell Sizes and Spacing, Varieties of Boolean Functions, Adjustable Device Threshold Voltage

UNIT IV **10 Periods**

Power Estimation: Modeling of signals - signal probability calculation - Statistical techniques - estimation of glitching power- Sensitivity Analysis-Power estimation using input vector compaction, power dissipation in Domino logic, circuit reliability, power estimation at the circuit level, Estimation of maximum power: test generation based approach, steepest descent, generic based algorithm based approach

UNIT V **10 Periods**

Software Design for Low Power: Sources of software power dissipation - software power estimation: Gate level, architecture level, bus switching activity, instruction level power analysis - software power optimization: minimizing memory access costs, instruction selection and ordering, power management - Automated low power code generation – Co-design for low power.

TEXT BOOKS:

1.Kaushik Roy, S.C.Prasad,"LowpowerCMOSVLSIcircuitdesign",Wiley,2000
2.A.P. Chandrasekaran, R.W. Broadersen,"Low power digital CMOS design", Kluwer,1995
3.Gary Yeap,"PracticallowpowerdigitalVLSIdesign",Kluwer,1998

REFERENCE BOOKS:

1. DimitriosSoudris,ChristiansPignet,CostasGoutis,"DesigningCMOSCircuitsforLowPower", Kluwer,2002
2. J.B.Kulo, J.HLou,"Low VoltageCMOSVLSICircuits",Wiley1999.

MICROWAVE & RADAR ENGINEERING

ECE 415 **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40

End Exam : 3 Hours End Exam Marks:60

Prerequisites: Electromagnetic Field Theory

Course Objectives:

- To explain the theoretical principles underlying in the operation of microwave devices and circuits
- To understand the principles behind the measurement of various microwave parameters and required bench setup
- To understand different microwave sources and amplifiers
- To understand the basics of the Radar Engineering

Course Outcomes:

By the end of the course, students will be able to

1.	Apply Electromagnetic field theory to rectangular waveguides and analyze waveguides
2.	Analyze the working of passive microwave components using S-matrix.
3.	Apply the operating principles in generating/amplifying microwave signals using microwave tubes and solid state devices.
4.	Analyze the working of RADAR and its range equation.
5.	Apply the principles of Radar to identify different radars

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3												3	3
CO2	3	3	1											3	3
CO3	2	3												3	2
CO4	2	3	2											3	2
CO5	2	3												3	2

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS

UNIT I 12 Periods

Microwave Components:

Introduction to Microwaves, advantages and applications; Theory of Guided Waves- Waves in between parallel plates, Wave Guide – Derivation of Field Equations, Modes of Propagations, and their parameters, Types of Wave-guides; Excitation methods for different TE modes, Wave impedance in waveguide; Attenuators; Cavity Resonators, Re-entrant Cavities, Wave-meters, Microwave Filters, Detectors.

UNIT II 12 Periods

Microwave Circuits& Measurements:

S Matrix and its Properties. S Matrix of E Plane Tee, H plane Tee and Magic Tee, Directional coupler. S Matrix of Ferrite Devices and applications. Microwave Bench Setup - Introduction and its features, Measurement of Frequency, Wavelength, VSWR, Unknown impedance, attenuation, Coupling, Isolation and Directivity measurements of Directional coupler

UNIT III 12 Periods

Microwave Tubes & Solid State Devices:

Resonant Cavity Devices, Reflex Klystron, Two – Cavity Klystron, Multi – Cavity Klystron, Slow – Wave Devices, TWT, Magnetrons; PIN Diode, Tunnel Diodes, Gunn Diode, IMPATT, TRAPATT Diodes, Crystal Diode.

UNIT IV 12 Periods

Fundamentals of Radar:

Radar Range Equation, Radar Block Diagram and Operation, Prediction of Range, Minimum Detectable Signal, Receiver Noise, Radar Cross-section, Transmitter Power, PRF and Range Ambiguities, Radar Antenna Parameters, System Losses and Propagation Effects.

UNIT V 12 Periods

Types of Radars:

Doppler effect, FMCW Radar, MTI Radar – Block Diagram &Principle, Delay line cancellers, Blind speeds, Range gated Doppler filters, MTI delay lines, limitations, Pulse Doppler Radar, Tracking Radar –Sequential Lobing, Conical scan; Monopulse tracking radar.

TEXT BOOKS:

1. M. Kulakarni, " *Microwave& Radar Engineering* ", 5th ed., Umesh Publication, 2014.
2. M.I. Skolnik, "*Introduction to Radar Systems*", McGraw Hill, 2007.
3. G.S.N. Raju, "*Microwave Engineering*",1st ed., IK International Publishers, 2008
4. G.S.N Raju, "*Radar Engineering and Fundamentals of Navigational Aids*", 1st ed. IK International Publishers, 2008

REFERENCE BOOKS:

1. D.M.Pozar, "*Microwave Engineering*", 2nd ed., McGraw Hill.2015.
2. G. SasibhushanRao, "*Microwave & Radar Engineering*" ,1st ed., Pearson Education,2014.

MICROWAVE EINGINEERING LABORATORY

ECE 416 **Credits:1.5**

Instruction: 3 Practical's/week Sessional Marks:50

End Exam: 3 Hours End Exam Marks:50

Prerequisites: Antennas and propagation, Microwave engineering

Course Objectives:

- The main objective of the course is to make the students get the exposure to various microwave sources, microwave passive components and bench setup in this lab. Also, get the opportunity to measure various parameters related to components, and characterize microwave devices with the microwave bench setup.

Course Outcomes:

At the end of the course, students will be able to

1.	Find the bench set up before start of the experiment, identifying the required apparatus and procedure of doing the experiment.
2.	Measure various parameters of the signal, load & characterize various microwave sources using microwave bench setup.
3.	Plot the radiation pattern of horn antenna and other antennas using antenna trainer system.
4.	Design the antenna with given specification using simulation tools.
5.	Measure and record the experimental data, plot it and analyse the results, and prepare a formal laboratory report.

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	1	2	1	-	-	-	-	2	-	-		1	2	2
CO2	-	2	1	3	-	-	-	-	2	-	-	2	2	2	2
CO3	-	2	2	1	-	-	-	-	2	3	-	1	1	1	1
CO4	-	3	3	3	-	-	-	-	2		-	3	1	2	2
CO5	-	-	-	3	-	-	-	-	2	3	-		1	2	3

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS

List of Experiments

1. Study of microwave components.
2. Determine the Characteristics of the GUNN diode.
3. Determination of Mode Characteristics of reflex klystron.
4. Measurement of the frequency and wavelength of a given signal.
5. Determine the VSWR of a given load.
6. Determine the Unknown Load Impedance of a given load.
7. Determine the Attenuation characteristics of a given load .
8. Determine the scattering parameters of E-Plane tee junction.
9. Determine the scattering parameters of H-Plane tee junction.
10. Determine the scattering parameters of Magic Tee Junction.
11. Determine the characteristics of a given Directional Coupler.
12. Determining the radiation pattern of the Horn Antenna.
13. Study of Antenna Trainer Systems.

14. Determining the radiation pattern of a 3 element Yagi- Uda antenna with folded dipole.
15. Determining the radiation pattern of a 5 element Yagi- Uda antenna with folded dipole.
16. Determining the radiation pattern of a $\lambda/2$ phased array antenna.
17. Design of a Rectangular Microstrip Patch Antenna using HFSSsoftware.
18. Design of a Circular Microstrip Patch Antenna using HFSS software.
19. Design of a Rectangular waveguide using HFSS software.

Note:A student has to complete 12 experiments as decided by the instructor.

DIGITAL SIGNAL PROCESSING LAB

ECE 417 **Credits:1.5**

Instruction: 3 Practical's /Week Sessional Marks:50

End Exam: 3 Hours End Exam Marks:50

Prerequisites: Signals and systems, Digital signal Processing, Digital Image Processing

Course Objectives:

- To perform DSP algorithms like convolution, DFT & FFT in MATLAB software
- To design the digital filter types like IIR-Butterworth, Chebyshev using Bilinear, Impulse invariant filters and FIR filters window-design methods using MATLAB
- To perform IIR and FIR filters using transformation and windowing techniques using MATLAB
- To Illustrate the effect of Decimation and interpolation by an integer factor.
- To Analyze N Ponit DFT and Properties by using DSP starter Kit.

Course Outcomes:

By the end of the course, students will be able to

1.	Compute and analyze signal spectrum of discrete system using DFT/FFT algorithms in MATLAB
2.	Design and analyze the digital filters.
3.	Design and analyze IIR and FIR filters using transformation and windowing techniques.
4.	Illustrate the effect of Decimation and interpolation by an integer factor.
5.	Analyze N Ponit DFT and Properties by using DSP starter Kit.

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1			2	2								2		
CO2	1		2	2	2								2		
CO3	1			2	2								2		
CO4	1		1	2	2								2		
CO5	1			2	2								2		

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS

Digital Signal Processing based Experiments

MATLAB based experiments

1. Perform (i) Circular convolution of the given two sequences(ii) Linear convolution using circular convolution.
2. Compute the DFT of a sequence and verify the properties of DFT.
3. Design analog Butterworth (i) low pass filter (ii) high pass filter for the given specifications.
4. Design an analog Chebyshev type-I and II (i) low pass filter (ii) high pass filter for the given specifications.
5. Design an IIR digital filter using Impulse invariant method
6. Design an IIR digital filter using Bilinear transformation
7. Design a FIR digital filter using (i) Rectangular and (ii) Hanning window techniques

8. Design a FIR digital filter using Kasier window techniques
9. Illustrate the effect of Decimation by an integer factor. Plot the magnitude spectrum
10. Illustrate the effect of Interpolation by an integer factor. Plot the magnitude spectrum

DSP Starter kits-based experiments:

11. Linear and circular convolution using CC Studio
12. IIR Filter design using TMS320C6713 DSP Processor

Experiments beyond syllabus

1.Write a program to compute the histogram of an input image and improve the appearance using histogram equalization technique.

2. Write a program to perform smoothing and sharpening operation of an image using spatial filtering

3. Write a program in MATLAB for edge detection using different edge detection mask

PROJECT PHASE-I

ECE 419 **Credits:2**

Instruction: 4 Practical's /Week Sessional Marks:100

Prerequisites: As per the domain

Course Objectives:

- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes:

By the end of the course, students will be able to

1.	Identify the mathematical, engineering and other relevant knowledge that applies to a problem
2.	Demonstrate the ability to identify and characterize an engineering problem through review research literature describing the causes of the problem and its effects using first principles of mathematics, natural sciences, and engineering sciences
3.	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
4.	Demonstrate collaborative skills and independent learning through working in a team to complete a task.
5.	Scheduling an engineering project and identifying the resources required to complete an engineering activity.

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3												3	3	3
CO2		3		3											
CO3				3	3								3	3	3
CO4									3	3		3			
CO5											3				

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Justification of Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO's	Justification of CO's correlation with PO's and PSO's
CO1	Students will be able to apply mathematics, Electronics and Communication engineering concepts to solve engineering problems.**PO1.**
CO2	Students will Identify the mathematical, engineering and other relevant knowledge that applies to a given problem**PO2.**
	Students will be able to Define a problem, its scope and importance for purposes of investigation**PO4.**
CO3	Students will be able to apply appropriate instrumentation and/or software tools to make measurements of physical quantities**PO4.**
	Students will be able to discuss limitations and validate tools, techniques and resources.**PO5**
CO4	Students will present results as a team, with smooth integration of contributions from all individual efforts **PO9.**
	Students will be able to deliver effective oral presentations to audiences **PO10.**
	Students able to recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.**PO12**
CO5	Students will identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. **PO11.**
CO1-CO5	Students will be able to identify a problem in the areas like image processing, communication systems and embedded systems, and apply modern tools to solve the problem**PSO1,2,3**.

PROJECT PHASE-II

ECE 422 **Credits:8**

Instruction: 16 Practical's /Week Sessional Marks:100

End Exam Marks:100

Prerequisites: As per the domain

Course Objectives:

- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes:

By the end of the course, students will be able to

1.	Apply the knowledge of mathematics, science, engineering fundamentals for analysis and synthesis of practical systems.
2.	Conduct scientific and engineering experiments of their own, as well as analyze and interpret data.
3.	Apply modern engineering techniques and simulation tools to solve engineering problems.
4.	Carry out analysis of cost-effective, environmental friendly designs of engineering systems
5.	Demonstrate skills in writing technical/project reports and oral presentation of the project work done to a panel of experts.

CO-PO –PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3											3	3	3
CO2				3				2				3			
CO3					3								3	3	3
CO4			3			2	2		3		3				
CO5										3					

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Justification of Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO's	Justification of CO's correlation with PO's and PSO's
CO1	Students will be able to apply mathematics, Electronics and Communication engineering concepts to solve engineering problems.**PO1.**
CO2	Students will be able to apply engineering mathematics and computations to solve mathematical models.**PO2**
	Students will examine and apply moral & ethical principles to known case studies**PO8.**
CO3	Students will be able to Define a problem, its scope and importance for purposes of investigation**PO4.**
	Students will be able to recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.**PO12**
CO4	Students will be able to verify the credibility of results from tool use with reference to the accuracy andlimitations.**PO5**
	Students will be able to identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level**PO6.**
	Students will be able to identify risks/impacts in the life-cycle of an engineering product or activity **PO7.**
CO5	Students will be able to implement the norms of practice of effective team work, to accomplish a goal.**PO9**
CO1-CO5	Students able to identify the tasks required to complete an engineering activity, and the resources required to complete the tasks..**PO11**