CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
Autonomous Institution under UGC
Hyderabad-500 075 -T.S.

DEPARTMENT OF
ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Instruction
And
Syllabi of

M.E. (ECE)
COMMUNICATION ENGINEERING
(With effect from 2016-2017)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
(Autonomous)

VISION AND MISSION OF THE INSTITUTE

Vision

To be a centre of excellence in technical education and research.

Mission

To address the emerging needs through quality technical education and advanced research.

VISION AND MISSION OF THE DEPARTMENT

Vision

To develop the department into a full fledged centre of learning in various fields of Electronics & Communication Engineering, keeping in view the latest developments.

Mission

To impart value based technical education and train students and to turn out full fledged engineers in the field of Electronics & Communication Engineering with an overall background suitable for making a successful career either in industry/research or higher education in India/Abroad.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
(Autonomous)

Programme Educational Objectives

Name of the Programme	**:**	**M.E (Master of Engineering)**
Specialization	**:**	**Communication Engineering**

Post graduates of M.E (Communication Engineering) programme

- Will excel in wired and wireless telecommunications area.
- Will become successful in executing software related applications.
- Will carry out research in new technologies relevant to Communication Engineering.
- Will develop with professional ethics, effective communication skills and knowledge of societal impacts of computing technologies.

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Programme Out Comes

Name of the Programme : M.E (Master of Engineering)
Specialization : Communication Engineering

- Student will demonstrate an ability to identify, formulate and solve complex engineering problems with the fundamentals of Electronics and communication engineering.

- Student will demonstrate an ability to visualize and work for research in the field of communication engineering.

- Student will be able to use modern engineering tools, software and equipment to analyze problems.

- Student will develop self confidence, team work, ability for life-long learning.

- Student will demonstrate an ability to design a system, component or process as per the specifications.

- Student will understand the impact of complex engineering solutions in a global, economic, environmental and societal context.

- Student will understand and commit to professional ethics and responsibilities.

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Scheme of Instruction & Examination
M.E Four Semester Course (Regular) 2016-2017

I- SEMESTER

Course Code	Subject	No. of Hrs./Week		Marks for		Total Marks	Credits
		Lecture	T/P/S	Internal Assessment	End Exam		
	Core 1	3	1	30	70	100	4
	Core 2	3	1	30	70	100	4
	Core 3	3	1	30	70	100	4
	Elective 1	3	--	30	70	100	3
	Elective 2	3	--	30	70	100	3
	Elective 3	3	--	30	70	100	3
16ECC107	Lab 1	---	3	50	-	50	2
16ECC109	Seminar 1	---	3	50	-	50	2
	Soft Skills	---	2	--	-	-	-
Total		18	11	280	420	700	25

Soft Skills is included as a non-credit course in the I-semester

II-SEMESTER

Course Code	Subject	No. of Hrs./Week		Marks for		Total Marks	Credits
		Lecture	T/P/S	Internal Assessment	End Exam		
	Core 4	3	1	30	70	100	4
	Core 5	3	1	30	70	100	4
	Core 6	3	1	30	70	100	4
	Elective 4	3	---	30	70	100	3
	Elective 5	3	---	30	70	100	3
	Elective 6	3	---	30	70	100	3
	Lab 2	---	3	50	-	50	2
	Seminar 2	---	3	50	-	50	2
	Mini Project	---	2	50	-	50	1
Total		18	11	330	420	750	26

III-SEMESTER

Course Code	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
	Project Work-Project Seminar (i) Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd semester. (50 Marks) (ii)Preliminary work on Project Implementation. (50 Marks)	100	----	100	6
Total		100		100	6

IV-SEMESTER

Course Code	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
	Project Work and Dissertation	100	100	200	12
Total		100	100	200	12

List of Subjects for ME (ECE) Course with specialization in COMMUNICATION ENGINEERING W.E.F. 2016-2017

S.No	Syllabus Ref. No	Subject	Hours per week
Core Subjects			
1	16ECC101	Data and Computer Communication Networks	4
2	16ECC102	Modern Digital Signal Processing	4
3	16ECC103	Detection and Estimation Theory	4
4	16ECC104	Wireless Mobile Communication Systems	4
5	16ECC105	Probability and Random Processes	4
6	16ECC106	Coding Theory and Techniques	4
7	16ECC107	Communications Lab	3
8	16ECC108	Computer Communication Networks Lab	3
9	16ECC109	Seminar – 1	3
10	16ECC110	Seminar – 2	3
11		Soft skills	2
12	16ECC111	Mini project	2
13	16ECC112	Project work - Project Seminar	--
14	16ECC113	Project Work - Dissertation	--
Elective Subjects			
15	16ECE101	Radar Signal Processing	3
16	16ECE102	Global Navigational Satellite Systems	3
17	16ECE103	Optimization Techniques	3
18	16ECE104	Image and Video Processing	3
19	16ECE105	Satellite and Microwave Communications	3
20	16ECE106	Optical Fiber Communication Systems	3
21	16ECE107	Statistical Signal Processing	3
22	16ECE108	Smart Antennas for Mobile Communications	3
23	16ECE109	Voice Over Internet Protocols	3
24	16ECE110	Modern Digital Communication Systems	3
25	16ECE111	Embedded System Design	3
26	16ECE112	Data Compression	3
27	16ECE113	Software Defined and Cognitive Radio	3
28	16ECE114	Engineering Research Methodology	3
29	16ECE115	Real Time Signal Processing	3
30	16ECE116	Speech Signal Processing	3
31	16ECE117	Multimedia Information Systems	3
32	16ECE118	Adaptive Signal Processing	3
33	16ECE119	Selected Topics In Strategic Electronics	3

16ECC101

DATA AND COMPUTER COMMUNICATION NETWORKS

Instruction	4 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Digital communication is required

Course Objectives:

The main objective of this course is that the student shall develop an understanding of the underlying structure of the data and communication networks with special emphasis on the following concepts:

1. Fundamental concepts of computer networking like protocols, structured architecture models and topologies;
2. Link control concepts of flow and error control, switching concepts of circuit switching, packet switching, ATM etc., SS7.
3. Working of network components like Bridges, switches ; routing concepts and routing strategies; Network management, transport and application layer concepts

Topics Covered:

UNIT – I

Data Communications Model, communication Tasks, basic concepts of Networking and Switching, Line/Networking configurations; Protocols and Architecture, PDU, OSI and TCP/IP Architectures, Comparisons between OSI and TCP/IP; Flow Control, Sliding Window Flow Control, Error control, ARQ Protocols.

UNIT – II

Data Link Control, Bit stuffing, HDLC frame format, HDLC Modes and Operation; Circuit Switching concepts, Circuit SwitchElements, Three Stage Blocking type Space Division Switch, Time Division Switching**;** Packet Switching, Datagram and Virtual Circuit switching Principles, Effects of variable packet size.

UNIT – III

Control Signaling Functions, In Channel Signaling, Common Channel Signaling, Introduction to Signaling System Number 7 (SS7); X.25, X.25 Protocol Control Information; Routing, Routing in Packet Switched Networks and Routing Strategies; LAN Architecture, Topologies, Choice of

Topology, Ring and Star Usage, MAC and LLC, Generic MAC Frame Format; Hubs, Two Level Star Topology, Layer 2 Switches.

UNIT – IV

Bridge, Bridge Operation, Bridges and LANs with Alternative Routes, Spanning Tree, Loop resolution in bridges; Internetworking; Internet Protocol, IP address, IPv4, IPv6 comparison; Transport layer protocols, UDP Operation, TCP features, TCP/IP Addressing Concepts, Credit based Flow Control, Error Control and Congestion Control.

UNIT – V

Wireless LAN, IEEE 802.11 Architecture, IEEE 802.11- Medium Access Control logic; ATM, features and Architecture of ATM, Quality of Service in ATM; Security in the Internet, IP Security, Firewalls; Network Management System, SNMP.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Explain the importance of data communications and each of the Computer Networks related communication protocols in a structured architecture.
2. Recognize and explain the working of different networking devices like bridges, switches and routers.
3. Analyze the services and features at various layers of data communication network architecture including switching methodologies, routing strategies, flow, congestion and error control mechanisms etc.
4. Analyze the features and operations of various technologies like ATM, ISDN and applications like Mail Transfer, network management etc.

Suggested Reading:

1) William Stallings, "Data and Computer Communications", Ninth Edition, Pearson Prentice Hall, 2011.
2) Behrouz A. Forouzan, "Data Communications and Networking", Fourth Edition, Tata Mc Graw Hill, 2007.

16ECC102

MODERN DIGITAL SIGNAL PROCESSING

Instruction	4 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Signals and systems is required

Course objectives:

1. To design FIR and IIR filters.
2. To understand multi rate signal processing techniques and filter banks.
3. To understand short time Fourier Transform.
4. To learn Wavelet Transforms and its advantages compared to STFT.

Topics Covered:

UNIT I
Digital filters: Review of FIR and IIR filters, Optimal FIR filters, Spectral or frequency transformation of IIR filters, cascaded and lattice structures of FIR and IIR filters, Comparison of FIR and IIR filters.

UNIT II
Multirate signal processing – Decimation by a integer factor , Interpolation by a integer factor , Sampling rate conversion by a rational factor , Design of practical sampling rate converters, Software implementation of sampling rate converters, Applications of Multirate signal processing.

UNIT III
Digital filter banks and Transmultiplexers: Digital filter banks, Maximally decimated DFT filter banks, Transmultiplexers, applications of transmultiplexers to digital communications modulation.

UNIT IV
Maximally decimated filter banks: Two- channel quadrature mirror filter banks, L–channel QMF banks, multi level filter banks, Two channel perfect reconstruction conditions, Design of perfect reconstruction filter banks with real coefficients, lattice implementation of orthonormal filter banks, application to an audio signal.

UNIT V

Introduction to wavelet transforms – Short time Fourier transform, Gabar transform, wavelet transform, Recursive multi resolution Decomposition, Haar wavelet, Digital filter implementation of the Haar wavelet, Digital Filtering interpretation.

Course Outcomes:

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

1. Design and implement the required filter.
2. Analyze the contaminated signals using filter banks or Wavelet transforms.
3. Take up research problem in the area of signal processing.

Suggested Reading:

1. Proakis, JG and Manolakis, DG, 'Digital signal Processing', PHI, 4th ed., 2006.
2. Roberto Cristi, Modern Digital Signal Processing, Thomson Books, 2004.
3. SK Mitra, Digital Signal Processing, TMH, 2006.
4. Emmanuel C. Ifeachor and Barrie W. Jervis, 'Digital Signal Processing- A practical approach, 2nd edition, Pearson Education, 2004.

16ECC103

DETECTION AND ESTIMATION THEORY

Instruction	4 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Digital signal processing is required

Course Objectives:

1. To provide basic estimation and
2.
3. detection background for engineering applications.
4. Understand the main concepts and algorithms of detection and estimation theory for practical applications as well as for their research.

Topics Covered:

UNIT I

Elements of Hypothesis Testing: Introduction, Baye's Hypothesis Testing, Minimax Hypothesis Testing, Neyman – Pearson Hypothesis Testing and Composite hypothesis testing.

UNIT II

Signal Detection in Discrete Time : Models and Detector structures, Detection of deterministic signals in independent noise, Detection of deterministic signals in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detection procedures.

UNIT III

Elements of Parameter Estimation: Bayesian Parameter Estimation, MMSE, MMAE and MAP estimations. Non random parameter estimation. Exponential families, completeness theorem for exponential families. The information inequality. Maximum likelihood Estimation (MLE). Asymptotic normality of MLE's

UNIT IV

Elements of Signal Estimation: Introduction, Kalman – Bucy filtering. Linear estimation, Orthogonality Principle. Wiener – Kolmogrov filtering; Causal and non-causal filters.

UNIT V

Signal Detection in Continuous Time: Detection of deterministic and partly determined signals in Gaussian noise; Coherent detection. Detection of signals with unknown parameters.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Learn about basic Estimation Methods: Maximum Likelihood Estimation, Maximum Estimation, Minimum Variance Unbiased Estimation, Minimum Mean Square Error Estimation, Linear Minimum Mean Square Error Estimation and Kalman Filtering
2. Learn Classical and Bayesian Estimation Approaches
3. Gain ability to apply estimation methods to real engineering problems.

Suggested Reading:

1. H.V. Poor, "An Introduction to Signal Detection and Estimation", Springer – Verlag, 2nd edition, 1994.
2. M.D. Srinath & P.K. Rajasekaran, "An introduction to statistical signal processing with applications", Prentice Hall, 2002.
3. H.L. Vantrees, "Detection, Estimation & Modulation Theory", Part-I, John Wiley & Sons, 1968.

16ECC104

WIRELESS MOBILE COMMUNICATION SYSTEMS

Instruction	4 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Analog and Digital Communication Systems is required

Course Objectives:

To introduce the knowledge of the following mobile and wireless communication concepts and technologies along with their applications to the students such as

1. The concepts of frequency reuse, handoff, channel assignment, interference and system capacity enhancement.
2. Methods to estimate large scale path loss and received signal strength in case of various outdoor and indoor wireless propagation conditions.
3. The concepts of small scale fading due to multipath, Doppler Effect, signal and channel bandwidth conditions.

Topics Covered:

UNIT I

Modern Over View wireless communication systems: 1G, 2G, 2.5G, 3G and 4G technologies WLL, WLAN, PAN and Bluetooth.
Cellular Concept: Frequency reuse, Channel assignment strategies, handoff strategies.

UNIT II

Interference and system capacity, near end and far end interference, effect of near end mobile units. Grade of service, improving coverage and capacity in cellular systems.

UNIT III

Mobile radio propagation : large scale propagation free space propagation model. Outdoor propagation models: longely Rice model, Durkin's model, A case study, okumura model, Hata model, PCS Extension to Hata model. Indoor propagation models: partition losses(same floor), partition losses(between floors), log distance path loss model, ericsson multiple breakpoint model, attenuation factor model, signal penetration into buildings.

UNIT IV

Small scale fading & multipaths: Factors influencing small scale fading, small scale multipath measurements, parameters of mobile multipath channel. Types of small scale fading. Spread Spectrum techniques,Multiple Access techniques: FDMA, TDMA, CDMA, CDMA Cellular radio networks.

UNIT V

Modulation techniques for mobile radio, constant enevelop modulation AMPS, and ETACS, GSM.Intelligent network for wireless communication advanced intelligent network (AIN), SS7 network for ISDN & AIN. Wireless ATM networks.

Course Outcomes:

Upon the completion of the course, the student should be able to

1. Distinguish the major cellular communication standards (1G/2G/3G/4G systems)
2. Appreciate the tradeoffs among frequency reuse, signal-to-interference ratio, capacity, and spectral efficiency
3. Analyze large-signal path loss and shadowing and compare different outdoor and indoor propagation models.
4. Characterize small-scale fading in terms of Doppler spectrum, coherence time, power delay profile and coherence bandwidth
5. Analyze the performance of trunked radio systems
6. Distinguish the merits and demerits of TDMA, FDMA and CDMA technologies used for mobile cellular communication

Suggested Reading:

1. Rappaport, “Wireless Communication”, Pearson Education, 2^{nd} edition, 2002.
2. William C. Y. Lee, “Mobile Cellular Telecommunications: Analog and Digital Systems”, 2^{nd} edition, McGraw-Hill Electronic Engineering Series, 1995.
3. William C.Y. Lee, “Mobile Communication Engineering”, Mc-Graw Hill, 1997.
4. Mike Gallegher, Randy Snyder, “Mobile Telecommunications Networking with IS-41”, McGraw Hill 1997.
5. Kernilo, Feher, “Wireless Digital Communications”, PHI, 2002.

16ECC105

PROBABILITY AND RANDOM PROCESSES

Instruction	4 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of some mathematical concepts and preliminaries of probability theory is required

Course Objectives:

1. To give the students concepts of probability, random variable, random signal principles and noise and to compute standard distributions
2. To facilitate the students to identify a random signal, estimate autocorrelation and PSD of random processes and then to classify stationary process.
3. To find the response of a linear system to a random process such as noise and also to model resistive noise sources.

Topics Covered:

UNIT I

Probability and distribution: Joint and conditional probability, independent events, Combined sample space, events in the combined space, probabilities in combined experiments, concept of random variables, distribution and density functions: Binomial, Poison, Uniform, Exponentia, Gaussian, and Rayleigh distributions. Conditional distribution and density functions.

UNIT II

Operations in Random Variables: Expectation, moments, Chebychev's inequality and Markov's inequality. functions that give moments, characteristic functions, moment generating function, transformation of a random variable, computer generation of one random variable, vector random variables, joint distribution and joint density properties, condition distribution and density, statistical independent, sum of several variables, central limit theorem: unequal distribution, equal distribution.

UNIT III

Multiple Random Variables and Processes: Expected value of a function of Random variables, Joint moments about the origin, joint central moments, joint characteristic functions, jointly Gaussian random variables and properties, Linear transformation of Gaussian Random Variables. Sampling and Limit theorems: estimation of Mean, Power and Variance. Complex random variables.

UNIT IV

The random process and spectral characteristics: concept, stationarity and independence, correlation functions, complex random processes.

Spectral Characteristics of Random Processes: Power density spectrum and its properties. Relationship between power spectrum and auto correlation function. Cross power density spectrum and its properties, Relationship between cross power spectrum and cross correlation.

UNIT V

Linear System with Random Inputs: Random signal response of linear systems, auto correlation of response and cross correlation functions of input and out put. System evaluation using random noise. White and colored noise. Spectral characteristic of a system response. Noise band width, band pass, band limited processes and narrow band processes, properties of band limited processes. Modeling of noise sources, an antenna as noise source.

Course Outcomes:

Upon the completion of the course, the student should be able to

1. Students will be able to apply the knowledge of probability, random variables and random processes gained in this course to several complex engineering problems.
2. Students will be able to model a random variable / process into a mathematical model. Compute probability distributions and estimate statistical / time variations
3. Identify a random signal, obtain the autocorrelation and PSD. Also able to estimate the response of a linear system to a random process such as noise.

Suggested Reading:

1. Peyton Z. Peebles JR., "Probability Random Variables and Random Signal Principles", Tata Mc Graw Hill, edition, 4/e, 2002.
2. Athanasios Papolis, "Probability, Random Variables and Stochastic Processes", McGraw Hill, Inc., 3rd edi., 1991.
3. Stark, "Probability & Random Process with Application to Signal Processing", Pearson Education, 3rd edition, 2002.

16ECC106

CODING THEORY AND TECHNIQUES

Instruction	4 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Digital communication is required.

Course Objectives:

1. To study the various algorithms and compare bit error rate for different systems.
2. To develop an understanding of the underlying mathematical structure and algorithms different codes and how they applicable.
3. To study and analyze the real time applications of each coding technique.

Topics Covered:

UNIT – I

Introduction:
Digital communication system, Wireless channel statistical models, BER performance in AWGN and fading channels for different modulation schemes, BER performance of CDMA, FH – CDMA in AWGN and fading channels, capacity of fading channels with CSI, Diversity reception, channel coding Theorem, Channel coding gain.

UNIT – II

Block Coding:
Galois fields, polynomials over Galois fields, RS codes, Decoding Techniques for RS codes, LDPC encoder and decoder, Performance analysis of RS and LDPC codes. BCH codes.

UNIT – III

Convolution codes:
Linear convolution encoders, Structural properties of Convolution codes, Viterbi decoding technique for convolution codes – Soft / Hard decision, concatenation of block codes and convolutional codes, performance analysis, concept of Trellis coded modulation.

UNIT – IV

Turbo Codes:
Parallel concatenation, Turbo encoder, Iterative decoding using BCJR algorithm, Performance analysis.

UNIT – V

Space – Time Coding:

MIMO systems, MIMO fading channels, rate gain & diversity gain, transmit diversity, Alamouti scheme, OSTBC codes, Linear space – time codes, trellis space – time codes, Space – time codes with no CSI

Course Outcomes:

Upon completion of this course, the student will be able to

1. Demonstrate a systematic and critical understanding of the theories and principles of Coding theory and techniques.
2. Design specific Coding technique and calculate the BER achieved
3. Creatively apply contemporary theories, Algorithms in the development and evaluation of solutions to problems and code design.
4. Apply and control specific coding methods and be able to calculate the rate and error probabilities achieved to understand the basic concepts and their practical applications

Suggested Reading:

1. S.B. Wicker, Error control systems for Digital communication and storage, Prentice-hall 1995.
2. E. Biglieri, Coding for Wireless Channels, Springer,2007.
3. K.L.Du & M.N.S.Swamy, Wireless Communication Systems: From RF Subsystems to 4G Enabling Technoligies, Cambridge,2010.
4. J.G. Proakis & M. Salehi, Digital Communications, Mc Graw-Hill, 2008.

16ECC107

COMMUNICATIONS LAB

Instruction	3 Hours per week	End Exam- Duration	-
Sessionals	50 Marks	End Exam- Marks	-

Prerequisites: A prior knowledge of Digital communication is required.

Course Objectives:

The main objective of this course is that the student shall develop an understanding of the underlying concepts of communication systems with special emphasis on the following concepts:

1. Fundamental modulation schemes.
2. Synchronous and asynchronous serial data communication
3. Study of noise figure and error coding
4. Establishing a simple optical fibre communication link

List of Experiments Covered:

1. Study of Phase Shifter, Multiplier and Integrate and Dump Filter
2. Measurement of noise figure
3. Analysis of error coding, parity check and hamming check.
4. Study of wavelength division multiplexing and de-multiplexing.
5. Establishment of Analog / Digital links on optical fibre communication systems, study of 4 channel TDM on optical fibre link
6. Serial communication using RS 232C / Standard Asynchronous / Synchronous model
7. Characterization of Optical directional coupler.
8. Study of modulation schemes using Spectrum analyzer.

9. Simulation of Analog and Digital Communication Modulators / Demodulators using MATLAB and SIMULINK.
10. Simulation of Channel coding / decoding using MATLAB and SIMULINK

Experiments on TMS320 C6748 Processor using CCS

11. Familiarity with CCS-Creation, debugging and running a project
12. Implementation of convolution and correlation
13. Implementation of Decimation and Interpolation
14. Implementation of FFT
15. Implementation of FIR and IIR filters

Course Outcomes:

Upon completion of this course, the student will be able to

1. Able to Formulate and interpret the presentation and processing of signals in communication systems
2. Able to apply suitable modulation schemes and coding for various applications.
3. Able to identify and describe different techniques in modern digital communications, in particular in source coding, modulation and detection, carrier modulation, and channel coding.

16ECC108

COMPUTER COMMUNICATION NETWORKS LAB

Instruction	3 Hours per week	End Exam- Duration	-
Sessionals	50 Marks	End Exam- Marks	-

Prerequisites: A prior knowledge of Data and Computer Communication Networks is required.

Course Objectives:

The main objective of this course is that the student shall develop an understanding of the underlying structure of the data and communication networks with special emphasis on the following concepts:

1. Fundamental concepts of computer networking like Stop & Wait protocol, Go to back N-protocol, Selective Retransmission protocols, LAN fundamentals;
2. Concepts of Data encryption in data communication networks, Network Management and wireless LAN
3. Working of IEEE standards like token bus (IEEE 802.4 standard) and token ring (IEEE 802.5 standard)

List of Experiments Covered:

1. Data communication protocols
    a) Stop & Wait protocol
    b) Go to back N-protocol
    c) Selective Retransmission
2. PC to PC file transfer
3. Error detection codes in data communications
4. Study of LAN fundamentals
5. Data encryption in data communication networks
6. Point – to – Point communication in communication networks

7. Multicast / Broadcast communication
8. Study of Token bus – IEEE 802.4 standard
9. Network / Token management
10. Client Sever Simulation
11. Study of wireless LAN

Experiments on Embedded Applications

12. Design and development of embedded application by using serial communication protocols (7-segement display, ADC and DAC)
13. Design and development of ARM based wireless embedded networking Applications (GSM, GPS and Zigbee)
14. Implementation of multitasking by using Vx-Works IDE
15. Implementation of IPC by using Vx-Works IDE

Note: The experiments will be decided and modified if necessary and conducted by the lecture concerned.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Design, configure and maintain a small office network
2. Analyze network performance through simulation.
3. The course also includes a short introduction to Data encryption in data communication networks.

16ECC109

SEMINAR - 1

Instruction	3 Hours per week	End Exam- Duration	-
Sessionals	50 Marks	End Exam- Marks	-

Prerequisites: A prior knowledge of any Subject in Communication Engineering (related to the seminar topic) is required.

Course Objectives:

1. Awareness of how to use values in improving own professionalism
2. Learning about personal and communication styles
3. Learning management of values for personal and business development
4. Increase knowledge of Emotional Intelligence

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- Literature survey
- Organization of the material
- Presentation of OHP slides / LCD presentation
- Technical writing

Each student required to:

1. Submit a one page synopsis before the seminar talk for display on the notice board.

2. Give a 20 minutes time for presentation following by a 10 minutes discussion.

3. Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Develop and support a relevant and informed thesis, or point of view, that is appropriate for its audience, purpose, discipline, and theme.
2. Demonstrate effective writing skills and processes by employing the rhetorical techniques of academic writing, including invention, research, critical analysis and evaluation, and revision.
3. Effectively incorporate and document appropriate sources in accordance with the formatting style proper for the discipline and effectively utilize the conventions of standard written English.
4. Better understand the role that effective presentations have in public/professional contexts and gain experience in formal/informal presentation.
5. Identify and critically evaluate the quality of claims, explanation, support, and delivery in public and professional discourse, and understand the factors influencing a speaker's credibility.
6. Develop audience-centered presentations meeting concrete professional objectives and integrating ethical and legal visual aids.
7. Deliver well-rehearsed and polished presentations meeting time, content, and interactive requirements.

16ECC110

SEMINAR - 2

Instruction	3 Hours per week	End Exam- Duration	-
Sessionals	50 Marks	End Exam- Marks	-

Prerequisites: A prior knowledge of any Subject in Communication Engineering (related to the seminar topic) is required.

Course Objectives:

1. Awareness of how to use values in improving own professionalism
2. Learning about personal and communication styles
3. Learning management of values for personal and business development
4. Increase knowledge of Emotional Intelligence

Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- Literature survey
- Organization of the material
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For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Develop and support a relevant and informed thesis, or point of view, that is appropriate for its audience, purpose, discipline, and theme.
2. Demonstrate effective writing skills and processes by employing the rhetorical techniques of academic writing, including invention, research, critical analysis and evaluation, and revision.
3. Effectively incorporate and document appropriate sources in accordance with the formatting style proper for the discipline and effectively utilize the conventions of standard written English.
4. Better understand the role that effective presentations have in public/professional contexts and gain experience in formal/informal presentation.
5. Identify and critically evaluate the quality of claims, explanation, support, and delivery in public and professional discourse, and understand the factors influencing a speaker's credibility.
6. Develop audience-centered presentations meeting concrete professional objectives and integrating ethical and legal visual aids.
7. Deliver well-rehearsed and polished presentations meeting time, content, and interactive requirements.

16ECC111

PROJECT WORK - PROJECT SEMINAR

Instruction		End Exam- Duration	-
Sessionals	100 Marks	End Exam- Marks	-

Prerequisites: A prior knowledge of subjects related to the project work is required.

Course Objectives:

The overall objective of the project seminar is to help develop an emerging field at the intersection of multi-disciplinary understandings of engineering education

1. To prepare the students for the dissertation to be executed in 4^{th} semester, solving a real life problem should be focus of Post Graduate dissertation
2. To explore new research from a range of academic disciplines which throws light on the questions unanswered.
3. To showcase cutting edge research on engineering from outstanding academic researchers.

The main objective of the Project Seminar is to prepare the students for the dissertation to be executed in 4^{th} semester. Solving a real life problem should be focus of Post Graduate dissertation. Faculty members should prepare the project briefs (giving scope and reference) at the beginning of the 3^{rd} semester, which should be made available to the students at the departmental library. The project may be classified as hardware / software / modeling / simulation. It may comprise any elements such as analysis, synthesis and design.

The department will appoint a project coordinator who will coordinate the following:

- Allotment of projects and project guides.
- Conduct project - seminars.

Each student must be directed to decide on the following aspects

- Title of the dissertation work.
- Organization.
- Internal / External guide.

- Collection of literature related to the dissertation work.

Each student must present a seminar based on the above aspects as per the following guidelines:

1. Submit a one page synopsis before the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP, PC followed by a 10 minutes discussion.
3. Submit a report on the seminar presented giving the list of references.

Project Seminars are to be scheduled from the 3rd week to the last week of the semester. The internal marks will be awarded based on preparation, presentation and participation.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Develop and support a relevant and informed thesis, or point of view, that is appropriate for its audience, purpose, discipline, and theme.
2. Demonstrate effective writing skills and processes by employing the rhetorical techniques of academic writing, including invention, research, critical analysis and evaluation, and revision.
3. Effectively incorporate and document appropriate sources in accordance with the formatting style proper for the discipline and effectively utilize the conventions of standard written English.
4. Better understand the role that effective presentations have in public/professional contexts and gain experience in formal/informal presentation.
5. Identify and critically evaluate the quality of claims, explanation, support, and delivery in public and professional discourse, and understand the factors influencing a speaker's credibility.
6. Develop audience-centered presentations meeting concrete professional objectives and integrating ethical and legal visual aids.

Deliver well-rehearsed and polished presentations meeting time, content, and interactive requirements.

16ECC112

PROJECT WORK AND DISSERTATION

Instruction	--	End Exam- Duration	--
Sessionals	100	End Exam- Marks	100

Prerequisites: A prior knowledge of subjects related to the project work is required.

Course Objectives:

The Objectives of the dissertation are to:

1. Put into practice theories and concepts learned on the programme
2. Provide an opportunity to study a particular topic in depth;
3. Show evidence of independent investigation;
4. Combine relevant theories and suggest alternatives;
5. Enable interaction with practitioners (where appropriate to the chosen topic);
6. Show evidence of ability to plan and manage a project within deadlines

The students must be given clear guidelines to execute and complete the project on which they have delivered a seminar in the 3rd semester of the course.

All projects will be monitored at least twice in a semester through student’s presentation. Sessional marks should be based on the grades/marks, awarded by a monitoring committee of faculty members as also marks given by the supervisor.

Efforts be made that some of the projects are carries out in industries with the help of industry coordinates.

Common norms will be established for documentation of the project report by the respective department.

The final project reports must be submitted two weeks before the last working day of the semester.

The project works must be evaluated by an external examiner and based on his comments a viva voice will be conducted by the departmental committee containing of HOD, two senior faculty and supervisor.

Course Outcomes:

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Plan, and engage in, an independent and sustained critical investigation and evaluation of a chosen research topic relevant to environment and society
2. Systematically identify relevant theory and concepts, relate these to appropriate methodologies and evidence, apply appropriate techniques and draw appropriate conclusions
3. Engage in systematic discovery and critical review of appropriate and relevant information sources
4. Appropriately apply qualitative and/or quantitative evaluation processes to original data\
5. Understand and apply ethical standards of conduct in the collection and evaluation of data and other resources
6. Define, design and deliver an academically rigorous piece of research;
7. Understand the relationships between the theoretical concepts taught in class and their application in specific situations
8. Show evidence of a critical and holistic knowledge and have a deeper understanding of their chosen subject area
9. Appreciate practical implications and constraints of the specialist subject

16ECE101

RADAR SIGNAL PROCESSING

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Radar and Satellite Communication Systems is required.

Course Objectives:

1. Learn the fundamental issues involved in radar signal processing.
2. Learn the concept of Optimum receivers, Correlator and Band pass Matohed Filter Receivers
3. Learn the concept of range and Doppler resolution, ambiguity function and its properties.
4. Learn the concept of doubly dispersive fading target and clutter models
5. Introductory concept of to Adaptive Detection and CFAR Techniques

Topics Covered:

UNIT-I
Introduction : Classification of Radars based on functions, principles of operation etc., performance measures and interplay between Radar parameters, Target parameters and Environment parameters. Classical Detection and Estimation Theory, Binary Hypotheses Testing, Likelyhood Ratio Test, Neymon square, MAP, Maximum Likelihood Estimation of parameters, Cramer-Rao Bounds, Chemoof Bounds.

UNIT – II
Representation of Singals, K-L expansion, Equivalent Low-pass representation of Band pass signals and noise. Detection of Slowly Fluctuating point Targets in white noise and coloured noise. Swerling Target models. Optimum receivers. Correlator and Band pass M atohed Filter Receivers. PD – PF performance; Coherent and non-coherent Integration sub-optimum Reception. Radar Power – Aperture product.

UNIT III
Range and Doppler Resolution : Ambiguity function and its properties. Local and Global Accuracy. Signal Design. LFM. Polyphase coded signals Detection of a Doppler shifted slowly fluctuating point target return in a discrete scatterer environment.

UNIT IV

Dobly dipersive Fading Target and Clutter models-Scattering function description. Land clutter-pulse length limited and Beam width limited clutter. Sea clutter.

UNIT V

Optimum / Sub optimum reception of Range Spread / Doppler Spread / Doubly spread targets in the presence of noise and clutter. Introduction to Adaptive Detection and CFAR Techniques.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Understand the essential principles of operation of radar systems
2. Apply appropriate mathematical and computer models relevant to radar systems to calculate system performance, and assess the limitations of particular cases
3. Understand the design of radar signals, and Doppler radar
4. Design simple radar systems and the associated signal processing, at block diagram level

Suggested Reading:

1. Di Franco. JV and Rubin, WL., "Radar Detection", Artech House, 1980.
2. Gaspare Galati (Ed), "Advanced Radar Techniques and Systems", Peter Perigrinus Ltd., 1993.
3. Ramon Nitzberg, "Radar Signal Processing and Adaptive Systems", Artech House, 1999.
4. August. W Rihaczek, "Principles of High Resolution Radar", Artech House, 1996.

16ECE102

GLOBAL NAVIGATION SATELLITE SYSTEMS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Satellite Communication, Radio Navigation Aids and INS is required

Course Objectives

1. To explain the basic principles of various positioning techniques and introduce GPS operating principle.
2. To make the students to understand the essential features such as signal structure, errors, coordinate systems etc., and highlight the importance of integrating GPS with other systems.
3. To teach the necessity of augmentation of GPS and discuss SBAS and GBAS systems.

Topics Covered:

UNIT 1

GPS fundamentals: INS, Trilaiteration, Hyperbolic navigation, Transit, GPS principle of operation, architecture, operating frequencies, orbits, Keplerian elements.Solar and Siderial days, GPS and UTC Time.

UNIT 2

GPS Signals:, Signal structure, C/A and P-Code, ECEF and ECI coordinate systems and WGS 84 and Indian datums, Important components of receiver and specifications, link budget.

UNIT 3

GPS Error Models: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Antenna Phase center variation, multipath; estimation of Total Electron Content (TEC) using dual frequency measurements, Various DOPs, UERE. Spoofing and Anti-spoofing. : Future GPS satellites, new signals and their benefits GPS integration – GPS/GIS, GPS/INS, GPS/pseudolite, GPS/cellular.

UNIT 4

GPS data processing, DGPS and Applications: RINEX Navigation and Observation formats, Code and carrier phase observables, linear combination and derived observables, Ambiguity resolution, cycle slips, Position estimation. principle of operation of DGPS, architecture and errors.

UNIT 5

Other Constellations and Augmentation systems Other satellite navigation constellations GLONASS and Galileo IRNS System. : Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, GAGAN, EGNOS and MSAS. Local area augmentation system (LAAS) concept.

Course Outcomes

1. Students will be able to calculate user position for a given inputs related to various positioning methods.
2. Students will be able estimate the contribution of each error and estimate the GNSS positional accuracy.
3. Students will have clear idea what type of integration or augmentation is necessary in a particular scenario.

Suggested Reading:

1. B.Hofmann Wollenhof, H.Lichtenegger, and J.Collins, "GPS Theory and Practice", Springer Wien, new York, 2000.
2. Pratap Misra and Per Enge, "Global Positioning System Signals, Measurements, and Performance," Ganga-Jamuna Press, Massachusetts, 2001.
3. Ahmed El-Rabbany, "Introduction to GPS," Artech House, Boston, 2002.
4. Bradford W. Parkinson and James J. Spilker, "Global Positioning System: Theory and Applications," Volume II, American Institute of Aeronautics and Astronautics, Inc., Washington, 1996.

16ECE103

OPTIMIZATION TECHNIQUES

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: There are no pre-requisites for this subject.

Course Objectives:

1. To understand LPP and NLPP techniques.
2. To compare gradient based methods.
3. To study two global optimization method-simulated annealing and genetic algorithm.
4. To compare different optimization techniques.

Topics Covered:

UNIT I
Use of optimization methods. Introduction to classical optimization techniques, motivation to the simplex method, simplex algorithm, sensitivity analysis.

UNIT II
Search methods - Unrestricted search, exhaustive search, Fibonocci method, Golden section method, Direct search method, Random search methods, Univariate method, simplex method, Pattern search method.

UNIT III
Descent methods, Gradient of function, steepest decent method, conjugate gradient method. Characteristics of constrained problem, Direct methods, The complex method, cutting plane method.

UNIT IV
Review of a global optimization techniques such as Monte Carlo method, Simulated annealing and Tunneling algorithm.

UNIT V
Generic algorithm - Selection process, Crossover, Mutation, Schema theorem, comparison between binary and floating point implementation.

Course Outcomes:

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

1. Take an optimum decision to increase the production/ get more profit
2. Design IC's/Processor which are optimum with respect to power or efficiency
3. Take up research to design new IC's

Suggested Reading:

1. SS Rao, "Optimization techniques", PHI, 1989.
2. Zhigmiew Michelewicz, "Genetic algorithms + data structures = Evaluation programs", Springer Verlog - 1992.
3. Merrium C. W., "Optimization theory and the design of feedback control systems", McGraw Hill, 1964.
4. Weldo D.J., "Optimum seeking method", PHI, 1964.

16ECE104

IMAGE PROCESSING AND VIDEO PROCESSING

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Signal Processing is required

Course Objectives:

1. To introduce the basic concepts and methodologies involved in image and video processing.
2. To understand the basic image transform techniques and use them in real time enhancement, segmentation and compression of images and videos
3. To provide a conceptual foundation that can be used as a basis for further study and research in this field.

Topics Covered:

UNIT I

Fundamentals of Image Processing and Image Transforms

Basic steps of Image Processing System, Sampling and Quantization of an image, relationship between pixels.

Image Transforms

2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Wavelet Transforms: Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT II

Image Processing Techniques

Image Enhancement

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Image Segmentation

Segmentation concepts, Point, Line and Edge Detection. Thresholding, Region Based segmentation.

UNIT III

Image Compression

Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, JPEG Standards.

UNIT IV

Basic concepts of Video Processing

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT V

2-D Motion Estimation

Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Demonstrate a systematic and critical understanding of the theories and principles of image and video processing.
2. Analyze degraded or contaminated images using various image enhancement tools.
3. Creatively apply contemporary theories, processes and tools in the development and evolution of solutions to problems related to processing

Suggested Reading:

1. Gonzaleze and Woods ,Digital Image Processing , 3rd ed., Pearson.
2. Yao Wang, Joem Ostermann and Ya–quin Zhang ,Video processing and communication, 1st Ed., PH Int.
3. M. Tekalp ,Digital Video Processing , Prentice Hall International

16ECE105

SATELLITE AND MICROWAVE COMMUNICATIONS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of satellite communication is required

Course Objectives:

1. To acquire the students with the essential knowledge to understand CCITT modulation plans, units for power calculations, Noise calculations.
2. To explain the students about LOS propagation, Link engineering, Path and link reliability, Tropospheric scatter communication system.
3. The concepts of Earth station Technology, Uplink and down link path calculations, G/T and C/N link calculations and various multiple access techniques.
4. Reliability, redundancy and quality assurance of satellite communication, and introductory concepts of V-Sats, GIS and GPS.

Topics Covered:

UNIT I

Introductory concepts: Transmission problem, simplified transmission system, the decibel and basic derived decibel unit, Neper, practical transmission, speech, SNR, Noise figure and noise temperature, EIRP and conversion factors, CCITT modulation plan, loading of FDM system, pilot tones, noise calculation, through super group techniques, compandors, characteristics of carrier equipment.

UNIT II

Line-of-sight communication systems: Link engineering, propagation characteristics in free space, path calculations, feeding, diversity reception, noise power ratio and its measurements, frequency planning. Path and link reliability, rainfall and other precipitation attenuation, radio link repeaters, antenna towers and masts, plain reflectors as passive repeaters, noise planning on radio links.

UNIT – III

Tropospheric scatter communication system: Introduction, phenomenon of tropospheric scatter, tropospheric fading, path loss calculations, aperture to medium coupling loss take of angle, equipment configuration, isolation, inter modulation, typical tropospheric scatter parameters.

Frequency assignment. Earth station technology: The satellite earth space window, path loss considerations of the up link and down path calculations.

UNIT- IV

Earth station, G/T, C/N , link calculation, C/N for the complete link, and design of communication systems via satellites, Modulation, Multiplexing and multiple access techniques: TDMA,FDMA, CDMA,SSMA, SPADE.

UNIT – V

Reliability, Redundancy, Quality assurance, Echo control and Echo suppression, introductory concepts of VSATS, GIS, GPS and Future trends, Pay load engineering – Definition, constraints, specification and configurations.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Acquire fundamental knowledge CCITT modulation plans, power and noise calculations.
2. Analyze a LOS propagation system and calculate the path and link reliability. Understand and compare the Tropospheric communication system.
3. Calculation of G/T and C/N ratios of a path link and understanding of Earth station Technology.
4. Understand of the basic concepts of GIS and GPS

Suggested Reading:

1. Roger L Free man, “Telecommunication transmission handbook”, John Wiley, 4th Edition, 1998.
2. T.Pratt & C.W. Bostian, “Satellite Communication Systems”, PHI, 1st edition,1986.
3. B.G.Evans, Satellite communication system edited, 3rd edition, IET, U.K., 2008.
4. Dennis Roddy, “Satellite Communication Systems”, Mc Graw Hill publications, 4th Edition, 2006.
5. Wayne Tomasi “Advanced Electronics Communication System” Pearson Education, 6thEdt, Apr 2003.

16ECE106

OPTICAL FIBRE COMMUNICATION SYSTEMS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of basics of communication is required

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration
5. To learn the application of optical fibre in Local Area Networks and operational principles of WDM

Topics Covered:

UNIT I

Optical Fibres: Fibre Structures, Wave-guiding and fabrications, Nature of light, Basic optical laws and definitions, Modes and configurations, Mode theory of circular wave guides, Single, Multi mode step index and Graded index Fibres , Fibre materials and fabrication. Attenuation, Dispersion, Signal distortion in optical wave-guides, Mode coupling, Design optimization of single mode couplers.

UNIT II

Optical Sources & Detectors: Semiconductors as optical Sources and their fabrication. LED and Laser diodes, Linearity of sources, Modal, Partition and reflection noise, Power launching and coupling. Physical principles of PIN and APD, Photo detector noise, detector response time, Avalanche multiplication noise, Temperature effect on avalanche gain, Photo diode materials.

UNIT III

Optical Fibre communication: Basic communication system, Fundamental receiver operation, Digital receiver performance calculations. Preamplifiers types, Analog receivers.Fibre Links: Point to point links, Line coding, Eye pattern, Noise effects on digital transmission system performance. Overview of analog links, Carrier noise ratio in analog systems. Power budget, Time budget, Maximum link length calculations.

UNIT IV

Opto-Electronic Integrated Circuits (OEICs): Basic concepts of OEICs. Optical Planar and Strip waveguides. Principles of Electro-Optic Effect. Guided wave devices – Phase modulator, Mach-Zehnder Interferometer modulator and switch, Optical directional coupler and switches.

UNIT V

Multi channel transmission techniques, Classification of coherent optical Fibre systems, Modulation techniques, polarization control requirements, WDM. Application of optical Fibre in Local Area Networks, Introduction of optical amplifiers.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Analyze the performance of both digital and analog optical fibre systems
2. Calculate the system bandwidth, noise, probability of error and maximum usable bit rate of a digital fibre system.
3. Calculate the system link loss, distortion and dynamic range of an RF photonic link.

Suggested Reading:

1. Djafar K.mynbaev Lowell l.Scheiner "Fibre Optic Communications Technology", Pearson Education Asia.
2. Senior John M. "Optical Fibre Communications Principles and Practice", Prentice Hall India, second edition, 1996
3. Keiser Gerd , "Optical Fibre Communications", Mc GrawHill, second edition, 1991.

16ECE107

STATISTICAL SIGNAL PROCESSING

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of signal processing is required

Course Objectives:

Given a discrete time sequence {x(n)}, is to develop

1. Statistical and spectral signal representations
2. Filtering, prediction, and system identification algorithms
3. Optimization methods that are:
    a) Statistical
    b) Adaptive
4. Power spectrum estimation algorithms
5. Algorithms on array signal processing.

Topics Covered:

UNIT I

Optimum Linear Filters: Representation of stationary random process – Rational power spectra, Filter parameters and autocorrelation sequence. Forward and backward predictors, Reflection coefficients, AR Process and Linear Prediction. Solution of normal equations – Levinson & Durbin Algorithms, Schur Algorithm. Properties of linear prediction error filters. AR Lattice and ARMA Lattice – Ladder filters. FIR and IIR Wiener filtering and prediction.

UNIT II

Power Spectrum Estimation: Estimation of Spectra from finite duration observation of a signal. Hourogram. DFT in power spectrum estimation. Non-parametric methods – Bartlett's welch's and Blackman-Turkey methods; Computational requirements and performance characteristics. Parametric methods – Relation between auto correlation sequence and model parameters. Methods for AR model parameters. Yule – walker, Burg and unconstrained, Least squares methods. Sequential estimation methods. Selection of AR model order; Moving average (MA) and ARMA models.Capon's minimum variance method. Pisarenko's harmonic decomposition method. Eigen structure methods – Music and ESPIRIT. Order selection criteria.

UNIT III

Array Signal Processing: Array fundamentals – Spatial signals, Signal models, Spatial sampling. Conventional beam forming-Spatial matched filter, Tapered Beam forming. Optimum Beam forming, Eigen Analysis, Interference cancellation, sidelobe canceller. Performance considerations for optimum beam forming.Basic ideas of direction of arrival estimation using a uniform linear array. Maximum likelihood estimate. Pisaxenko's method. MUSIC.

UNIT IV

Adaptive Filters: Applications of adaptive filters-Prediction, System modeling, Interference cancellation, Channel equalization. Adaptive direct form FIR filters – MMSE extension, LMS algorithm, properties of LMS algorithm, Recursive Least Squares (RLS) algorithm and its properties. Adaptive Lattice – Ladder filters, properties of lattice – Ladder algorithm.

UNIT V

Introduction. Moments, cumulant and polyspectra. Higher Order Moments (HOM) and LIT systems, HOM's of linear signal methods. Blind deconvolution. Blind equilization algorithm. Conventional estimators for HOS. Parametric method for estimation of HOS – MA, AR & ARMA methods. Ceptra of HOS. Phase and magnitude retrival from the bispectrum.

Course Outcomes:

Upon completion of this course, the student will be able to:

1. Learn advanced statistical methods and algorithms for parameter estimation
2. Design optimum filters and adaptive filters.

Suggested Reading:

1. John G. Proakis et.al, "Introduction to Digital Signal Processing", PHI, 1997.
2. D.G. Manolakis, Ingle & S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, Int. edition, 2000.
3. John G. Proakis, Rader, et.al, "Algorithms for Statistical Signal Processing", Pearson Education, Asia Publishers, Indian edition, 2002.
4. S. Kay: Modern Spectral Estimation, "Theory & Applications", PH publication, 1st edition, 1987.
5. Simon Haykins, "Array Signal Processing", P.H. Publication 1985. (Chapters 2,3 and 4).

16ECE108

SMART ANTENNAS FOR MOBILE COMMUNICATIONS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Antenna and wave propagation is required

Course Objectives:

To gain an understanding and experience with

1. Cellular Radio concepts and smart antenna environments, algorithms and implementation.
2. Spatial processing for wireless systems. Adaptive antennas and Wide band Smart Antennas
3. Coherent and non-coherent CDMA spatial processors.
4. Optimal spatial filtering – adaptive algorithms for CDMA. Multitarget decision – directed algorithm.

Topics Covered:

UNIT I

Cellular Radio concepts – Spread Spectrum CDMA – Antenna Systems – Radio wave propagation – fading – Cellular CDMA – IS-95 CDMA system work – Reverse Traffic Transmission – Forward Channel Signal – Evaluation of CDMA 2000.

UNIT II

Introduction to Smart Antennas – Spatial processing for wireless systems – Fixed beam forming networks – Switched beam systems – Adaptive Antenna Systems – Wide band Smart Antennas – Digital Radio Receiver techniques - Array calibrations.

UNIT III

Smart Antennas Techniques for CDMA: Non Coherent CDMA – Coherent CDMA –Multi user spatial processing – Re sectoring using Smart Antennas – Down link beam forming for CDMA.

UNIT IV

CDMA System Range and Improvements using Spatial Filtering – Range extensions in CDMA – Spatial filtering at IS-95 base station – Reverse channel performance – Spatial filtering at WLL subscriber unit – Range and Capacity Analysis.

UNIT V

Optimal Spatial Filtering and Adaptive Algorithms – Array performance in Multipath – under loaded , over loaded adaptive arrays – Adaptive algorithms for CDMA – Multi Target Decision Directed Algorithms – Estimation Algorithms – RF position location systems.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Evaluate a system requirement for the implementation and design of an appropriate Smart Antenna.

2. Mathematical descriptions with intuitive explanations will assist the students in acquiring a deeper understanding of the area

3. Provides a complete framework for developing, analyzing and understanding the algorithms needed for advanced processing in emerging field of smart antennas for mobile communications.

Suggested Reading:

1. Joseph C. Liberti Jr., Theodore S Rappaport, "Smart Antennas for wireless communications IS-95 and third generation CDMA applications", PTR – PH publishers, 1st edition, 1989.
2. T.S Rappaport, "Smart Antennas Adaptive arrays algorithms and wireless position location", IEEE press 1998, PTR – PH publishers 1999.
3. Garg, "IS-95 CDMA and CDMA 2000, "Cellular / PCs systems implementation", Pearson Education, 2002.

16ECE109

VOICE OVER INTERNET PROTOCOLS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Data communication and computer networks is required

Course Objectives:

1. To provide the concept of Circuit-switching technology is traditionally used to transport voice over the telephone system.
2. To examine the emerging trend of using packet-switching network to transport voice - especially over the Internet Protocol (IP) network.
3. To provide students the theory of "IP Telephony". Students will also get the bigger picture of how VoIP technology is changing the telecom

Topics Covered:

UNIT I

Overview of IP Protocol Suite

The internet protocol, the Transmission control Protocol(TCP), The User Datagram Protocol(UDP), The Real–time Transport Protocol(RTP), IP multicast, IP version 6 (IP v6),Internetworking IPv4 and IPv6, The VoIP Market, VoIP Challenges.

UNIT II

H.323 and H.245 Standards

The H.323 Architecture, Call Signaling-Call Scenarios, H.245 Control Signaling Conference Calls- The Decomposed Gateway.

UNIT III

The Session Initiation Protocol (SIP)

SIP-Architecture- Overview of SIP Messaging syntax- Examples of SIP Message Sequence-Redirect Servers- Proxy Servers. The Session Description Protocol (SDP)-Usage of SDP with SIP.

UNIT - IV

Quality of Services (QoS)

Need for QoS- End-to end QoS, Overview of QoS Solutions- The Resource reservation Protocol (RSVP) - Diffserv – The Diffserv Architecture- Multi-Protocol Label Switching (MPLS)-The

MPLS Architectures- MPLS Traffic Engineering- Label Distribution Protocols and constraint-Based Routing.

UNIT V

VoIP and SS7

The SS7 Protocol Suit- The Message Transfer Part (MTP), ISDN User Part (ISUP) and Signaling connection control part (SCCP), SS7 Network Architecture- Signaling Points (SPs)- Single Transfer Point (STP),- Service Control Point (SCP),- Message Signal Units (MSUs)- SS7 Addressing, ISUP, Performance Requirements for SS7, Sigtran –Sigtran Architecture- SCTP-M3UA Operation- M2UA Operations-M2PA Operations- Interworking SS7 and VoIP Architectures- Internetworking Soft switch and SS7- Internet working H.323 and SS7.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Identify architectures used in the enterprise environment.
2. Name the key VoIP industry protocols
3. Explain the application of technologies, architectures, and protocols used in the VoIP environment.
4. Describe Quality of Service (QoS) and its importance to phone services.
5. Explain differences among various protocols: SIP, H.323, H.245, RSVP, VoIP
6. Describe the principles of IP switching and routing.
7. Explain how the Internet Protocol is key to VoIP.
8. Appraise the importance of quality of service with regard to availability,

   reliability, and serviceability of a voice network.

Suggested Reading:

1. Daniel Collins, Carrier Grade Voice over IP, 2nd ed., TMH.
2. MPEG-4, part 2: ISO/IEC 14496-2: coding of audio- visual objects-part2, visual, Third Edition, May 2004

16ECE110

MODERN DIGITAL COMMUNICATION SYSTEMS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: The students are expected to have a background that includes probability theory and random processes, analog and digital signal processing, and analog communication systems.

Course Objectives:

1. To understand, analyze, fundamental digital communication systems and the characteristics of Communication signals and systems
2. To understand baseband data transmission, duo-binary signaling and decoding, poly-binary signaling, Coherent and non coherent modulation and detection of digital signals,
3. To understand the concept of Minimum Shift Keying and the concept of fading channel.

Topics Covered:

UNIT I

FIR filters: Review of frequency response of discrete time systems and FIR filters, Optimal FIR filters, Frequency sampling method of FIR filters, Comparison of different methods, FIR cascaded and lattice structures.

UNIT II

IIR filters: Design of digital IIR low pass filters, Spectral or frequency transformation of IIR filters, Computer aided design of IIR filters, cascaded and lattice structures of IIR filters, Finite word length effects in IIR filters..

UNIT III

Multirate signal processing – Decimation by a integer factor , Interpolation by a integer factor , Sampling rate conversion by a rational factor , Design of practical sampling rate converters, Software implementation of sampling rate converters, Applications of Multirate signal processing.

UNIT IV

Multi rate filter banks and wavelets: Digital filter banks, Two- channel quadrature mirror filter banks, L – channel QMF banks, multi level filter banks.

UNIT V

Introduction to wavelet transforms – Short time Fourier transform, Gabar transform, wavelet transform, Recursive multi resolution Decomposition, Haar wavelet, Digital filter implementation of the Haar wavelet, Digital Filtering interpretation.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Students are able to analyze digital communication signals.
2. Students understand the basics of Baseband transmission, Coherent and non coherent modulation and detection and MSK.
3. They can analyze probability of error performance of such systems and are able to design digital communication systems based on these modulation techniques as block diagrams.
4. Students understand and are able to analyze the concept of fading channel.
5. Students understand the concept of Mitigation techniques for multipath fading channel.

Suggested Reading:

1. Emmanuel C. Ifeachor and Barrie W. Jervis, 'Digital Signal Processing- A practical approach, 2^{nd} edition, Pearson Education, 2004.
2. Proakis, JG and Manolakis, DG, 'Digital signal Processing', PHI, 4^{th} ed., 2006.
3. Roberto Cristi, Modern Digital Signal Processing, Thomson Books, 2004.
4. SK Mitra, Digital Signal Processing, TMH, 2006.

16ECE111

EMBEDDED SYSTEM DESIGN

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Microprocessors-Microcontrollers and basics of operating systems is required.

Course Objectives:

1. Embedded system design requires a comprehensive understanding of the overall system architecture involving hardware and software components as well as of its complex communication structure.
2. It also requires understanding the concepts of Real Time Operating System.
3. To develop an innovative embedded application through different case studies

Topics Covered:

UNIT – I
Introduction to Embedded Systems: An Embedded system, Classification, processor in the system, other hardware units, structural units in a processor, processor selection for an embedded system, memory devices, memory selection for an embedded system, introduction to ARM processors.

UNIT – II
Devices and Buses: I/O devices, Serial communication using IIC and CAN buses, advanced I/O buses between the networked multiple Devices, Device drivers: Classification, Parallel port device drivers in a system, Serial port device drivers in a system.

UNIT – III
Interprocess communication and synchronization of processes, Task and Threads: Multiple processes in an application, problem of sharing data by multiple tasks and routines, Embedded programming in C++ and Java.

UNIT – IV
Real time Operating Systems: Operating system services, Real time operating system services, interrupt routines in RTOS Environment, RTOS Task scheduling, embedded Linux internals, OS Security issues, Mobile OS.

UNIT – V

Hardware-Software Co-Design in an Embedded System: Embedded system project Management, Embedded system Design and Co-Design issues in system development process. Design cycle in system development phase for an embedded system, Emulator and ICE, Use of software tools for development of Embedded systems, Case studies of programming with RTOS(Examples: Automatic chocolate vending machine, vehicle tracking system, Smart card).

Course Outcomes:

Upon completion of this course, the student will be able to

1. Understand basic concepts of hardware and its interfacing for an embedded system.
2. Simulate the various functionalities of RTOS for different embedded system design.
3. Combine the design and development of hardware and software for an embedded system application.

Suggested Reading:

1. Raj Kamal,"Embedded Systems" Architecture, Programming and Design, TMH, 2006.
2. Jonathan W Valvano, "Embedded Micro Computer Systems" Real Time Interfacing, Books / cole, Thomson learning 2006.
3. Arnold S Burger, "Embedded System Design" An Introduction to Processes, Tools and Techniques by CMP books, 2007.
4. David.E. Simon, "An Embedded Software Primer", Pearson Edition, 2009.
5. Andrew N.sloss, Dominic Symes, Chris Wright, "ARM System Developer's guide", Elsevier publications 2005.

16ECE112

DATA COMPRESSION

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Digital Signal Processing is required.

Course Objectives:

1. To acquire the students with the essential knowledge to understand various data compression coding techniques like Huffman run length, arithmetic Ziv lemple coding.
2. To explain the students about various speech and Image waveform characterization, Quantization and source models.
3. The concepts of Differential PCM Linear prediction of for video, motion compensation for video.
4. Understanding of the various transform coding like Fourier, Cosine and wavelet based speech and Image compression.
5. To learn various compression techniques like Sub band coding, Fractal coding of image. Also learning of various standards speech, audio, video and Image.

Topics Covered:

UNIT I
Data Compression: Entropy coding – Huffmann Run length, arithmetic and Ziv-Lemple coding

UNIT II
Speech & Image waveform characterization – source models, Quantization, Optimal & adaptive waveform coders for speech & images.

UNIT III
Predictive coding – DPCM, Linear prediction, prediction for video, adoptive prediction, motion compensation for video.

UNIT IV
Transform Coding: Orthogonal transforms – Fourier, Cosine, wavelet based approaches to speech & image compression.

UNIT V

Subband coding, VQ based compression, Fractal coding of images.High quality video & audio compression for digital broadcasting.Standards for digital signal compression-data, speech, audio, image & Video.

Course Outcomes:

Upon completion of this course, the student will be able to

1. Acquire fundamental knowledge of different coding techniques and their merits and demerits.
2. Analyze speech and image waveform characterization.
3. Motion compensation for video and PCM linear prediction will be known.
4. Understanding of the various transform coding methods.
5. Various standards for audio, video and speech signals are understood. Other coding techniques like sub-band coding are also learnt.

Suggested Reading:

1. M. Nelson, "The data compression book", 2nd edition, BPB publications, 1997.
2. Jananth & Noll, "Digital coding of waveforms-Principles and applications to speech & video", PHI, 1984.
3. K.R. Rao & Hwang. JJ, "Techniques & standards for image, video & audio coding", Prentice Hall, 1996.
4. Elliot, "Handbook of Digital Signal Processing", Academic Press, 1985.
5. Ning Lu, "Fractal Imagin", Academic Press, 1997.

16ECE113

SOFTWARE DEFINED AND COGNITIVE RADIO

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of signal processing, Communication and spectral knowledge is required.

Course Objectives:

1. To make the students understand the difference between Superhetrodyne Radio and Software defined Radio (SDR).
2. To differentiate between Cognitive Radio (CR) and SDR and study their architectures.
3. To give the Knowledge to students about FPGA based architectures with low power consumption.
4. To make the students know about the CR signal processing Techniques and applications.

Topics Covered:

UNIT I
Introduction to SDR: What is Software-Defined Radio, The Requirement for Software-Defined Radio, Legacy Systems, The Benefits of Multi-standard Terminals, Economies of Scale, Global Roaming, Service Upgrading, Adaptive Modulation and Coding, Operational Requirements, Key Requirements, Reconfiguration Mechanisms, , Handset Model, New Base-Station and Network, Architectures, Separation of Digital and RF, Tower-Top Mounting, BTS Hoteling, Smart Antenna Systems, Smart Antenna System Architectures, Power Consumption Issues, Calibration Issues, Projects and Sources of Information on Software Defined Radio,

UNIT II
Basic Architecture of a Software Defined Radio: Software Defined Radio Architectures, Ideal Software Defined Radio Architecture, Required Hardware Specifications, Digital Aspects of a Software Defined Radio, Digital Hardware, Alternative Digital Processing Options for BTS Applications, Alternative Digital Processing Options for Handset Applications, Current Technology Limitations, A/D Signal-to-Noise Ratio and Power Consumption, Derivation of Minimum Power Consumption, Power Consumption Examples, ADC Performance Trends, Impact of Superconducting Technologies on Future SDR Systems.

UNIT III
Signal Processing Devices and Architectures: General Purpose Processors, Digital Signal Processors, Field Programmable Gate Arrays, Specialized Processing Units, Tilera Tile Processor, Application-Specific Integrated Circuits, Hybrid Solutions, Choosing a DSP Solution. GPP-Based SDR, Non real time Radios, High-Throughput GPP-Based SDR, FPGA-Based SDR, Separate Configurations, Multi-Waveform Configuration, Partial Reconfiguration, Host

Interface, Memory-Mapped Interface to Hardware, Packet Interface, Architecture for FPGA-Based SDR, Configuration, Data Flow, Advanced Bus Architectures, Parallelizing for Higher Throughput, Hybrid and Multi-FPGA Architectures, Hardware Acceleration, Software Considerations, Multiple HA and Resource Sharing, Multi-Channel SDR.

UNIT IV

Cognitive Radio : Techniques and signal processing History and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection, cyclostationary and wavelet based sensing- problem formulation and performance analysis based on probability of detection vs SNR. Cooperative sensing: different fusion rules, wideband spectrum sensing- problem formulation and performance analysis based on probability of detection vs SNR.

UNIT V

Cognitive Radio: Hardware and applications: Spectrum allocation models. Spectrum handoff, Cognitive radio performance analysis.Hardware platforms for Cognitive radio (USR , WARP), details of USRP board, Applications of Cognitive radio

Course Outcomes:

1. The students would learn the difference between the superhetrodyne receiver, Software Defined Radio and Cognitive Radio.

2. The different architectures of SDR and CR would be learnt by the student.

3. Various signal processing techniques of CR would be known.

4. The applications of CR would be understood by the student.

Suggesting Reading:

1. “RF and Baseband Techniques for Software Defined Radio” Peter B. Kenington, ARTECH HOUSE, INC © 2005.
2. “Implementing Software Defined Radio”, Eugene Grayver, Springer, New York Heidelberg Dordrecht London, ISBN 978-1-4419-9332-8 (eBook) 2013.
3. “Cognitive Radio Technology”, by Bruce A. Fette, Elsevier, ISBN 10: 0-7506-7952-2, 2006.
4. “Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems”, Hüseyin Arslan, Springer, ISBN 978-1-4020-5541-6 (HB), 2007.

16ECE114

ENGINEERING RESEARCH METHODOLOGY

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Mathematics, statistical exposure and data analysis and modeling skills are required

Course Objectives:

1. To motivate the students to do Ph.D and choose research as career.
2. To explain how to choose research problem in the context of latest developments in the area of electronics and communications with the help of literature survey.
3. To familiarize the students with the procedures to acquire, process, analyze and validate the experimental data and techniques for producing a good technical report.

Topics Covered:

UNIT-I

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Important of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. **Defining the Research Problem:** Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

UNIT-II

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.
Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

UNIT-III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

UNIT-IV

Data Collection: Exploring the data, Description and Analysis of Data, Sample Design and Sampling, Role of Statistics for Data Analysis, Functions of Statistics, Estimates of Population, Parameters, Parametric V/s Non Parametric methods, Descriptive Statistics, Points of Central tendency, Measures of Variability, Measures of relationship, Inferential Statistics-Estimation, Hypothesis Testing, Use of Statistical software.

Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student‟s„t‟ test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

UNIT-V Research Report Writing: Format of the Research report, Style of writing report, References/Bibliography/Webliography, Technical paper writing/Journal report writing. **Research Proposal Preparation:** Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Course Outcomes:

1. Students will become more enthusiastic about doing research oriented project for their thesis.
2. Students will gain knowledge and will be capable of choosing a research problem that is relevant to latest fields and be more imaginative.
3. Students will become capable of proposing modifications to the existing methods or proposing a new technique in whatever field they choose to work and produce a good technical document about the work.

Suggested Reading:

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
4. P. Ramdass and A. Wilson Aruni, Research and Writing across the Disciplines, MJP Publishers, Chennai, 2009

16ECE115

REAL TIME SIGNAL PROCESSING

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Signal Processingis required.

Course Objectives:

1. To understand the motivation of the specialized processors.
2. To understand the architecture and addressing modes of TMS320c54xx and Analog Devices Blackfin processors.
3. To generate various types of test signals.
4. To implement various filters on these processors.

Topics Covered:

UNIT I
Real time concepts, Structural levels of processing, Digital Signal processing and DSP systems, Comparison between general purpose and DSP processors. Examples of digital signal processors, Motivation of the specialized processors. Fixed point vs Floating point, native data word width.

UNIT II
Key features of TMS 320CS54XX, architecture, addressing modes and Instruction set of TMS 320C54XX, special instructions - FIRS and LMS.

UNIT III
Architecture, addressing modes and instruction set of Analog devices Blackfin Processor ADSP 215XX

UNIT IV
Implementation of Digital Filters on DSP Processors – FFT, FIR filters, IIR filters, Adaptive filters and multirate filters.

UNIT V
Practical DSP applications in communications, Sine wave generators and applications, Noise generators and applications, DTMF tone detection, Adaptive echo cancellation, Speech enhancement techniques.

Course Outcomes:

At the end of the course the student will be able to

1. Implement various filters on DSP processors.

2. Implement echo/noise cancellation algorithms on DSP processors.

3. Takeup project in the area of implementation of filters.

Suggested Reading:

1. John G. Ackenhhusin, Real time Signal Processing, Prentice Hall of India, 1999.
2. Sen M. Kuo and Bob H. Lee, Real time Digital Signal Processing - Implementations, applications and experiments with TMS 55XX, John Wiley Publications, 2001.
3. TMS 320C54XX,User's guide.
4. Avatar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP processors, Thomson Brooks, 2004.
5. Data Sheets of Blackfin Processor.

16ECE116

SPEECH SIGNAL PROCESSING

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Signal Processing is required.

Course Objectives:

1. To provide students with the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
2. To describe basic algorithms of speech analysis common to many applications.
3. To give an overview of applications (recognition, synthesis, coding) and to inform about practical aspects of speech algorithms implementation.
4. To give an idea of how DTW and HMM are useful in speech signal processing.

Topics Covered:

UNIT I

The process of speech production: Production Mechanism and acoustic phonetics. Digital models for speech signals: Vocal Tract, Radiation, Excitation and complete model speech perception: Loudness, Bark Scale, masking, perception and Psychoacoustics.

UNIT II

Short-time Hour analysis: Short-time energy, Average magnitude, zero crossing, Speech vs Silence discrimination and zero crossing rate, Pitch Hour estimation using parallel processing approach. Autocorrelation function, Pitch Hour estimation using Auto correlation function, The average magnitude function, median smoothing. Short time Fourier Analysis: Fourier transform interpretation, linear filtering interpretation, sampling rates in time and frequency, Filter banks, Spectctrograms, pitch detection. Cepstral analysis, Complex and real cepstrum, pitch detection and Formant estimation.

UNIT III

Digital speech representation and coding: Review of PCM, adaptive PCM, differential PCM, delta modulation. Linear Predictive coding (LPC) analysis: Basic principles, autocorrelation and covariance methods, Computation of LP coefficients, Cholesky decomposition, Durbin's recursive solution, Frequency domain interpretation of LPC, CELP.

UNIT IV

Analysis by synthesis: Phase vocoder, subband coding, Formant/homomorphic vocoder, cepstral vocoder, vector Quantizer coder, Speech Enhancement techniques: Spectral subtraction, enhancement by resynthesis.

UNIT V

Automatic speech recognition: Basic pattern recognition approaches, Evaluating the similarity of speech patterns, Dynamic Time Warping (DTW), HMM's for speech recognition, forward, backword algorithms and parameter estimation. Speaker recognition, Features that distinguish speakers.

Course Outcomes:

1. The students will get familiar with basic characteristics of speech signal in relation to production and hearing of speech by humans.

2. They will understand basic algorithms of speech analysis common to many applications.

3. They will be given an overview of applications (recognition, synthesis, coding) and be able tolearn about practical aspects of speech algorithms implementation.

4. The students would be able to design a simple system for speech processing (speech activity detector, recognizer of limited number of isolated words), including its implementation into application programs.

Suggested Reading:

1. Rabinar and Schafer, Digital Processing of Speech Signals, Pearson Education, 2004.
2. Deller, Hansen, Proakis, "Discrete-Time Processing of Speech signals", IEEE presses, 2000.
3. R & J Rabinar and Juang, "Fundamentals of speech recognition", Prentice Hall, 1993.
4. Douglas O'Shaughnessy, Speech Communication: Human and Machine, 2nd ed., University Press, Hyderabad, 2001.

16ECE117

MULTIMEDIA INFORMATION SYSTEMS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 MARKS	End Exam- Marks	70 MARKS

Prerequisites: A prior knowledge of Computer Networks is required.

Course Objectives:

1. To generate understanding about Multimedia systems and its applications
2. To compare various Multimedia Networking systems
3. To learn Motion estimation techniques and standard approaches in Image compression
4. To differentiate the salient features of various audio encoding practices
5. To study different Multimedia information Indexing and Retrieval models.

Topics Covered:

UNIT I

Definition of Multimedia, Multimedia system description. Applications of Multimedia. Types of Multimedia: a non-interactive, interactive. Hypertext.

UNIT II

Multimedia Networking: ATM. ISDN. WAN and their comparisons, Multimedia synchronization. Serial and Parallel.

UNIT III

Motion estimation techniques: Bruteforce, algorithm three step, search algorithm. 2-D algorithm and conjugate direction search algorithm.

Image compression standards: Review on loseless and lossy comprssion models.JPEG.H261 MPEG1,MPEG2 and MPEG4.

UNIT IV

Audio coding: Introduction to multi rate signals. MPEG1 and MPEG2 audio encoder and decoder.

UNIT V

Multimedia information indexing and Retrieval: General information Retrieval (IR) model. Differences between IR and DBMS Basic IR models. File structure, audio indexing and Retrieval methods. Image Retrieval based on shape and moments and watermarking Techniques.

Course Outcomes:

After completing the course in Multimedia Information Systems the learner must be able

1. To Know about the different multimedia systems and their applications
2. To compare Wide Area Multimedia networks like ATM and ISDN in terms of synchronism, serial and parallel communication.
3. To analyze different search algorithms and Image compression Standards
4. To distinguish between MPEG1 and MPEG2 audio encoders.
5. To make PPT on at least one each of Information Indexing and Retrieval systems

Suggested Reading:

1. Guojun Lu., Communication and Computing for distributed multimedia systems, Artech House, Bosto, London,1995.
2. Bhaskar V and Konstantindes K, Image and Video Compression Standards algorithms and Architecture kluwer Academic, Sept, 1997.
3. Judith Jeffocate, Printmedia in practice (Theory and Applications), PHI, 1998.

16ECE118

ADAPTIVE SIGNAL PROCESSING

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Signal Processing is required.

Course Objectives:

1. To understand the principles of Wiener filter theory and mean square error.
2. To understand the concepts of Gradient algorithms.
3. To learn noise cancellation techniques.
4. To understand the concepts of Kalman filters.

Topics Covered:

UNIT I
Approaches to the development *of* adaptive filter theory. Introduction to filtering, smoothing and prediction. Wiener filter theory, introduction; Error performance surface; Normal equation; Principle of orthogonality; Minimum mean squared error; example.

UNIT II
Gradient algorithms; Learning curves; LMS gradient algorithm; LMS stochastic gradient algorithms; convergence of LMS algorithms.

UNIT III
Applications of adaptive filter to adaptive noise canceling, Echo cancellation in telephone circuits and adaptive beam forming.

UNIT IV
Kalman Filter theory; Introduction; recursive minimum mean square estimation for scalar random variables; statement of the kalman filtering problem: the innovations process; Estimation of state using the innovations process; Filtering examples.

UNIT V
Vector Kalman filter formulation. Examples. Application of kalman filter to target tracking.

Course Outcomes:

At the end of the course the student will be able to

1. Apply Wiener and/or Kalman filters for the analysis of noisy random signals.
2. Design adaptive filters for noise or echo cancellation in telephone circuits.

3. Takeup project in the area of noise cancellation.

Suggested Reading:

1. Sophoclas, *J*. Orphanidies, "Optimum signal processing an introduction", McMillan, 1985.
2. Simon Haykins, "Adaptive signal processing", PHI, 1986.
3. Bernard Widrow, "Adaptivesignal processing", PHI,1986.
4. Bozic. SM., Digital and kalman Filtering.

16ECE119

SELECTED TOPICS IN STRATEGIC ELECTRONICS

Instruction	3 Hours per week	End Exam- Duration	3 Hours
Sessionals	30 Marks	End Exam- Marks	70 Marks

Prerequisites: A prior knowledge of Radar Engineering, communication and antenna concepts are required

Course Objectives

1. To explain the concepts of electronic intelligence using the fundamentals of radar and simple localization techniques along with appropriate mathematical analysis necessary for solving new problems.
2. To teach the position fixing techniques and communication EW systems along with standard methods for electronic jamming.
3. To present the concepts of DF antennas and shared aperture arrays necessary for complete understanding of both ELINT and COMINT systems.

Topics Covered:

UNIT – I: Electronics Intelligent

Electronic Intelligence Defined, The Importance of Intercepting and Analyzing Radar Signals, Limitations Due to Noise, Probability of Intercept Problems. Inferring Radar Capabilities from observed Signal Parameters, Receivers for Radar Interception. Major ELINT Signal Parameters,the Impact of LPI Radar on ELINT, Direction Finding, Instantaneous Direction Finding.Amplitude Comparison AOA Measurement, Phase Interferometers, Bearing Discriminators. Short Baseline TDOA for AOA.

UNIT – II: Emitter Location

Introduction, Emitter Location Estimation, Deriving the Location Covariance Matrix. Angle of Arrival Location Analysis, Time Difference of Arrival Location Analysis, Time/Frequency Difference of Arrival Location Analysis. Geometric Dilution of Precision, Incorporation of Measurement Error.

UNIT – III: **Position – Fixing Techniques**

Position – fixing algorithms: Eliminating Wild Bearings, Stansfield Fix Algorithm, Mean-Squared Distance Algorithm. Single-site location techniques: Fix accuracy, GDOP and fix coverage. Time difference of Arrival: Position-Fixing using TDOA Measurements, GDOP.Differential Doppler, Position-Fix Accuracy. Time of Arrival.

UNIT–IV: Communication EW Systems and Techniques for Electronic Jamming

Introduction, Information warfare, Electronic warfare: Electronic support, Electronic attack, Electronic Protect.Electron support: Low probability of detection/interception/exploitation.Typical EW System Configuration.Electronic attack: Introduction, Communication jamming, jammer deployment, narrow band / partial-band jamming, barrage jamming, follower jammer, jamming LPI targets.A General Description of the Basic Elements of Electronic Jamming. Mathematical Models of Jamming Signals: Fundamental Principles.

UNIT – V:DF Antennas and Shared aperture arrays

Omni-Directional Antennas: Omni-Directional Antenna Applications, Parameters for Omni-Directional Antennas, Directional Intercept Antennas. Linear arrays: Uniformly spaced line source of equal amplitude, array grating lobes, Beam width and band width of phased arrays. Array directivity, array SNR gain, mutual coupling between antenna elements.Electronic warfare arrays, Shared aperture arrays: the arguments for systems integration, the case for shared aperture systems, the case for independent systems and the ideal shared aperture arrays.

Course Outcomes

1. Students will be capable of understanding the intricacies of any ELINT system and mathematically estimate emitter locations for simple cases
2. Students will be able to fix the position of the COMINT system and able design a simple jammer.
3. Students are expected to understand the concepts of antennas and should be able to tell which type of antenna is suitable for either ELINT or COMINT systems.

Suggested Readings:

1. Richard G. Wiley, "ELINT: The Interception andanalysis of Radar Signals", Artech House Inc., 2006
2. Richard A. Poisel, "Introduction to Communication Electronic Warfare Systems", 2nd edition, 2008, Artech house, Inc.
3. Sergei A. Vakin, Lev N. Shustov, Robert H. Dunwell "Fundamentals of Electronic Warfare", 2001, Artech House, Inc.
4. Nicholas Fourikis, "Advanced array systems, Applications and RF technologies, 2005, Academic Press.