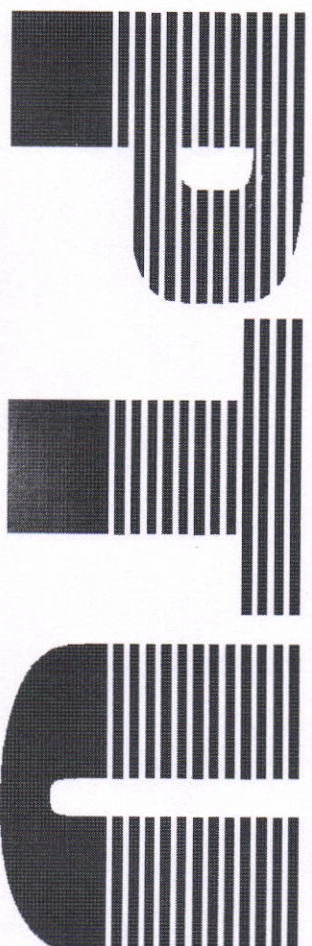


Scheme and Syllabus
of
M. Tech.
Electronics and Communication Engineering
(Wireless Communication)

BATCH-2011

Punjab Institute of Technology, Kapurthala
(A constituent college of Punjab Technical University)





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Main Campus, Kapurthala (Punjab)-144603

First Semester

Course Code	Course Title	Load Allocation				Marks Distribution			Credits
		L	T	P	Hours/Week	Internal	External	Total	
ECL-101	Research Methodology	3	1	-	4	40	60	100	4
ECE-(1XX)	Elective - I	3	1	-	4	40	60	100	4
ECL-102	Information Theory & Coding	3	1	-	4	40	60	100	4
ECL-103	Wireless Communication	3	1	-	4	40	60	100	4
ECE-(1XX)	Elective - II	3	1	-	4	40	60	100	4
Total		15	5	-	20	200	300	500	20

Second Semester

Course Code	Course Title	Load Allocation				Marks Distribution			Credits
		L	T	P	Hours/Week	Internal	External	Total	
ECL-201	Advanced Wireless Communication	3	1	-	4	40	60	100	4
ECL-202	Simulation Of Wireless Communication Systems	3	1	-	4	40	60	100	4
ECL-203	Soft Computing Techniques	3	1	-	4	40	60	100	4
ECE-(1XX)	Elective -III	3	1	-	4	40	60	100	4
ECE-(1XX)	Elective -IV	3	1	-	4	40	60	100	4
ECP-101	Wireless Simulation Laboratory	-	-	4	4	60	40	100	2
Total		15	5	3	20	260	340	600	22

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Third Semester

Course Code	Course Title	Load Allocation				Marks Distribution		Credits	
		L	T	P	Hours/Week	Internal	External		Total
ECE-(1XX)	Elective – V	3	1	-	4	40	60	100	4
ECE-(1XX)	Elective – VI	3	1	-	4	40	60	100	4
ECS-101	Seminar	-	-	2	2	100	-	100	2
ECD-101	Dissertation (Part – I)	-	-	8	8	60*	40	100	8
Total		6	2	10	18	260	140	400	18

Fourth Semester

Course Code	Course Title	Load Allocation	Marks Distribution		Credits
			Internal	External	
ECD-101	Dissertation (Part - II)	24Hours per week	60*	40**	100
Total			100		20

*To be evaluated by department research committee.

**To be evaluated by student research committee along-with external examiner.

Elective – I, II, III, IV, V and VI is to be chosen from the set list of electives.



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List of Electives*

1. ECE-101 Advanced Digital Signal Processing
2. ECE-102 Advanced Communication Systems
3. ECE-103 Smart Antennas
4. ECE-104 RF MEMS For Wireless Communications
5. ECE-105 CDMA Technology
6. ECE-106 Wireless Sensor Networks
7. ECE-107 Software Defined Radio
8. ECE-108 Bluetooth Technology
9. ECE-109 Soft Computing Techniques
10. ECE-110 Emerging Technologies in wireless communications
11. ECE-111 Advanced Antenna Systems
12. ECE-112 Space Time Wireless Communication
13. ECE-113 Wireless Protocols and Architecture
14. ECE-114 Microwave and RF Design
15. ECE-115 Audio and Video Signal Processing
16. ECE-116 Detection and Estimation Theory
17. ECE-117 Mobile Ad hoc Networks
18. ECE-118 Wireless LAN and PAN
19. ECE-119 Wireless Security
20. ECE-120 Advanced Wireless Networks



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Syllabus Already covered in 1st Sem

Research Methodology

Overview of Research

Research and its types, identifying and defining research problem and introduction to different research designs. Essential constituents of Literature Review. Basic principles of experimental design, completely randomized, randomized block, Latin Square, Factorial, response surfaces (8)

Methods of Data Collection

Primary data and Secondary Data, methods of primary data collection, classification of secondary data, designing questionnaires and schedules. (4)

Sampling Methods

Probability sampling: simple random sampling, systematic sampling, stratified sampling, cluster sampling and multistage sampling. Non-probability sampling: convenience sampling, judgement sampling, quota sampling. Sampling distributions. (8)

Processing and analysis of Data

Statistical measures and their significance: Central tendencies, variation, skewness, Kurtosis, time series analysis, correlation and regression, Testing of Hypotheses: Parametric (t, z and F) Chi Square, ANOVA, and non-parametric tests. (8)

Multivariate Analysis

Multiple Regression, Factor Analysis, Discriminant Analysis, Cluster Analysis, multidimensional scaling (6)

Reliability and Validity

Test-retest reliability, alternative-form reliability, internal-comparison reliability, and scorer reliability. Content validity, criterion-related validity, and construct validity. (3)

Essential of Report writing (3)

Note: Application and use of various software for case studies should be essential

Reference Books

- Levin, R.I. and Rubin, D.S., Statistics for Management, 7th Edition, Pearson Education: New Delhi.
- Malhotra, N.K., Marketing Research An Applied Orientation, 4th Edition Pearson Education: New Delhi.
- Zikmund, W.G., Business Research Methods, 7th Edition, Thomson South-Western.
- Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., Management Research Methodology, Pearson Education: New Delhi.
- Kothari C.R., Research Methodology Methods and techniques by, New Age International Publishers, 2nd edition

ADVANCED COMMUNICATION SYSTEMS



- **INTRODUCTION**

Introduction to communications systems, analog and digital communication systems, Applications of communication systems.

- **DIGITAL COMMUNICATION**

Introduction, Digital Modulation techniques, BPSK, QPSK, PCM, DPCM, Delta Modulation, Digital Transmission and Transmission Impairments.

- **OPTICAL NETWORKS**

WDM, TDM, Telecommunication Infrastructure, Switching, 3G systems, SONET, SDH, Architecture of Optical Transport Network, Link Management Protocols, Solutions.

- **SATELLITE COMMUNICATION**

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Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design Of Down Links, Domestic Satellite Systems Using Small Earth Stations, Uplink Design, Design Of Satellite Link For Specified (C/N), Multiple Access Techniques, Frequency Division Multiple Access(FDMA), TDMA, CDMA, Estimating Channel Requirements, Practical Demand Access Systems, Random Access, Multiple Access With On Board Processing, VSAT

- **MOBILE COMMUNICATIONS**

Mobile telephone service, Transmission protocols, Introduction to GSM, GPRS, CDMA, Switching techniques, Fading, Quality of service (QoS).

BOOKS:

1. Advanced Communication Systems - by Wayne Tomasi; Pearson.
2. Digital Communication - by Proakis; PHI
3. Optical Networks - by Uyles Black; Pearson
4. Satellite Communication - by Timothy Pratt; Addison Wesley.
5. Related IEEE/IEE publications

WIRELESS COMMUNICATION

Physical modelling for wireless channels :

Free space, fixed transmit and receive antennas, Free space, moving antenna, Reflecting wall, fixed antenna, Reflecting wall, moving antenna, Reflection from a ground plane, Power decay with distance and shadowing, Moving antenna, multiple reflectors

Input/output model of the wireless channel :

The wireless channel as a linear time-varying system, Baseband equivalent model, discrete-time baseband model, Additive white noise

Time and frequency coherence :

Doppler spread and coherence time, delay spread and coherence bandwidth

AWGN channel capacity :

Repetition coding, Packing spheres, Capacity-achieving AWGN channel codes, Reliable rate of communication and capacity, Resources of the AWGN channel- Continuous-time AWGN channel, Power and bandwidth, Bandwidth reuse in cellular systems

Linear time-invariant Gaussian channels :

Single input multiple output (SIMO) channel, Multiple input single output (MISO) channel, Frequency-selective channel

Capacity of fading channels :

Slow fading channel, Receive diversity, Transmit diversity, Time and frequency diversity, Time and frequency diversity, Outage for parallel channels, Fast fading channel, Transmitter side information, Frequency-selective fading channels

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Outage for parallel channels, Fast fading

Uplink and Downlink AWGN channel :

Capacity via successive interference cancellation, Comparison with conventional CDMA, Comparison with orthogonal multiple access, General K-user uplink capacity, Symmetric case: two capacity achieving schemes, General case: superposition coding achieves capacity

Uplink and Downlink fading channel :

Slow fading channel, Fast fading channel, Full channel side information, Channel side information at receiver only, Full channel side information, Frequency-selective fading channels

Multuser diversity :

Multuser diversity gain, Multuser versus classical diversity, Fair scheduling and multuser diversity, Channel prediction and feedback, Opportunistic beam forming using dumb antennas, Multuser diversity in multicell systems

Physical modeling of MIMO channels :

Line-of-sight SIMO channel, Line-of-sight MISO channel, Antenna arrays with only a line-of-sight path, Geographically separated antennas, Line-of-sight plus one reflected path, MIMO multipath channel, Angular domain representation of signals, Angular domain representation of MIMO channels, Statistical modeling in the angular domain, Degrees of freedom and diversity, Dependency on antenna spacing

1. Andrea Goldsmith, "Wireless Communications" Cambridge University Press, 2005

2. David Tse, Pramod Viswanath "Fundamentals of Wireless Communications" Cambridge University Press 2005

ADVANCED DIGITAL SIGNAL PROCESSING

Review :

Fourier Transforms, Z-Transforms, Discrete Fourier Transform, Fast Fourier Transform, Convolution And Correlation.

Design of digital filters:

Introduction to filter design, types of digital filters, choosing between, fir and iir filters, filter design steps, effect of finite register length in filter design, realization of iir digital filters and fir digital filter, design of iir filters from continuous time filters, design of fir filters by windowing.

Digital signal processors:

General and special purpose digital signal processors, computer architecture for signal processing, selecting digital signal processors, architecture and programming of ADSP 2181 processor.

Spectrum estimation:

non-parametric methods correlation method, co-variance estimator, performance analysis of estimators, consistent estimators, ar, ma, ARMA signal modeling, parameter estimation using Yule-walker method.

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Linear estimation and predication:

Maximum likelihood criterion efficiency of estimator, least mean squared error criterion, recursive estimators, and linear predications.

Multirate digital signal processing:

Mathematical description of change of sampling rate, interpolation and decimation, continuous time model, direct digital domain approach, interpolation and decimation by an integer factor, single and multistage realization, applications of sub band coding.

Adaptive Filters:

Applications Of Adaptive Filters, Adaptive Direct Form FIR Filters: The LMS Algorithm, Adaptive Lattice Ladder Filters, Recursive Least Squares Lattice Ladder Algorithms.

BOOKS/REFERENCE

- Monson H.Hayes, " Statistical Digital Signal Processing and Modeling ", John Wiley and Sons, Inc., New York, 1996
 - Emmanuel C.Ifeachor Barrie W.Jervis, "Digital Signal Processing", Pearson Education Asia
 - Proakes Manolakis, " Digital Signal Processing principles, algorithms, and applications", Prentice Hall India
 - ADSP 2181 manuals
 - Keshab K. Parhi, " VLSI DSP Systems; Design & implementation", Wiley InterScience Publishers
- Moonen, Ian k. Proudler, " Algorithms for statistic

INFORMATION THEORY & CODING

UNIT I INFORMATION THEORY

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – ~~BSK~~ BEC – Channel capacity, Shannon limit.

UNIT II

SOURCE CODING: TEXT, AUDIO AND SPEECH

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Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MPEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

UNIT III SOURCE CODING: IMAGE AND VIDEO

Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

UNIT IV ERROR CONTROL CODING: BLOCK CODES

Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC

UNIT V ERROR CONTROL CODING: CONVOLUTIONAL CODES

Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

TEXT BOOKS:

1. R Bose, "Information Theory, Coding and Cryptography", TMH 2007
2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Perason Education Asia, 2002

REFERENCES:

1. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
2. S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007
3. Amitabha Bhattacharya, "Digital Communication", TMH 2006

Proposed core subjects syllabi for 2nd Sem

SIMULATION OF WIRELESS COMMUNICATION SYSTEMS

UNIT-I: Introduction to simulation approach

Methods of performance evaluation-simulation approach- Advantages and limitations. System model steps and its types involved in simulation study. Error sources in simulation. Role of simulation in communication system and random process. Introduction to random variables - univariate models (discrete and continuous) and multi-variate models.

UNIT-II: Review of Stochastic process and parameter estimation

Stochastic process: Definitions, properties – stationarity, time averaging and ergodicity, random process models

Parameter estimation: Quality of an estimator, estimating average power probability density function, estimation of power spectral density of a process, delay and phase. SNR estimation and importance sampling.

UNIT-III, Numerical methods for wireless Communication Systems: numerical differentiation, integration, differential equation.

Monte Carlo simulation: concepts and integration, Application in wireless Communication Systems.

UNIT-III: Modeling of Communication systems

, properties, generation and techniques for generating random numbers and processes.

Introduction to modeling of communication systems - Information sources, source coding, base band modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modeling considerations for PLL.

UNIT-IV: Communication channel models

Statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Finite state channel models – channels with and without memory. Methodology for simulating communication systems operating over fading channels.

TEXT BOOKS:

1. M.C. Jeruchim, Philip Balaban & K.Sam shannugam. "Simulation of communication systems", Plenum press, New York, 1992
2. M.Law & W.David Kelton, "Simulation Modelling and analysis", McGraw Hill, New York, 1999.
3. K.Hayes, "Modelling and Analysis of computer communication networks", Plenum press, New York, 1984.
4. Banks, J.S.Carson, Nelson and D.M.Nicol, "Discrete –Event system simulation", Prentice Hall of India, 4th Edition, 2005.
5. Z.Peebles, "Probability, Random Variable and Random Signal Principles", Tata McGraw Hill, 4th edition 2002.

DESIGN AND SIMULATION OF WIRELESS LABORATORY

1. Generation of Voice, Data and Video traffic.
2. Simulation of the Radio Channel.
3. Simulation of Hand off mechanisms.
4. Simulation of CDMA Transmitter and Receiver.
5. Coding Techniques for Wireless Communication.
6. Link Budget.33
7. Simulation of Security Algorithms.
8. Study of Glomosisim and NS2.

Soft Computing Techniques

Artificial Neural Network

Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model, Properties of neural network, Typical architectures: single layer, multilayer, competitive layer, Different learning methods: Supervised, Unsupervised & reinforced; Common activation functions: Feed forward, Feedback & recurrent N.N; Application of N.N; Neuron.

Pattern Recognition

Pattern Classification, Pattern Association, Clustering, Simple Clustering algorithm, k-means & k-medoid based algorithm.

Models Of Neural Network

Architecture, Algorithm & Application of -- McCulloh-Pitts, Hebb Net, Perceptron (with limitations & Perceptron learning rule Convergence theorem), Backpropagation NN, ADALINE, MADALINE, Discrete Hopfield net, BAM, Maxnet, Kohonen Self Organizing Maps, ART1, ART2.

Fuzzy Sets & Logic

Fuzzy versus Crisp; Fuzzy sets—membership function, linguistic variable, basic operators, properties; Fuzzy relations—Cartesian product, Operations on relations; Crisp logic—Laws of propositional logic, Inference; Predicate logic—Interpretations, Inference; Fuzzy logic—Quantifiers, Inference; Fuzzy Rule based system; Defuzzification methods; FAM;

Genetic Algorithm

Basic concept; role of GA in optimization, Fitness function, Selection of initial population, Cross over(different types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation; Genetic Programming; Schema theorem; Multiobjective & Multimodal optimization in GA; Application— Travelling Salesman Problem

Hybrid soft computing Techniques



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GA based BPNN(Weight determination, Application); Neuro Fuzzy Systems—Fuzzy BPNN—fuzzy Neuron, architecture, learning, application; Fuzzy Logic controlled G.A;

Books:


- 1.Principles of Soft Computing –S. N. Sivanandam, S.N. Deepa; Wiley India
2. Neural Networks- A Comprehensive foundation, Simon Haykin, 2nd Ed; Pearson
3. Neural Networks, Fuzzy Logic & Genetic Algorithms – Synthesis & applications, T. S. Rajasekaran & G.A. Vijaylakshmi Pai, PHI
4. Genetic Algorithm & fuzzy Logic Systems - Sanchez, Takatori, Zadeh; World Scientific
5. Genetic Algorithm, Goldberg David E.; Pearson
6. Fuzzy Set Theory & Its Applications - Zimmermann H. J.; Allied Publishers

ADVANCED WIRELESS COMMUNICATION

UNIT-I: REVIEW OF FUNDAMENTALS OF WIRELESS COMMUNICATION: MULTIPATH FADING, MULTIPATH CHANNEL MODELS, CAPACITY OF WIRELESS CHANNELS.

UNIT-II: PERFORMANCES OF DIGITAL MODULATION OVER WIRELESS CHANNELS: AGWN CHANNELS SIGNAL TO NOISE POWER RATIO AND BIT/SYMBOL ENERGY, ERROR PROBABILITY FOR BPSK, QPSK, MPSK, MPAM, MQAM- THEIR COMPARISON.

UNIT-III: MULTICARRIER MODULATION: DATA TRANSMISSION USING MULTIPLE CARRIERS, MULTICARRIER MODULATION WITH OVERLAPPING SUBCHANNELS, MITIGATION OF SUBCARRIER FADING, DISCRETE IMPLEMENTATION OF MULTICARRIER MODULATION, CHALLENGES IN MULTICARRIER SYSTEMS.

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