Aliah University

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
IIA/27, New Town, Rajarhat, Kolkata- 700 160

Date : 28.06.2019

Board of studies (BOS) approved curriculum and syllabi for M Tech in Electronics and Communication Engineering (Specialization : Communication engineering)

(Academic Session 2018-19 & onwards)

Board of studies (BOS) members present on 28.6.2019 at 2.00 pm at HoD room, Electronics and Communication Engineering department.

1.	Dr. SK. Moinul Haque, HoD, ECE Dept., Aliah University	Chairperson
2.	Mr. Md. Abdul Alim Sheikh, Asst. Prof., ECE Dept., Aliah University	Member
3.	Dr. Md. Asraful Sekh, Asst. Prof., ECE Dept., Aliah University	Member
4.	Mr. Somsubhra Talapatra, Asst. Prof., ECE Dept., Aliah University	Member
5.	Mr. Anisur Rahaman, Asst. Prof., ECE Dept., Aliah University	Member
6.	Mr. Sabir Ali Mondal, Asst. Prof., ECE Dept., Aliah University	Member
7.	Mr. A.H.M. Toufique Ahmed, ECE Dept., Aliah University	Member
8.	Mr. Md. Aftab Alam, Asst. Prof., EE Dept., Aliah University	Member
9.	Dr. Ayatullah Faruk Mollah, Asst. Prof., CSE Dept., Aliah University	Member

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Annexure II

ALIAH UNIVERSITY

Curriculum and syllabi of Master of Technology

Programme

In

ELECTRONICS AND COMMUNICATION ENGINEERING

(Specialization in Communication Engineering)

(Academic Session 2018-19 & onwards)

ALIAH UNIVERSITY

Course Structure of 2 year M.Tech Programme
In Electronics and Communication Engineering
(Departmental Code: ECE)

Note: For subjects, if any, with codes initiated by CSE/EE, the concerned departments (CSE/EE) will have to organize the course. The detailed courses in such cases have to be recommended by the concerned departments.

Subject Coding followed

A	B	C	1	2	3

ABC Three Character Department Code

1 One digit Year code (6 for 1st year and 7 for 2nd year of M.Tech.)

2 One digit code of Nature of Subject as per the following:

'0' for theory, '9' for practical, '7' for project, '8' for Industrial training / seminar / viva/Term-Paper, '3' for subsidiary

3 One digit serial number of subject (odd numbers for Odd Semester and even number of Even Semester)

Summary of Credits

	1st Sem	2nd Sem	3rd Sem	4th Sem	Total
M.Tech	26	22	14	20	82

First Semester Structure

Sl. No.	Subject Code	Name of the Subject	Contacts (periods/week)				Marks		Total Marks	Credits
			L	T	P	Total	Internal	End-Sem		
Theory										
1	ECE601	Theory of Statistical Communication	4	0	0	4	20	80	100	4
2	ECE603	Advanced Digital Signal Processing	4	0	0	4	20	80	100	4
3	ECE605	Optical Communication and Network	4	0	0	4	20	80	100	4
4	ECE607	Advanced Digital Communication	4	0	0	4	20	80	100	4
5	ECE609	Advanced Microwave Engineering	4	0	0	4	20	80	100	4
Total Theory						20	100	400	500	20
Practical										
6	ECE693	Advanced Digital Signal Processing Lab	0	0	3	3			100	2
7	ECE695	Optical Communication& Network Lab.	0	0	3	3			100	2
8	ECE697	Advanced Digital Communication Lab.	0	0	3	3			100	2
Total Practical						9			300	4
Total of Semester						**26**			**800**	**26**

2nd Semester Structure

Sl. No.	Subject Code	Name of the Subject	Contacts (periods/week)				Marks		Total Marks	Credits
			L	T	P	Total	Internal	End-Sem		
Theory										
1	ECE602	FPGA Architecture	4	0	0	4	20	80	100	4
2	ECE604	Adaptive Signal Processing	4	0	0	4	20	80	100	4
3	ECE606	Advanced Computer	4	0	0	4	20	80	100	4

		Networks								
4	Given Below	***Elective-I***	4	0	0	4	20	80	100	4
Total Theory						16	80	320	400	16
Practical										
5	ECE692	FPGA Lab	0	0	3	3			100	2
7	ECE682	Term Paper	0	0	0	0			100	2
8	ECE684	Seminar-I	0	0	3	3			100	2
Total Practical						9			400	6
Total of Semester						**25**			**800**	**22**

3rd Semester Structure

Sl. No.	Subject Code	Name of the Subject	Contacts (periods/week)				Marks		Total Marks	Credits
			L	T	P	Total	Internal (Guide/*EC)	End-Sem		
Theory										
1	ECE771	Thesis Part-I			16	16	200	--	200	12
2	ECE785	Seminar-II						100	100	2
Total Theory						**16**	**200**	**100**	**300**	**14**

NB: The student has to undertake the departmental work assigned by HOD & Faculty
*EC – Evaluation Committee

4th Semester Structure

Sl. No.	Subject Code	Name of the Subject	Contacts (periods/week)				Marks		Total Marks	Credits
			L	T	P	Total	Internal (Guide/*EC)	End-Sem (Extl. Guide)		
Theory										
1	ECE772	Thesis Part-II			16	16	100	100	200	16
2	ECE782	Comprehensive Viva Voce					100		100	4
Total Theory						**16**	**200**	**100**	**300**	**20**

NB: The student has to undertake the departmental work assigned by HOD & Faculty
*EC – Evaluation Committee

Elective-I: *Subject name (code)*

1. Mobile Computing (ECE608)
2. Computational Electromagnetics (ECE610)
3. Satellite Communication & Remote Sensing (ECE612)
4. CMOS Analog & RF IC Design (ECE614)
5. Wireless & Sensor Network (ECE616)
6. Advanced Antenna Theory and Application (ECE 618)

Specialization offered is as follows:

1. M. Tech in Electronics & Communication Engineering with specialization in Communication Engineering

Syllabus

First Semester

Theory of Statistical Communication
Code: ECE601
Contacts: 4-0-0
Credits: 4

1. L**inear algebra and numerical analysis**: Special matrix forms – diagonal matrix, exchange matrix, triangular matrix, Toeplitz matrix, Hankel matrix, symmetric matrix, parametric matrix, centro symmetric matrix. Interpolation formulae, Difference equations, Roots of equations, Solutions of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, solution of matrix eigen value and eigen vector problems.[10]

2. **Optimization techniques:** Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Elements of calculus of variation, Constrained Optimization, Lagrange multipliers, Gradient method, Dynamic programming.[6]

3. **Vector Space and Linear Transformation**: Vector spaces. Subspaces, Linear independence, Span, basis, dimension, finite dimensional vector spaces, direct sum. Examples of finite dimensional vector spaces – RN, CN, vector space of matrices. Dimensionality of Row and Column space (rank of the matrix). Non-singular, Hermitian and Unitary matrices. Linear Transformation, range and null space, rank nullity theorem, Matrix representation of linear transform. Change of basis [8]

4. **Random processes:** Definition and description of random processes with practical examples. Time average, ensemble average, covariance, autocorrelation, cross correlation. Stationary process, ergodic process, WSS process, power spectrum of random processes. Filtering of random processes – filtering of white noise, spectral shaping filter, spectral factorization. Special random processes – Autoregressive moving average process, autoregressive process, moving average process, harmonic process.[6]

5. **Signal modeling**: Least square method, Pade approximation method, filter design using Pade approximation, Prony's method of signal modeling, filter design using Prony's method, FIR least square inverse filter, iterative prefilters, Stochastic models – ARMA model, AR model, MA model.[8]

6. **Theories and hypothesis of probability and statistics**: Definition and postulates of probability, Field of probability, Mutually exclusive events, Decision theory, Bay's likihood ratio, ideal observer strategy, Neyman-Pearson strategy, Bay's strategy for single and multiple sample values, optimum linear estimation composite hypothesis testing, optimum detection with incomplete knowledge of the signal, adaptive detection and estimation. Bernoulli trial, Discrete Distributions, Continuous distributions, Probable errors, Linear regression, Introduction to non-linear regression, Correlation, Analysis of variance.[10]

Books:

1. An Introduction to Statistical Communication Theory- John B. Thomas, Wiley.
2. An Introduction to Statistical Communication Theory- David Middleton (Pub: IEEE Press).
3. Detection, Estimation and Modulation theory– Part I/ Edition 2,- Harry L. Van Trees, John Wiley & Sons, NY, USA, 2013.
4. Statistical theory of Communication- S. P. Eugene Xavier, New Age International Ltd. Publishers, New Delhi, 2007.
5. Statistical communication theory and its application- Prof. B.R. Levin, MIR Publishers, Moscow, 1982
6. Numerical Mathematical Analysis- J. B. Scarborough, Oxford University Press
7. Elementary Numerical Analysis- S. D. Cone, Mc. Graw Hill.
8. Mathematical Statistics- P. Mukhopadhyay, New Central Book Agency
9. Introduction to Mathematical Probability- J. V. Uspensky, Tata Mc. Graw Hill

Advanced Digital Signal Processing

Code: ECE-603
Contacts: 4L
Credits: 4

Module1

Introduction to Multi-rate Digital Signal Processing – Sample rate reduction – decimation by integer factors- sampling rate increase – interpolation by integer facto – Design of practical sampling rate converters Filter Specification- filter requirement for individual stages – Determining the number of stages and decimation factors – Sampling rate conversion using poly-phase filter structure – poly-phase implementation of interpolators, Nyquist Filters.

Module2

Digital filer banks, Two-channel Quadrature-Mirror Filter bank, Perfect reconstruction Two-channel FIR filter banks, Polyphase representation- perfect reconstruction systems, L-channel QMF Banks, Multilevel filter Banks, Discrete Wavelet transform.

Module3

Digital Filter Structures-block diagram representation, equivalent structures, basic FIR, IIR filter structures, Allpass Filter, IIR tapped cascaded lattice structures, FIR cascaded lattice structures, Parallel Allpass realization of IIR transfer functions, tunable High-order Digital filters, computational complexity of digital filter structures.

Module3

Introduction to two dimensional signal and systems – 2D – DFT Transforms – Properties and applications – Discrete Hilbert Transform and Discrete Cosine Transform – Properties and Applications – Short term Fourier Transform – Wavelet Transform-Gabor Transform – Properties and Applications.

Module 5

Introduction to a popular DSP from Texas Instruments: CPU Architecture - CPU Data Paths and Control - Timers - Internal Data/Program Memory - External Memory Interface - Programming - Instructions Set and Addressing Modes – Code Composer Studio - Code Generation Tools - Code Composer Studio Debug tools – Simulator General and special purpose DSP Processors, Brief study of TMS320C4X and ADSP 2106 processors.

References

1. *Digital Signal Processing: A computer based approach*, Sanjit K. Mitra, McGraw Hill.1998.
1. *Multirate digital signal processing*, N.J. Fliege. John Wiley 1994.
2. *Multirate Digital Signal Processing*, R.E. Crochiere. L. R., Prentice Hall. Inc.1983.
3. *Digital Signal Processing: Principles. Algorithms and Applications*, J.G. Proakis. D.G. Manolakis, 3rd Edn. Prentice Hall India, 1999.
4. *Digital Signal Processing* Emmanuel C Ifeachor, Barrie W Jrevis, Pearson Education.
5. *Theory and Applications of DSP* L.R Rabiner and B gold
6. *Electronic filter Design Hand Book* A .B Williams and FT Taylor, McGraw Hill
7. *Wavelets and Subband Coding* Valterli & Kovaceric, PHI.
8. Rulf Chassaing, *Digital Signal Processing and Application with C6713 and C6416 DSK*, Wiley-Interscience Publication
9. *Analog Devices & Texas Instruments Users Manuel of TMS320C4X and ADSP 2106x*.
10. *Fundamentals of Statistical Signal Processing: Estimation Theory* by Steven Kay, Prentice Hall, 1993

Internal continuous assessment: 20 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 80 marks

Optical Communication & Networks
Code: ECE605
Contacts: 4-0-0
Credits: 4

1. **Introduction**: Historical Background of evaluation of Lightwave Systems, Basic concepts of signals, modulation types and formats, multiplexing, data hierarchies.**(2)**
2. Optical fiber: Wave propagation, fiber modes, dispersion management, Non linear effects **(6)**
3. **Optical Transmitter and Receivers**: Semiconductor laser characteristics: DFB, VCSEL, modulation, RIN, spectral width. Transmitter design issues. Optical modulators. Receiver sensitivity, sensitivity degradation.**(6)**
4. **Multichannel Systems & Components**: Optical Amplifiers- Basic concepts of gain, bandwidth, gain saturation & noise. EDFA structure, pumping requirements, E-B diagram, gain spectrum. WDM lightwave systems, WDM components: tunable optical filters, star coupler, MUX/DeMux, FBG, ADM, Wavelength Routers, optical cross connect, wavelength converters, WDM Tx, Rx.**(10)**
5. **Coherent lightwave systems**: Basic concepts: LO, homodyne & heterodyne detection, SNR. Modulation format, Demodulation schemes, Sensitivity degradation, system performance.**(4)**
6. **Soliton Systems**: Non linear Schrodinger equation, bright & dark solitons, soliton based communication.**(4)**
7. **Fiber optic networks**: Network Concepts, topologies, SONET/SDH, high speed lightwave links, WDM network examples, IP over DWDM, Optical Ethernet.**(6)**

8. **FTTH and PON Technology**: Proposed architecture and issues of Fiber to the home (FTTH) – Passive optical networks (PON) – Near space communication – Open air optical communication – Inter satellite link hops (ISL). Introduction to all optical networks (AON). Military, civil,consumer and industrial applications.**(6)**

Books:

1. D K Mynbaev and L L Scheiner, Fiber Optic Communication Technology, Pearson
2. John M Senior, Optical Fiber Communications: Principles and Practice, PHI
3. Fiber-Optic Communication Systems-Govind P. Agarwal, Willey Interscience
4. Optical fiber communications-Gerd Keiser, McGraw Hill
5. Optical Communication Networks- Biswanath Mukherjee, New York, McGraw-Hill.
6. Optical Networks-A Practical Perspective, Rajiv Ramaswami, Kumar N. Sivarajan, Academic Press.
7. WDM Optical Networks: Concepts, Design and Algorithms- C. Siva Ram Murthy and Mohan Gurusamy, Prentice Hall India.

Advanced Digital Communication
Code: ECE607
Contacts: 4-0-0
Credits: 4

1. **Baseband Transmission Systems**: Spectral Density of Digital Baseband Signals, Fundamentals of Band Limiting and Eye Diagrams, Pulse-Shaping Techniques, Nyquist's minimum-bandwidth theorem, Nyquist's vestigial symmetry theorem-Raised Cosine Filter, Gaussian Pulse-Shaping Filter.
2. Inphase and Quadrature (I-Q) Modulation and Demodulation: Real and Complex Signal Models, Geometrical Representation of Modulation Signals, Constellation Diagram, I-Q Diagram. Spread spectrum modulation, Modulation Techniques used in Wireless Systems: BPSK, DPSK, QPSK and Offset QPSK, MSK, GMSK, GFSK, QAM, OFDM, FQPSK, FQAM, FBPSK, M-ARY FSK.
3. Multiplexing and Multiple access: TDM/TDMA, FDM/FDMA, Space & Polarization DMA, OFDM – principles and comparative performances.
4. **OFDM1**: Principles of QAM-OFDM, Modulation by DFT, Transmission via Bandlimited Channels, Generalised Nyquist Criterion, Basic OFDM Modem Implementations, Cyclic OFDM Symbol Extension, Reducing MDI by Compensation, Transient system analysis, Recursive MDI compensation, Decision-directed Adaptive Channel Equalisation, OFDM Bandwidth Efficiency.
5. **OFDM2:** Peak-to-mean power ratio, Synchronisation, OFDM in CDMA, Adaptive antennas, OFDM applications, Choice of the OFDM Modulation, OFDM System Performance over AWGN Channels, Clipping Amplification, OFDM signal amplitude statistics, Clipping amplifier simulations, Peak-power reduction techniques, BER performance using clipping amplifiers, Signal spectrum with clipping amplifier, Analogue-to-Digital Conversion, Phase Noise, Effects of phase noise, Phase noise simulations, White phase noise model, Serial modem, OFDM modem, Coloured phase noise model.
6. Interference & Noises: Carrier-to-Interference and Carrier-to-Noise Limited Systems, Cochannel Interference, Adjacent Channel Interference, Externally caused Cochannel Interference. Noise representation in frequency domain and its power spectral density.
7. Equalization: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Linear Equalizers, Nonlinear Equalization, Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer.

BOOKS:

1. Digital Communications, 2nd ed. – Bernard Sklar, Pearson Education
2. Digital Communications - J. G. Proakis,, McGraw-Hill, Edition 2005
3. Principles of Digital Communication – Haykin
4. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.
5. Principle of Communication Systems – Taub, Schilling, TMH
6. Digital and Analog Communication Systems - Leon W Couch, Pearson Education.
7. OFDM and MC-CDMA for Broadband Multi-User Communications, WLANs and Broadcasting by Lajos L. Hanzo, M. Münster, Byungcho Choi and Thomas Keller, IEEE Press.

Advanced Microwave Engineering
Code: ECE609
Contacts: 4-0-0
Credits: 4

Microwave wave devices:
Overview of Gunn devices, oscillator using Gunn diode, IMPATT devices, Klystron, and microwave and mm wave performance of IMPATT, Tunnel diode, BARITT and TRAPAT.

Microwave circuits:
Review of scattering matrix concept in the light of vector network analyzer, impedance matching network, couplers, power dividers, resonators and filters. Detectors, mixers, attenuators.

Antennas:
Different Types of feed Technology: Probe feed, Slot coupled microstrip feed, coplanar feed. Different Types of CPW feed: Inductive, capacitive, square and circular feed. Advance antennas for communication system: Dielectric resonator antenna (DRA), Metamaterial in antenna, Microstrip antenna, electrically small antenna, Antenna miniaturization techniques, Conformal antennas

Microwave propagation.
Overview of basic radio wave propagation mechanisms, Friis transmission formula, plane earth propagation model, microwave radio link and calculation of link budget. Effect on radio wave propagation due to rain, fog, snow, ice, atmospheric gases, Earth's magnetic field.

Books
1. David M Pozar, Microwave Engineering, John Wiley & Sons
2. R E Collin, Antenna & Radio wave Propagation, McGraw Hill Book Co.
3. Jordan & Balman, Electromagnetic waves & Radiating System
4. R E Collin, Microwave Engineering, McGraw Hill CO.

Advanced Digital Signal Processing Lab
Code: ECE-693
Contacts: 3P
Credits: 2

Objective:

- To experiment the concepts introduced in the courses **ADVANCED SIGNAL PROCESSING**

Tools:

1. Numerical Computing Environments –MATLAB or any other equivalent tool.
2. DSP Kits – TMS320C6X or equivalent

Suggested Experiments:

Numerical Computing Environments – Time domain characteristics of Up-sampler and Down-sampler, Frequency domain characteristics Up-sampler and Down-sampler, Decimator and Interpolator Design and Implementation, Model based design of multi-rate signal processing systems. Design of Filter Banks, Design of Nyquist Filters, Realization of Basic structures using MATLAB.

DSP Kits – FIR and IIR Filter Design, Lattice structures, Code Generation Tools - Code Composer Studio Debug tools – Simulator General and special purpose DSP Processors

Internal Continuous Assessment *(Maximum Marks-100):*

Regularity - 30 marks
Record - 20 marks
Tests, Viva - 50 marks

Optical Communication & Network Lab
Code: ECE695
Contacts: 3P
Credits: 2

List of Experiments

Simulation Study of the following Experiments using Optisystem software

1. Study of GVD on Gaussian pulse propagation.
2. Study of non linear fiber optic effects: XPM and FWM.
3. Study of transmitter using LED and its modulation characteristics.
4. Study of transmitter using Laser and its modulation characteristics.
5. Design of optical transmitter using external modulator-Mach-Zehnder/$LiNob_3$

6. Study of fiber optic receiver noise characteristics.
7. Study of EDFA-basic concepts.
8. Study of EDFA gain optimization for WDM.
9. Study of 16 Ch WDM network
10. Performance analysis of bi-directional broadband optical network(BPON)

Wireless and Mobile Communication Lab
Code: ECE697
Contacts: 3P
Credits: 2

List of Experiments

1. Introduction to NI LabVIEW
2. Introduction to NI RF Hardware
3. Modulation and Detection
4. Pulse Shaping and Matched Filtering
5. Synchronization
6. Channel Estimation & Equalization
7. Frame Detection & Frequency Offset Correction
8. OFDM Modulation & Frequency Domain Equalization
9. Synchronization in OFDM Systems
10. Channel Coding in OFDM Systems

Second Semester

FPGA Architecture
Code: ECE602
Contacts: 4-0-0
Credits: 4

1. Types of IC Design flows. ASIC, custom Design, Structured ASIC, Gate Array, FPGA, FPAA organization, CLB, LUT, RAM based logic implementation, Shannon's expansion rule multiplier based implementation of combinational Boolean equation.
2. Fixed point representation, precision Qm.n format, Fixed point multiplier and adder (signed, and unsigned). Tree adder, (4,2) Compressor, implementation of multiplier using Compressor tree, Multiplier-less implementation of X(i+1)=X(i)+A(i)B(i), X=+A+B+C+..., Example-Walsh-Hadamard transform implementation.
3. Flip flop circuit, Implementation of asynchronous set & reset, setup & hold time, clk2q delay, min .clock pulse width, reset recovery & reset removal time. Synchronous vs asynchronous design.
4. Static Timing Analysis (STA) of critical paths – i/p, o/p, clk , cross clock paths, Multi cycle path , false path etc, Timing data as function of voltage, temperature process. Different VTP conditions Timing data/ file format, interpolation, setup and hold time analysis, slack and fixing, clock jitter, skew, phase, insertion delay etc. Time borrowing and time stealing in latch based design.
5. State machine -Moore vs Mealy, their impact on timing paths. An example protocol design using state machine.
6. Representation of DSP algorithms – block diagram, SFG, DFG, Dependence Graph, Interaction Bound and related algorithm.
7. Pipelining and parallel processing, retiming, unfolding, folding, shortest path algorithms.
8. Systolic Array design, FIR Systolic Arrays, Matrix-multiplier, fast convocation-Cook-Toom, Winograd ,etc algorithms.
9. Lattice filter (LF) structure, Schur algorithm, basic LF design. Derivation of normalized, LF, LF's round off noise, pipelining of LF etc.

BOOKS:

1. Verilog by Example: A Concise Introduction for FPGA Design by Blaine Readler (Pub: Full Arc Press).
2. Embedded Systems Design with Platform FPGAs: Principles and Practices by Ronald Sass and Andrew G. Schmidt (Pub**:** Morgan Kaufmann).
3. VLSI Digital Signal Processing Systems- Design and Implementation by Keshab K. Parhi (Pub: John Wiley –India)
4. FPGA Prototyping by VHDL Examples (Xilinx Spartan 3 Version) by Pong P. Chu (Pub: Wiley)
5. Synthesis of Arithmetic Circuits- FPGA, ASIC and Embedded Systems by Jean-Pierre Deschamps, Gery Jean Antoine Bioul and Gustavo D. Sutter
6. CMOS VLSI Design- A Circuit and System Perspective 3ed by Neil H. Weste and David Harris, (Pub: Pearson)
7. Xilinx ISE User guide, available online, also along with s/w installation.

Adaptive Signal Processing

Code: ECE604
Contacts: 4L
Credits: 4

Background and preview, Stationary Processes and Models, Optimum and adaptive signal processing with applications, Wiener Filtering, Linear prediction, Method of Steepest Descent. Least Mean Square algorithm, Frequency domain algorithms, Least Squares Estimation, Recursive Least Squares algorithm, Kalman Filters, Square Root Adaptive Filters, Order Recursive Adaptive Filters, Finite Precision Effects, Tracking of Time Varying Systems, Adaptive Filters using Infinite-Duration Impulse Response Structures, Applications: Adaptive equalization, echo cancellation, adaptive beam forming.

References

1. *Adaptive Filter Theory*, S. Haykin, Prentice-Hall, 4-th edition, 2001.
2. *Adaptive Signal Processing*, Bernard Widrow and Samuel D. stearns, Person Education, 2005.
3. *Adaptive Signal Processing*, Bernie Widrow and Stearns, Prentice Hall,
4. *Fundamentals of Adaptive Filtering*, Ali Sayed, Wiley, 2003
5. *Kernel Adaptive Filtering*, Liu, Principe and Haykin, Wiley 2010

Computer Projects:

Several application areas will be outlined. During the course students will have the opportunity to program adaptive algorithms in MATLAB and test them in real world data.

Internal continuous assessment: 20 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 80 marks
Advance Computer Networks
Code: ECE606
Contacts: 4L
Credits: 4

Unit I Introduction
Requirements, Network architecture , Networking principles, Network services and Layered architecture, Network services and Layered architecture , Future networks (Internet , ATM , Cable TV, Wireless – Bluetooth, Wi-Fi, WiMax, Cell phone) 8

Unit II Advanced Technologies
Virtual circuits, Fixed size packets, Small size packets, Integrated service, History, Challenges, ATM Network protocols, IP over ATM, Wireless networks: Wireless communication basics, architecture, mobility management, wireless network protocols. Ad-hoc networks Basic concepts, routing; Bluetooth (802.15.1), Wi-Fi (802.11), WiMAX (802.16), Optical Network: links, WDM system, Optical LANs, Optical paths and networks. 8

Unit III Performance of Networks

Control of networks: objectives and methods of control, Circuit switched networks, datagram and ATM networks. Mathematical background for control of networks like Circuit switched networks, Datagram and ATM networks 8

Unit IV Advanced Routing - I

Routing architecture , Routing between peers (BGP) , IP switching and Multi-Protocol Label Switching (MPLS), MPLS Architecture and related protocols, Traffic Engineering (TE) and TE with MPLS , NAT and Virtual Private Networks (L2, L3, and Hybrid), CIDR –Introduction , CIDR addressing, CIDR address blocks and Bit masks 8

Unit V Advanced Routing - II

Mobile IP- characteristics, Mobile IP operation, Security related issues. Mobility in networks. Voice and Video over IP (RTP, RSVP, QoS) IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, etc., neighbor discovery, auto-configuration, routing. Changes to other protocols. Application Programming Interface for IPv6. 8

Unit VI Ad Hoc Networking

An Introduction, A DoD Perspective on Mobile Ad Hoc Networks, DSDV: Routing over a Multihop Wireless Network of Mobile Computers, Cluster-Based Networks, DSR: The Dynamic Source Routing Protocol for Multihop Wireless Ad Hoc Networks 8

Text Books:

1. Larry L. Peterson, Bruce S ,"Computer Networks: A Systems Approach", 4th edition,Davie Publisher: Elsevier/Morgan Kaufmann, ISBN: 13:978-0-12-370548-8; 10:0-12-370548-7
2. Douglas E. Comer,"Internetworking with TCP/IP Vol –I",5th Edition Publisher:Prentice Hall, 5th edition.
3. Jean Walrand and Pravin Varniya,"High Performance Communication Networks"second edition Publisher: Morgan Kaufmann Publisher Elsevier ISBN: 1-5580-574-6 Indian ISBN: 81-8147-652-2
4. Charles E. Perkins, "Ad Hoc Networking", PEARSON, ISBN: 9788131720967

Reference Books:

1. Sam Halabi, "Metro Ethernet", Publisher: Cisco Press ISBN: 158705096X
2. A. S. Tanenbaum, "Computer Networks", Publisher: Pearson Education;
3. Krishna M. Sivalingham, Suresh Subramaniam,"Emerging Optical Network Technologies", Publisher: Springer ISBN: 0-387-22582-X
4. Wayne Grover, "Mesh Based Survivable Networks", Publisher: Prentice Hall, ISBN:013494576X
5. W. R. Stevens,"TCP/IP Illustrated, Volume 1,2,3", Publisher: Pearson Education
6. Advanced Computer Network published by dreamtech ISBN: 978-93-5004-013-3

Elective-I (Listed Below)

Mobile Computing
ECE608
Contracts: 4-0-0
Credits- 4

Introduction to Personal Communications Services (PCS): PCS Architecture, Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signalling

General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML). Wireless Local Loop(WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.

Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.

Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.

Server-side programming in Java, Pervasive web application architecture, Device independent example application.

Text/Reference Books :

1. "Mobile Communication", J. Schiller, Pearson.
2. "Mobile computing", Talukdar,, TMH
3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001
4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.
5. "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.
6. "The Wireless Application Protocol", Sandeep Singhal, Pearson .
7. "Third Generation Mobile Telecommunication systems", by P.Stavronlakis, Springer Publishers.
8. "Wireless communications: principles and practice", T. S. Rappaport, PHI / Pearson education.
9. "Wireless Communication and Networking", J.W.Mark, W. Zhuang, PHI.

Computational Electromagnetics
ECE610
Credit: (Lecture:3 + Tutorial:1=4)

Introduction
Basic Principles of Electromagnetic Theory, Analytical Methods and Orthogonal Functions, Green's Function, Fourier Transform Method

Introduction to Computational Methods
Elements of Computational Methods, Basis Functions, Convergence and Discretization Error, Stability of Numerical Solutions, Formulations for the Computational method.

Method of Finite Differences
Finite Difference Approximations, Treatment of Interface and Boundary Conditions, Finite Difference Analysis of Guiding Structures, Analysis of Enclosed Microstrip Line, Analysis of Geometries with Open Boundaries ,Wave Propagation and Numerical Dispersion, Analysis of Ridge Waveguide

Finite-Difference Time-Domain Analysis
Pulse Propagation in a Transmission Line, FDTD Analysis in One Dimension, Source or Excitation of the Grid .Absorbing Boundary Conditions for One-Dimensional Propagation, Applications of One Dimensional FDTD Analysis, Reflection at an Interface, Determination of Propagation Constant, Design of Material Absorber, Exponential Time-Stepping Algorithm in the Lossy Region, Extraction of Frequency Domain Information from the Time Domain Data, Dispersive Materials ,FDTD Analysis in Two Dimensions ,Unit Cell in Two Dimensions ,Numerical Dispersion in Two Dimensions, Absorbing Boundary Conditions for Propagation in Two Dimensions, Perfectly Matched Layer ABC, FDTD Analysis in Three Dimensions ,Yee Cell ,Numerical Dispersion in Three Dimensions, Absorbing Boundary Conditions and PML for Three Dimensions , Implementation of Boundary Conditions in FDTD, Perfect Electric and Magnetic Wall Boundary Conditions

Finite Element Method
Basic Steps in Finite Element Analysis ,Segmentation or Meshing of the Geometry, Derivation of the Element Matrix ,Assembly of Element Matrices, Solution of System Matrix, Post processing, FEM Analysis in One Dimension, Treatment of Boundary and Interface Conditions ,Accuracy and Numerical Dispersion, FEM Analysis in Two Dimensions , Solution of Two-Dimensional Wave Equation ,Element Matrix for Rectangular Elements, Element Matrix for Triangular Elements ,Capacitance of a Parallel Plate Capacitor Cutoff Frequency Waveguide Modes

Method of Moments
Introduction, Point Matching and Galerkin's Methods , Eigen value Analysis Using MoM
Static Charge Distribution on a Wire, Analysis of Strip Line

Books:

1. Analytical and computational methods in Electromagnetics by Ramesh Garg, Artech House
2. Computational Electromagnetics by Raj Mittra, Springer
3. Computational Electromagnetics by Anders Bondeson, Springer

Satellite Communication & Remote Sensing
Code: ECE612
Contacts: 4-0-0
Credits: 4

SYLLABUS

CMOS Analog & RF IC Design
Code: ECE614
Contacts: 4-0-0
Credits: 4

1. Architecture of a Transceiver: Principle of super-heterodyning –component blocks, noise figure and Friis equation; block diagrams of standard implementations.

2. Review of MOS Device Physics: Long channel vs short channel, concept of modeling, subthreshold, applicability of high frequency model in RF domain, GaAs vs Si, BJT vs MESFET vs HEMT vs MOSFET.

3. Passive Components: Parallel and series RLC circuits, resonant circuits, impedance transformers, driving point impedance of iterated RLC circuit, RF MEMs- capacitor and inductor, transmission line – infinite and finite, artificial TL, effect of substrate in TL model.

4. Performance Parameters: IIP3, IIP2, noise figure etc, noise types, 2-port noise theory, s-parameters, Smith chart.

5. High frequency amplifier design: Bandwidth estimation techniques, bandwidth enhancing techniques with circuit types, tuned amplifier, cascaded amplifier.

6. Operational Amplifier: Review of analog sub circuits, differential amplifier and various topologies, operational transconductance (OTC) amplifier, operational amplifier topologies, Miller's theorem, frequency compensation.

7. Constituent circuits blocks: **LNA** - topologies, noise optimization; **Mixer** - various approaches, Gilbert multiplier; **RF Power Amplifier** – class A, AB, B, C, D, E, F, distributed PA, modulation of PA, **ADC**; **DAC**.

8. Phased Lock Loop: Review of feedback theory; linearized PLL model; components – phase and phase-frequency detectors, loop filters, charge pump, VCO.

9. Oscillators: Review of purely linear oscillators, describing function, resonators, tuned oscillators, negative resistance oscillators, frequency synthesis using PLL; injection locking, phase noise.

10. Selected research topics: Determined by the subject teacher.

BOOKS:
1. The Design of CMOS Radio-Frequency Integrated Circuits, 2nd Ed. by Thomas H. Lee, (Cambridge University Press).
2. RF Microelectronics, 2nd Ed. by Behzad Razavi (PHI).
3. VLSI for Wireless Communication by Bosco Leung (Springer)
4. Design of Analog CMOS Integrated Circuits by by Behzad Razavi
5. CMOS Analog Circuit Design, 2nd Ed. by Phillip E. Allen and Douglas Holberg

Wireless Sensor Networks
Code: ECE616
Contacts: 4-0-0
Credits: 4

Sensor networks overview: introduction, applications, design issues, requirements.
Sensor node architecture. Network architecture: optimization goals, evaluation metrics, network design principles.Sensor network operating systems and brief introduction to sensor network programming. Network protocols: MAC protocols and energy efficiency.Routing protocols: data centric, hierarchical, location-based, energy efficient routing etc.Sensor deployment, scheduling and coverage issues, self configuration and topology control.Querying, data collection and processing, collaborative information processing andgroup connectivity.Target tracking, localization and identity management.Power management.Security and privacy.

Reference Books:

1.Wireless Sensor Network - C.S. Raghavendra, Krishna M. Sivalingam, Taieb Znati, Springer
2.Fundamentals of Wireless Sensor Networks: Theory and Practice – Waltenegus Dargie, Christian Poellabauer, Willey

Advanced Antenna Theory and Application

Code: ECE618
Contacts: 4-0-0
Credits: 4

Fundamental Concepts of Antenna:

Introduction, Different Types of antennas, Radiation mechanism of antenna, Poynting vector, Power intensity, Radiated power, Radiation pattern, Far Field regions, Near Field regions Impedance Bandwidth, Return Loss, Mode coupling, Mode suppression ,Directivity, Gain, Antenna polarization, Axial ratio, Input impedance, Reflection coefficient,VSWR, Radiation integrals and Auxiliary Potential Functions

Radiation Mechanism of Wires and Loops:

Introduction, Infinitesimal dipole, Infinitesimal dipole: Radiation zones, Total radiated power, Radiation resistance, Directivity, Effective area, Short dipole, Finite-length dipole, Finite-length dipole: Radiated power, Radiation resistance, Directivity, Effective area, Half-wave dipole and its properties, Loop antenna

Aperture antennas:

Introduction, Field equivalence principle, Love's equivalence principle, Electrical and magnetic conductor equivalence principle, Computation of field quantities of aperture antenna, Relation between wire and aperture antennas, Horn antenna design principle

Broadband antennas:

Introduction, Principle of frequency-independent antenna, Examples of frequency-independent antennas, Log-periodic antenna concept and examples,

Advanced antennas:

,Introduction, Microstrip antennas, Dielectric Resonator antennas(DRA), Electrically small antennas, Miniaturized antennas, Meta material antenna topologies,Advantages and disadvantages, Microstrip antenna configurations, Excitation techniques, Criteria for substrate selection, Radiation mechanism,

Arrays of antennas

Introduction, Two-element array, Example problems, Pattern multiplication concept, N-element array, Uniform array , Array factor, Broad-side and end-fire arrays, Phased array, Directivity and pattern characteristic of linear uniform array, Non-uniform array, Binomial array, Dolph-Chebyshev array concept, Design principle of Chebyshev array and examples

Books:

1. C. A. Balanis, "Antenna Theory and Design", John Wiley & Sons.
2. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill..
3. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", John Wiley & Sons.

FPGA Lab
Code: ECE692
Contacts: 3P
Credits: 2

Objective: Specification to circuit conception followed by implementation.

Preparatory Classes must cover the following:

- Introduction to synthesizable model using VHDL/Verilog/System-Verilog.
- Introduction to testbench development and working of a simulator. Various testbench languages (emphasis on System-Verilog)

Suggested List of Experiments

1. Tree adder (Sklansky, Brent-Kung, Kogge-Stone)
2. Compressor free based Multiplier
3. Signed multiplier using unsigned Multiplier in Q15.
4. Single and dual port RAM emulation.
5. Small state machine design (2-state)-- Moore & Mealy.
6. Small protocol design using state machine –DAC interfacing , and timing report analysis .
7. Complex protocol design using state machine –(Small project : Print your name on onboard LED).Use of microcontroller is prohibited.
8. Project for interested students: DDR3 RAM interface design, I2C Master/Slave design (3.3 / 2.5 Volt), etc.

Tools/Kits to be used: Xilinx ISE 14.5 suits for synthesis, ISim simulator, Spartan-3E starter kit, Spartan-6 development board.

Experiments (any 5 + project 7)=5*5+25=50, **Examination/Viva** = 50 ,
Total= **Experiments** + **Examination/Viva** = 100

Term Paper
Code: ECE682
Contacts: 3P
Credits: 2

Term paper subject assigned to a student is to be decided by the supervising teacher(s) of the student.

Seminar-I
Code: ECE684
Credits: 2

Seminar topic a student may be decided upon in consultation with a teacher of the department. Objective is to choose a topic that increases the knowledge of the student in an advanced/developing topic in electronic science.

Third Semester

Thesis Part-I
Code: ECE771
Credits: 12

A one-year long project must be completed solely by the student with supervision of the assigned teachers from the department. A progress report (Thesis Part-I) has to be submitted at the end of this semester. The project topic has to be fixed in consultation with the supervising teaches. In case, the student opts for an external project supervisor, he must also choose one internal co-supervisor.

Seminar-II
Code: ECE785
Credits: 2

Seminar topic a student may be decided upon in consultation with a teacher of the department. Objective is to choose a topic that increases the knowledge of the student in an advanced/developing topic in electronic science.

Fourth Semester

Thesis Part-I
Code: ECE772
Credits: 16

The one year long M.Tech. project, which was initiated in the 3rd semester, should be completed in this semester. If not, then student can apply for an extension of one semester after taking permission from the supervisor (s). This matter must be discussed in the Departmental Academic Committee for each such student. The DAC may reject the request of extension of any student. If DAC decides in favour of extension, then the application shall be forwarded to the Controller of Examination for his approval.
After completion of the project, the student must submit a full thesis report based work done on both 3rd and 4th semesters. The department shall arrange a seminar cum viva-voce examination which may be attended by at least one external expert from a similar field of study. The external guide(s) will evaluate within a full marks of 100. The internal guide(s) will evaluate within a full marks of 100. Net full marks of this paper in this semester is 200.

Comprehensive Viva Voce
Code: ECE782
Credits: 4

Students must appear for a viva voce examination, in which student may be asked several questions to evaluate his knowledge and analytical skill in the subjects of electronics and communication engineering. The examination board will evaluate the student within full marks of 100.