CURRICULUM
&
SYLLABUS

FOR

MASTER OF TECHNOLOGY
IN
ELECTRONICS & COMMUNICATION ENGINEERING

with Specialization in

- **Microelectronics & VLSI**
- **Communication Engineering & Signal Processing**

MANIPUR UNIVERSITY
CANCHIPUR

Content

VISION OF INSTITUTE

Excellence in engineering and technology education with good leadership in Human Resource Development.

MISSION OF INSTITUTE

- To produce technically strong, innovative, research oriented, all round developed engineers capable to solve modern challenges by adopting student centric teaching learning methods.
- To impart engineering and technology education for all round development
- To produce good engineering professionals with social commitment.

VISION OF DEPARTMENT

Impart quality education to create good technocrats and entrepreneurs with new ideas and innovations to meet industry expectations through advance research.

MISSION OF DEPARTMENT

- To develop and deliver quality academic programs in emerging and innovative field of engineering to empower the student to meet industry standard.
- To build student community with high ethical standards to undertake R&D in thrust areas of national and international needs.
- To create centre of excellence by establishing the incubation centres to meet latest research challenges.

Programme Educational Objectives (PEO)

PEO1: To produce graduates with a solid foundation in mathematical, scientific, computing and engineering fundamentals and working knowledge of managerial skills.
PEO2: To produce graduates with sound theoretical and practical knowledge in Electronics and Communication Engineering.
PEO3: To impart quality education to the students to become professionally, ethically and socially responsible and acquire skills for effective communication and team work in multidisciplinary environment.
PEO4: To inculcate the spirit of enquiry, creativity, collaboration and adaptability through the habit of problem solving and self-learning to keep the graduates motivated for higher studies, research and professional services.

Programme Specific Objectives (PSO)

At the time of graduation, the students would be able to:
PSO 1: Design Electronics and Communication systems including electronic circuits and devices, software and hardware using analytical knowledge in Core Electronics, IC Design, Robotics, Embedded Systems and Analog and Digital Communications.

PSO 2: Analyze specific engineering problems relevant to Electronics and Communication Engineering by applying the core knowledge of circuit design, signal processing, communication systems and networks, computing and control systems supported by the concepts of basic sciences and mathematics.

PSO 3: Apply the contextual knowledge of Electronics and Communication Engineering to address professional, societal and environmental issues with work ethics and function effectively as a team member.

PSO 4: Get acquainted with the usage of DSP and Communication boards, EDA tools, Microprocessors and Microcontrollers, Microwave benches and various simulation tools for analyzing and design of practical systems and processes.

Programme Outcome (PO)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: The problems:
that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline.
that may not have a unique solution.
that require consideration of appropriate constraints/requirements not explicitly given in the problem statement.
which need to be defined (modeled) within appropriate mathematical framework.
that often require use of modern computational concepts and tools.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

M.Tech in Electronics and Communication Engineering
1st Semester

Sl. No.	Subject Code	Subject Details	Periods/ Week			Marks Alloted				Credit/ hours
			L	T	P	PA*	CT	SE	Full Marks	
1	PG/ECE 111	Digital Logic Design with HDL	3	1	0	20	10	70	100	4
2	PG/ECE 112	Digital Signal Processing	3	1	0	20	10	70	100	4
3	PG/ECE 113	Elective-I	3	1	0	20	10	70	100	4
4	PG/ECE 114	Elective-II	3	1	0	20	10	70	100	4
5	PG/ECE 115	Elective-III	3	1	0	20	10	70	100	4
6	PG/ECE 116P	Practical-I	0	0	3	50	-	50	100	2
7	PG/ECE 117P	Practical-II	0	0	3	50	-	50	100	2
8	PG/ECE 118P	Seminar	0	0	4	50	-	-	50	2
		Total	**15**	**5**	**10**	**250**	**50**		**450**	**26**

*PA includes 5 marks for attendance
L-Lecture **T**-tutorial **P**-Practical **PA**-progressive Assessment
CT- Class Test **SE**- End Semester Examination

Digital Logic Design with HDL (PG/ECE 111) (3-1-0) (30+70=100)

Course Objectives:

1. To provide an introduction to digital circuits, CAD and HDL
2. To introduce various technologies to implement digital circuits
3. To study optimization techniques for POS and SOP
4. To study number representation to design arithmetic circuits
5. To study and analyse the different combinational blocks

Introduction to logic circuits:
Variables and functions, Synthesis using AND, OR and NOT gates, Introduction to CAD tools, Introduction to HDL(VHDL/Verilog)

Implementation Technology:
Transistor switches, CMOS Logic, PLD, Transmission gates

Optimized Implementation of Logic Functions:
Strategy for minimization, minimization of POS, Multiple Output circuits, Analysis of Multilevel Circuits

Number Representation and Arithmetic Circuits:
Positional Number representation, Addition of unsigned numbers, signed Numbers, Fast adders, Design of arithmetic circuits using CAD tools, Multiplication

Combinational Circuit Building blocks:
Multiplexers, Decoder, Encoder, Code Converters, Arithmetic Comparison circuits, Verilog for combinational circuits, Design of Sequential design, Design Asynchronous Sequential Design

Text Books

1. Fundamental of digital Logic with Verilog design by S. Brown & Z. Vransesic, TMH.
2. A VHDL Primer by J. Bhaskar, Addison Wesley.

Course outcomes: Students completing the course will be able to

1. Understand Digital circuits and understand the need for HDL
2. Implement different techniques to digital circuits according to need
3. Solve problems for different optimization techniques using Karnaugh map
4. Solve and convert numbers to different forms for circuit design
5. Explain the different combinational logic circuits

Digital Signal Processing (PG/ECE-112) (3-1-0) (30+70=100)

Course Objectives: This course will provide advanced topics on signal processing as:

1. The IIR and FIR filter design and realization will be elaborated.
2. The concept of short-time Fourier transform.
3. Wavelet transform will be introduced and their application.
4. To provide the importance and application of multirate signal processing.

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.

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..

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.

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

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

Suggested Reading:

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

Course outcomes: Upon the successful completion of the course, students will be able to:

1. Design and analyse the digital filters.
2. Understand the drawbacks of Fourier transform.
3. Familiarize the concept of short-time Fourier transform and spectrogram.
4. Visualize wavelets and wavelet transform
5. Understand the difference between CWT and DWT
6. Application of wavelet transforms
7. Acquire the basics of multirate digital signal processing.

Elective-I Device Modeling for Circuit Simulation (PG/ECE 113) (MVLSI)

Course Objectives: This course will enable student to:
1. Understand fundamentals of circuit simulation and objectives.
2. Introduce to Spice.
3. Learn about d.c., small signal, high frequency, noise models of diode, BJT and MOSFET.
4. Study of different types of MOS model.
5. Introduce to Device scaling.

Fundamentals
Semiconductor Physics, Principle of circuit simulation and its objectives.

Introduction to SPICE
AC, DC, Transient, Noise, Temperature extra analysis.

Junction Diodes
DC, Small signal, Large signal, High frequency and noise models of diodes, Measurement of diode model-parameters.

Modelling BJT
DC, small signal, high frequency and noise models of bipolar junction transistors. Extraction of BJT model parameters.

MOSFETs
DC, small signal, high frequency and noise models of MOSFETs, MOS Capacitors.

MOS Models: Level-1 and level-2 large signal MOSFET models. Introduction to BSIM models. Extraction of MOSFET model parameters.

Device SCALING
Short and narrow channel MOSFETs. MOSFET channel mobility model, DIBL, charge sharing and various non-linear effects.

JFET, MESFETs & HBTs
Modeling of JFET & MESFET and extraction of parameters. Principles of hetero-junction devices, HBTs, HEMT.

Text Books
1. S.M.Kang & Y.Leblibici, CMOS Digital Integrated Circuits-Analysis & Design, TMH, 3rd Ed.
2. S.M. Sze, Physics of Semiconductor Devices, Wiley Pub.

References
1. Sedra and Smith, SPICE.
2. H.M. Rashid, Introduction to PSPICE, PHI.
3. B.G. Streetman & S. Baneerjee, Solid State Electronic Devices, PHI.
4. R. Raghuram, Computer Simulation of Electronic Circuits, Wiley Eastern Ltd.
5. Bar Lev, Basic Electronics.

Course Outcomes:
After going through this course the student will be able to

1. State the constituents of a device model.
2. Recognize the importance of approximations in a model.
3. Distinguish among activities of analysis, modelling, simulation and design.
4. Transform the equivalent circuit from a device model into a mathematical form and vice versa.
5. Recognize how the equations get lengthy and parameters increase in number while developing a model.

Elective-I Advanced Digital Communication (PG/ECE 113) (CESP)

Course Objectives: This course will enable student to:
1. To study baseband data transmission over AWGN and band-limited channels
2. To study different digital modulation schemes
3. To study optimum receivers for different modulation schemes for AWGN channels
4. To study different techniques for carrier recovery and symbol synchronization in signal demodulation .

Optimum Receivers for the AWGN Channel
Performance of the receiver for memory less modulation, receiver for CPM signal, receiver for signals with random phase in AWGN channel.

Communication through Band Limited Channels
Optimum receiver with ISI & AWGN, Linear equalization, decision feedback equalization, maximum likelihood (ML) detectors, turbo equalization, adaptive equalization, equalizer, decision feedback equalizer, recursive least squares algorithms, blind equalization.

Multichannel and Multicarrier Systems in Digital Communication
Spread spectrum digital communication systems, direct sequence & frequency hopped spread spectrum signals, synchronization.

Digital Communications through Fading Multipath Channels
Characterization, channel models, diversity techniques for fading multipath channels, digital signaling, coded waveforms for fading channels, multiple antenna systems.

Multi User Communications
Multiple access techniques, code division multiple access, random access methods.

Recent advancements of Digital communication Systems

Text Book/ References:

1. J. Proakis and Masoud Salehi , "Digital Communications", McGraw Hill, 5th edition,2007
2. J. Viterbi and J. K. Omura, "Principles of Digital Communications and Coding",McGraw Hill, 1979
3. Marvin K. Simon, Jim K. Omura, Robert A. Scholtz, Barry K. Levit, "Spread Spectrum Communications", Computer Science Press, 1988
4. Andrew J Viterbi, "CDMA Principles of Spread Spectrum Communications", Addison Wesley, 1995.
5. Simon Haykin, "Digital Communications", John Wiley and sons, 1998

6. H. Taub and D.L. Schilling, Principle of Communication Systems, 2nd Ed., McGraw Hill, 1986.
7. J.G. Proakis, Digital Communication, McGraw-Hill Publications, 2000.
8. B.P.Lathi,Modern Digital and analog communication systems,3rd Edition, Oxford University Press,1998.

Course Outcomes:
Upon successful completion of the course, the students will be able to
1. Understand baseband data transmission over AWGN and band-limited channels
2. Understand and explain different digital modulation schemes
3. Analyze the performance of optimum receivers for different modulation schemes for AWGN channels
4. Analyze different techniques for carrier recovery and symbol synchronization in signal demodulation.

Elective –II VLSI TECHNOLOGY(PG/ECE 114)(MVLSI)

Course Objectives:
1. To make the students understand the fundamentals of electronic devices fabrication process of IC technology /Planar Technology.
2. To learn the MOS Process Technology
3. To provide knowledge of various material deposition techniques and electronic/VLSI device fabrication technologies.

Crystal growth: Wafer preparation, Processing considerations, Chemical cleaning, Getting the thermal stress factors etc.

Epitaxy: Vapors phase epitaxy basic transport processes & reaction kinetics, Doping & Auto doping, equipments, & Safety considerations, Buried layers, Epitaxial defects, Molecular beam epitaxy, Equipment used, Film characteristics, SOI structure.

Oxidation: Growth mechanism & kinetics, Silicon oxidation model, Interface considerations, Orientation dependence of oxidation rates thin oxides, Oxides, Oxidation technique & systems dry & wet oxidation., Masking properties of SiO2.

Diffusion: Diffusion from a chemical source in vapor form at high temperature, Diffusion from doped oxide source, Diffusion from an ion implanted layer.

Lithography: Optical lithography, Optical resists, Contact & proximity printing, Projection printing, Electron lithography, resists, Mask generation, Electron optics, Roster scans & vector scans, Variable beam shape, X-ray lithography, Resists & printing, X-ray sources &masks, Ion lithography.

Etching: Reactive plasma etching, AC & DC plasma excitation, Plasma properties, Chemistry & surface interactions, Feature size control & apostrophic etching, Ion enhanced & induced etching, Properties of etch processing. Reactive ion beam etching, Specific etches processes, poly/polycide, Trench etching.

Planarization Techniques: Need for planarization, Chemical Mechanical Polishing Copper damascene process, Metal interconnects; Multi-level metallization schemes, Process integration: NMOS, CMOS and Bipolar process.

Text books:
1. SM Sze, “Modern Semiconductor Device Physics”, John Wiley & Sons, 2000.
2. SM Sze, “VLSI Technology”, John Wiley & Sons, 2000.

Reference books:
1. B.G. Streetman, “Solid State Electronics Devices”, Prentice Hall, 2002.
2. Chen, “VLSI Technology” Wiley, March 2003.
3. Circuit, Device and Process Simulation: Mathematical and Numerical Aspects by Graham F. Carey (Editor), W. B. Richardson, C. S. Reed, B. Mulvaney, John Wiley & Sons; 1 edition.
4. Process and Device Simulation for MOS-VLSI Circuits, edited by P. Antognetti, D.A. Antoniadis , Robert W. Dutton, W.G. Oldham, kluwer Academic Publisher, 2000.
5. Gregory T.A. Kovacs, Micromachined Transducers Source book, The McGraw-Hill, Inc. 1998
6. Stephen D. Senturia, Microsystem Design, Kluar Publishers, 2001
7. Nadim Maluf, An Introduction to Micro electromechanical Systems Engineering, Artech House, 2000.

Course Outcomes:
1. Identify the various IC fabrication methods
2. In-depth knowledge of thin film deposition techniques
3. Understand operation of different fabrication tools and etching techniques
4. To relate theory on semiconductor processing and device physics to practical
5. technology development and device design considerations.

Elective II Information Theory and Coding(PG/ECE-114)(CESP)

Course objectives:

This course introduces
1. The principles and applications of information theory.
2. The concept of amount of information, entropy, channel capacity of discrete channel.
3. Provides an understanding of how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies.
4. The different source coding techniques has been discussed.
5. The coding schemes such as Linear Block Codes, Cyclic codes, Convolutional codes, BCH and RS codes has been elaborated along with the error detection/correction properties.

Information Theory: Entropy, Information rate, source coding: Shannon-Fano and Huffman coding techniques, Mutual Information, Channel capacity of Discrete Channel, Shannon- Hartley law, Trade-off between bandwidth and SNR.

Introduction and Overview Error Control Codes: Examples of the use of error control codes, basic notions, coding gain. Characterization of Error control codes performance of error control codes, comparision of uncoded and coded systems.

Convolution Codes: Convolution encoders, structural properties of convolution codes, Trelis Diagrams, Viterbi Algorithm, Performance Analysis.

Linear Block Codes: Linear block Codes and their properties, standard arrays, Syndromes, Weight Distribution. Error Detection/Correction Properties, Modified Linear block codes.

Finite Fields: groups, Rings, Fields Properties of finite Fields, Extension Fields, Polynomials over Finite Fields, Minimal Polynomials, Conjugates.

Cyclic Codes: General theory, Shift Register Implementations, Shortened Cyclic codes, CRCs for Error Detection.

BCH and RS Codes: Algebric Description, Frequency Domain Description, Decoding Algorithms for BCH and RS Codes.

Applications: Concatenated Codes, Interleaves, The Compact Disc, Codes for Magnetic recording.

Textbooks/References:

1. T.M. Cover and J.A. Thomas, *Elements of Information Theory*, John Wiley (1991).
2. Shu Lin, Daniel J. Costello, Jr., Error Control Coding(2005).
3. R.G. Gallager, *Information Theory and Reliable Communication*, Wiley (1968). For Discrete Memoryless Systems, Academic Press (1981).
4. R.J. McEliece, *The Theory of Information and Coding*, Addison-Wesley (1977).
5. Stephen B.Wicker Error Control Systems for Digital Communication and storage, Prentice Hall. 1995ISBN 0-13-200809-2

Course outcomes:

Upon successful completion of the course, the students should be able to:

1. Understand the basics of information theory.
2. Calculate information, entropy, mutual information and channel capacity of a system.
3. Compare various source coding techniques in terms of their efficiency.
4. Apply linear block codes for error detection and correction.
5. Implement convolution codes for performance analysis & cyclic codes for error detection and correction.
6. Design BCH & RS codes for Channel performance improvement against burst errors.

Elective-III MOSFET Physics and Sub−Micron Device Modeling (PG/ECE 115) (MVLSI)

Course Objectives:

The objective of the course is

1. To provide the fundamental knowledge for understanding concepts of semiconductor devices.
2. The first part of the course provides an introduction to the basic physics of electrons in solids, quantum mechanics, and solid - state physics needed to understand nano- electronic devices.
3. The second part covers various FETs and simulation of FET.

Metal Semiconductor contacts – idealized Metal, Semiconductor junction, current voltage characteristics of schottky barrier, ohmic contacts, surface effects, MOS electronics, capacitance of the MOS system, non-ideal MOS system.

Basic MOSFET behavior, Channel length modulation, Body bias effect, Threshold voltage adjustment, Sub threshold conduction.

Limitation of long channel analysis, short channel effects, mobility degradation, velocity saturation, drain current in short channel MOSFETS, MOSFET scaling and short channel model, CMOS devices, MOSFET scaling goals , gate coupling, velocity overshoot, high field effects in scaled MOSFETs, substrate current, hot carrier effects, effects of substrate current on drain current, gate current in scaled MOSFETS.

Moore law, Technology nodes and ITRS, Physical & Technological Challenges to scaling, Nonconventional

MOSFET – (FDSOI, SOI, Multi-gate MOSFETs). Numerical Simulation, basic concepts of simulations, grids, device simulation and challenges.

Importance of Semiconductor Device Simulators - Key Elements of Physical Device Simulation, Historical Development of the Physical Device Modeling. Introduction to the Silvaco ATLAS/Synopsis Simulation Tool, Examples of Silvaco ATLAS/Synopsis Simulations – MOSFETs and SOI.

Textbook/Reference:

1. Device Electronics for Integrated circuits by muller and kammins.
2. Computational Electronics by Dragica Vasileska and Stephen M. Goodnick.
3. Silicon Nanoelectronics – Shundri Oda & David Ferry, CRC Press.

Course Outcomes:

On successful completion of the course, the students will be able to

1. Describe the physics of semiconductor materials.
2. Understand the knowledge of metal-semiconductor junctions and current-voltage characteristics.
3. Analyse the effects at a *pn* junction by making use of the *depletion approximation.*
4. Solve the time-dependent continuity equation in simple cases to give meaning to the concept of the lifetime of excess carriers.
5. Demonstrate the simulation of various semiconductor devices.
6. Demonstrate the control applications using semiconductor devices. 5. Identify the fabrication methods of integrated circuits. 6. Classify and describe the different FET for special applications.

ELECTIVE – III (MOBILE COMMUNICATION) PG/ECE 115(CESP)

Course Objectives:

1. To understand the basic cellular system concepts.
2. To have insight into the various propagation models.
3. To understand the multiple access techniques used in different digital cellular systems.

Introduction to cellular mobile systems
Basic cellular systems, Performance criteria, Uniqueness of mobile radio environment, Operation of cellular systems, Concept of frequency reuse channels, Co-channel interference reduction factor, Desired C/I from a normal case in an omnidirectional antenna system, Handoff mechanism, Cell splitting.

Cell coverage for signal and traffic
General introduction, obtaining the mobile point-to-point model, Propagation over water or flat open area, Foliage loss, Propagation in near-in distance, Long-distance propagation, Obtain path loss from a point-to-point prediction model, Cell-site antenna heights and signal coverage cells.

Cochannel and adjacent-channel interference in mobile communications
Cochannel interference, Design of an omnidirectional antenna system in the worst case, Design of a directional antenna system, Lowering the antenna height, Power control, Diversity receiver, Adjacent-channel interference, Near-end – far-end interference, Effect on near-end mobile units.

Frequency management, channel assignment and handoffs:
Frequency management, Frequency-spectrum utilization, Set-up channels, Definition of channel assignment, Fixed channel assignment schemes, Non fixed channel assignment schemes, Concept of handoff, Initiation of a hard handoff, Delaying a handoff, Forced handoffs, Queuing of handoffs, Power-difference handoffs, Mobile assisted handoff, Soft handoffs, Cell-site handoff only, Intersystem handoff.

Multiple access techniques and digital cellular systems:
Multiple access techniques for mobile communications; Global system for mobile (GSM): GSM system architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, Signal processing in GSM; GPRS; EDGE; Overview of third generation (3G) wireless networks.

Textbooks/References

1. Mobile Cellular Telecommunications: Analog and Digital Systems by William C. Y.
2. Lee; Tata McGraw Hill Publication
3. Wireless Communications: Principles and Practice by Theodore S. Rappaport;
4. Pearson / PHI Publication
5. Wireless Communications and Networks: 3G and Beyond by Iti Saha Misra;
6. Tata McGraw Hill Publication
7. Wireless and Digital Communications by Dr. Kamilo Feher; PHI Publication.

Course outcomes: On the completion of this course, the students will be able to:
1. Discuss the cellular system design and technical challenges.
2. Identify various propagation effects, fading, diversity concepts.
3. Understand frequency management, channel assignment and types of handoff.
4. Analyse various methodologies to improve the cellular capacity.
5. Summarize the principles and applications of wireless systems and standards like GSM, GPRS, EDGE and 3G, 4G, 5G standards.

PRACTICAL-I (PG/ECE 116P) (0-0-3) (50+50=100)

Course Objectives:

1. To familiarize the students to basic concepts of HDL Programming
2. To verify basic logic circuits such as AND, OR, NOT, NAND, NOR, XOR and XNOR
3. To design logic circuits using both Verilog and VHDL languages.

Course outcomes: Students completing the course will be able to

1. To simulate and synthesize logic circuits in gate level
2. To simulate and synthesize logic circuits in Behavioural level
3. To simulate and synthesize logic circuits in Dataflow level
4. To understand and utilize test bench in programming

PRACTICAL-II Semiconductor device modelling & simulation using TCAD tools (PG/ECE 117P) (MVLSI) (0-0-3) (50+50=100)

Course Objectives:

1. To make the students exposed to Front end and Back end VLSI CAD tools.
2. To provides practical training in CMOS fabrication, device and process integration using technology computer-aided designed (TCAD) simulation tools
3. To understand and appreciate the underlying physics and principles involved in silicon processing and device characterization
4. To get familiarized with the use of TCAD tools as a design aid in process and device simulation .

Course Outcomes

1. Through dedicated design exercises, students are expected to learn basic trade-off in process influence on device performance, and technology optimization through computer Design of Experiments
2. They will also learn practical skills in state-of-the-art technology computer-aided design (TCAD) simulation tools that are routinely used in all semiconductor wafer fabrication
3. Apply them for 2D process simulation and numerical device characterization, together with process integration and optimization
4. To relate theory on semiconductor processing and device physics to practical technology development and device design considerations

Practical II (Advanced digital signal processing Lab.) (PG/ECE 117P) (CESP) (0-0-3) (50+50=100)

Course Objectives:

This Laboratory course will familiarize with design of digital filter using MATLAB filter design toolbox. Calculate STFT and wavelet transform.

Course outcomes:

Upon the successful completion of the course, students will be able to:

1. Design of FIR and IIR filter of any order in MATLAB.
2. Calculate STFT and interpret spectrogram.
3. Decomposition of a signal using wavelet transform.
4. Signal DE noising and compression using wavelet transform.
5. Demonstrate multirate signal processing.

Seminar (PG/ECE 118P) (0-0-4) (50+0=50)

Course objectives:

1. To acquire knowledge in their professional career.
2. To demonstrate depth of understanding, use primary and secondary sources.
3. To develop discussion skills.
4. To develop listening skills.
5. To develop argumentative skills and critical thinking.
6. Through asking appropriate questions, students will demonstrate their understanding of discussions.

Course outcomes:

1. Be able to show competence in identifying relevant information, defining and explaining topics under discussion.
2. Be able to judge when to speak and how much to say, speak clearly and audibility in a manner appropriate to the subject.
3. Can demonstrate that they have paid close attention to what others say can and respond constructively.
4. Will develop persuasive speech, present information in a compelling, well structure and logical sequence, respond respectfully to opposing ideas.

M.Tech in Electronics and Communication Engineering
2nd Semester

Sl. No.	Subject Code	Subject Details	Periods/ Week			Marks Alloted				Credit /hours
			L	T	P	PA *	CT	SE	Full Marks	
1	PG/ECE 121	Embedded systems Design	3	1	0	20	10	70	100	4
2	PG/ECE 122	RF Engineering	3	1	0	20	10	70	100	4
3	PG/ECE 123	Elective-IV	3	1	0	20	10	70	100	4
4	PG/ECE 124	Elective-V	3	1	0	20	10	70	100	4
5	PG/ECE 125	Elective-VI	3	1	0	20	10	70	100	4
6	PG/ECE 126P	Practical-III	0	0	3	50	-	50	100	2
7	PG/ECE 127P	Term Paper Leading to Thesis	2	0	0	50	-	-	100	2
8	PG/ECE 128P	Seminar	0	0	4	50	-	-	50	2
		Total	**17**	**5**	**7**	**250**	**50**	**400**	**700**	**26**

*PA includes 5 marks for attendance
L-Lecture **T**-tutorial **P**-Practical **PA**-Progressive Assessment
CT- Class Test **SE-** End Semester Examination

EMBEDDED SYSTEM DESIGN (PG/ECE 121) (3-1-0) (30+70=100)
Course Objectives:

1. To understand the meaning of embedded system and applications in which they are used.
2. To study different type of processor architecture and their operation.
3. To study different type of network protocols for data communication.

Introduction to Embedded Systems
Overview of Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in system, Embedded Software, Complex System Design, Design Process in Embedded System, Formalization of System Design, Classification of Embedded Systems.

Microcontrollers and Processor Architecture & Interfacing
8051 Architecture, Input/Output Ports and Circuits, External Memory, Counters and Timers, PIC Controllers. Interfacing Processor (8051, PIC), Memory Interfacing, I/O Devices, Memory Controller and Memory arbitration Schemes.

Embedded RISC Processors & Embedded System-on Chip Processor
PSOC (Programmable System-on-Chip) architectures, Continuous Timer blocks, Switched Capacitor blocks, I/O blocks, Digital blocks, Programming of PSOC, Embedded RISC Processor architecture – ARM Processor architecture, Register Set, Modes of operation and overview of Instructions

Interrupts & Device Drivers
Exceptions and Interrupt handling Schemes – Context & Periods for Context Switching, Deadline & interrupt latency. Device driver using Interrupt Service Routine, Serial port Device Driver, Device drivers for Internal Programmable timing devices

Network Protocols
Serial communication protocols, Ethernet Protocol, SDMA, Channel & IDMA, External Bus Interface

Text Books:

1. Embedded Systems - Architecture Programming and Design – Raj Kamal, 2nd ed., 2008, TMH.
2. PIC Microcontroller and Embedded Systems – Muhammad Ali Mazidi, Rolin D.Mckinaly, Danny Causy – PE.
3. Designers Guide to the Cypress PSOC – Robert Ashpy, 2005, Elsevier.

References:

1. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes / Cole, 1999, Thomas Learning.
2. ARM Systems Developers Guides- Design & Optimizing System Software - Andrew N. Sloss, Dominic Symes, Chris Wright, 2004, Elsevier.
3. Designing with PIC Microcontrollers- John B. Peatman, 1998, PH Inc.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Understand hardware and software units of an embedded system.
2. Understand different architecture of various microprocessors and its working.
3. Become familiar with interrupt handling scheme.
4. Understand the working of network protocols.

RF ENGINEERING (PG/ECE 122) (3-1-0) (30+70=100)

Course objectives:

1. To understand the fundamental concepts of transmission line theory and high frequency circuit behaviour.
2. To use S-parameters, ABCD parameters and Smith Chart in analysing the passive and active RF components and circuits.
3. To explain the design considerations for RF amplifiers, oscillators, mixers and filters.
4. To introduce the topic of Microwave Integrated Circuits and the various concepts of RF system design.

RF Passive Components and Transmission Line Analysis

High frequency Resistors, Capacitors and Inductors – Transmission Line Analysis – line equation – Micro stripe line – SWR voltage reflection co-efficient propagation constant, phase constant, phase velocity – smith chart – parallel RL and RC circuits – ABCD parameters and S parameters.

RF Active Components and RF Amplifier Design

RF Diode, PIN diode, GUNN diode, RF Bipolar junction Transistor, RF Field Effect Transistor – Modeling of Diode, transistor and FET - RF Amplifier: characteristics, power relational and stability considerations – LNA, Power amplifiers, Differential amplifiers, Distributed power amplifiers and Broad band amplifiers.

RF Circuits Design

RF Oscillator Design, Fixed frequency oscillator – Dielectric resonant oscillator, Voltage controlled oscillator- sun element oscillator – RF mixer design – single ended mixer – double ended mixer – RF filter resonator and filter configuration – Butterworth and chebyshev filters – Design of micro strip filters.

RF IC Design
Introduction to RFIC – Analog and Microwave design versus RFIC design – noise performance estimate – RF technology – receiver with single IF stage metallization – sheet resistance – skin effect –parasitic capacitance and inductance – current handling – metal capacitors – Spiral inductors – quality factor – layout in IC – mutual inductance – multilevel – measurement – packaging.

RF System Design
Link design – Fading design – Protected and non protected microwave systems – Path calculation – Spread spectrum microwave system – Compatibility – Safety co-ordinate systems – Datam's& GPS – Receiver design – receiver architecture dynamic range – frequency conversion and filtering – examples of practical receivers – FM broadcast, Digital cellular, Multimeter wave point to point, Direct conversion GSM receiver-RF MEMS: Concept, Implementation and Applications.

Text Books:

1. Reinhold Ludwig and PavelBretchko, "RF circuit design," Pearson Education, 2007.
2. David Pozar, "Microwave and RF design of Wireless systems," Johnwiley, 2008.

Reference Books:

1. Josn Rogers and Calvin Plett, "Radio frequency Integrated circuit design," Artech house, 2002.
2. FerriLosee, "RF systems, Components and Circuits handbook," Artech house, 2002.
3. Joseph.J.Carr, "Secrets of RF circuit design," Tata McGraw Hill, 2004.
4. VivekVaradhan," RF MEMS and their applications", Wiley Eastern edition, 2003.

Course outcomes:
On completion of this course, the students will be able to:
1. Apply transmission line theory.
2. Describe and utilize different network analysis for solving two or multiple port network.
3. Characterize various passive and active RF circuits and components.
4. Analyse the performance of RF circuits in terms of gain, stability and noise.
5. Utilize the various RF circuit design concepts in designing the RF transceiver system.

Elective IV-Adaptive Signal Processing(PG/ECE-123)(CESP)
Course objectives:
The objective of this course is to introduce some practical aspects of signal processing, and in particular adaptive systems. The concept of error performance surface and minimum mean square error has been studied. This course introduces the concept and need of adaptive filters and popular adaptive signal processing algorithms(e.g. the LMS algorithm). Demonstrate applications of adaptive filters to systems such as adaptive noise cancellation, echo cancellation in telephone circuits, adaptive beam forming, etc. Discusses the fundamentals of Kalman filtering problem and applications of Kalman filter.

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.

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

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

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.

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

Suggested Reading:

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

Course outcomes:

Upon successful completion of the course, students should be able to:

1. Understand the concepts of mean square error.
2. Analyse and implement Wiener filters.
3. Implement the adaptive algorithms in software to meet application specific performance criteria.
4. Apply adaptive filters to different systems such as echo cancellation, noise cancellation etc.
5. Design Kalman filter and implement the filter for certain applications.

Elective IV Analog VLSI Design(PG/ECE123)(MVLSI)

Course objectives:

1. Understand the relationship devices, circuits and systems.
2. Analyse and design of different CMOS amplifier and comparator.
3. Introduce to switched capacitors.

Introduction to Analog VLSI

Analog integrated circuit design, Circuit design consideration for MOS challenges in analog circuit design, Recent trends in analog VLSI circuits.

Analog MOSFET Modelling

MOS transistor, Low frequency MOSFET Models, High frequency MOSFET Models, Temperature effects in MOSFET, Noise in MOSFET.

Current Source, Sinks and References
MOS Diode/Active resistor, Simple current sinks and mirror, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.

CMOS Amplifier
Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier.

CMOS Feedback Amplifier
Feedback equation, Properties of negative feedback on amplifier design, Feedback Topology, Stability.

CMOS Differential Amplifier
Differential signaling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load,, Differential to single ended conversion.

CMOS Operational amplifier
Block diagram of Op-amplifier, Ideal characteristics of Op-Amplifier, Design of two stage Op- Amplifier, Compensation of Op-Amplifier, Frequency response of Op-Amplifier, Operational Transconductance Amplifier (OTA).

CMOS Comparator
Characteristic of a comparator, Two stage open loop comparator, Special purpose comparator, Regenerative comparator, High output current amplifier, High speed comparator.

Introduction to Switched Capacitor Circuits
Switched capacitor circuits, Switched capacitor amplifiers, Switch capacitor integrators.

Text Book:
1. Design of Analog CMOS Integrated Circuits by Behzad Razavi McGraw Hill.
2. CMOS: Circuit Design , Layout and Simulation by R. Jacob Baker, Harry W. Li, and David E. Boyce, Prentice Hall of India

Reference Books
1. Analog Integrated circuit Design by David A. Johns and Ken Martin, John Wiley & Son

Course outcomes:
Upon successful completion of the course, students should be able to:
1. Analyse low frequency characteristics of single stage amplifiers and differential amplifiers and high frequency response and noise of amplifier.
2. Understand the feedback concepts , stability analysis and frequency compensation techniques of amplifier .
3. Analyse and Design of high gain amplifier
4. Design and characterize amplifiers according to design specification in Cadence CAD software.

Elective-V Wireless Sensor Networks (PG/ECE 124) (CESP)
Course Objectives:
1. To understand the basics of Ad-hoc & Sensor Networks.
2. To impart knowledge about wireless sensor networks and its application area.
3. To familiarize with learning of the Architecture of WSN.

4. To introduce the fundamental concepts relevant to deployment and localization of wireless sensor networks.
5. To enable the students to understand the synchronization and dissemination of information using wireless sensor network about the target area..

Introduction

Wireless sensor networks: the vision, Networked wireless sensor devices Applications of wireless sensor networks, Key design challenges

Network deployment

Structured versus randomized deployment, Network topology, Connectivity in geometric random graphs, Connectivity using power control, Coverage metrics, Mobile deployment

Localization and Time synchronization

Key issues, Localization approaches, Coarse-grained node localization using minimal information, Fine-grained node localization using detailed information, Network-wide localization, Theoretical analysis of localization techniques, Key issues of time synchronization,Traditional approaches, Fine-grained clock synchronization, Coarsegrained data synchronization

Wireless characteristics and Medium-access

Wireless link quality, Radio energy considerations, The SINR capture model for interference, Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, Contention-free protocols.

Sleep-based topology control and Energy-efficient routing

Constructing topologies for connectivity, Constructing topologies for coverage, Set K-cover algorithms, Cross-layer issues, Metric-based approaches, Routing with diversity, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing, Routing to mobile sinks

Data-centric networking

Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval The database perspective on sensor networks

Transport reliability and congestion control

Basic mechanisms and tunable parameters, Reliability guarantees, Congestion control, Real-time scheduling

Textbooks/References

1. Bhaskar Krishnamachari : Networking Wireless Sensors- Cambridge University Press
2. Kazem Sohraby, Daniel Minoli, Taieb Znati : Wireless Sensor Networks: Technology, Protocols, and Applications- John Wiley & Sons

Course Outcomes:

At the end of this course, students will be able to :-

1. Identify different issues in wireless ad hoc and sensor networks.
2. Have an understanding of the principles and characteristics of wireless sensor networks.

3. To analyze protocols developed for sensor networks.
4. Apply knowledge of wireless sensor networks to various application areas.
5. Analyse WSN protocols in terms of their energy efficiency and design new energy efficient protocols.

Elective V Digital VLSI Design (PG/ECE 124) (MVLSI)

Course Objectives:

1. To lay out the foundations of MOS devices and CMOS inverter by explaining their characteristics and dealing with important parameters in the design of digital circuits
2. To teach the layout design rules and simulation
3. To explain combinational and sequential circuit design
4. To elaborate RAM and ROM design
5. To introduce low power design and BiCMOS

Introduction

Basic principle of MOSFETs, Introduction to large signal MOS models (long channel) for digital design.

MOS Inverters

Static and Dynamic characteristics: Inverter principle, Depletion and enhancement load inverters, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, and Dynamic behavior, transition time, Propagation Delay, Power Consumption.

MOS Circuit Layout & Simulation

Layout design rules, MOS device layout: Transistor layout, Inverter layout, CMOS digital circuits layout & simulation, Circuit Compaction; Circuit extraction and post-layout simulation.

Combinational MOS Logic Design

Static MOS design: Complementary MOS, Ratioed logic, Pass Transistor logic, Complex logic circuits, DSL, DCVSL, Transmission gate logic.

Dynamic MOS design

Dynamic logic families and performances.

Memory Design

ROM & RAM cells design

Sequential MOS Logic Design

Static latches, Flip flops & Registers, Dynamic Latches & Registers, CMOS Schmitt trigger, Monostable sequential Circuits, Astable Circuits. Adders, Multilpier Circuits.

VLSI Interconnects

Interconnect delays, Cross Talks. Introduction to low power design, Input and Output Interface circuits.

BiCMOS Logic Circuits

Introduction, Basic BiCMOS Circuit behavior, Switching Delay in BiCMOS Logic circuits.

Text Books

1. Kang & Leblebigi "CMOS Digital IC Circuit Analysis & Design"- McGraw Hill, 2003
2. JM Rabey, "Digital Integrated Circuits Design", Pearson Education, Second Edition, 2003
3. NHE Weste & K. Eshraghian, Principles of CMOS VLSI Design:A Sys.Pers., McGraw Hill Pub.

References

1. B.G. Streetman & S. Banerjee, Solid State Electronics.
2. Uyemera, CMOS Logic Circuit Design, Springer India Pvt. Ltd. New Delhi, 2007.
3. Eshraghian & Pucknell, Introduction to VLSI, PHI
4. David A. Hodges, Horace G. Jackson, Resve Saleh, "Analysis & Design of Digital Integrated Circuits", 3rd Edi Mc Graw Hill, 2003.
5. Sedra & Smith, SPICE.

Course outcomes: Students completing the course will be able to

1. Revise the basics of MOSFETs and large signal model
2. Understand the principle of inverter, its characteristics and analyse the issues in the design
3. Design and layout circuit simulation
4. Understand and design logic circuits according to the requirements
5. Study and learn dynamic logic
6. Understand RAM and ROM
7. Explain different sequential circuits such as FlipFlops, Static and dynamic latches, registers and multiplier circuits
8. Understand VLSI interface
9. Explain BiCMOS circuits

Elective VI Digital Image Processing and Pattern Recognition (PG/ECE 125) (CESP)

Course Objectives:

1. To introduce students to digital image processing.
2. Familiarize the students with various stages of digital image processing-- Image Transforms, Image Enhancement, Restoration and Compression, Morphological Image Processing, Image segmentation etc.
3. To understand various applications of digital image processing in real-life problems.
4. To familiarize with the stages of a pattern recognition system with emphasis on feature extraction and pattern classification.

Introduction

Steps in Digital Image Processing, Components of an Image Processing system, Applications. Human Eye and Image Formation; Sampling and Quantization, Basic Relationship among pixels- neighbour, connectivity, regions, boundaries, distance measures.

Image Enhancement

Spatial Domain-Gray Level transformations, Histogram, Arithmetic/Logical Operations, Spatial filtering, Smoothing & Sharpening Spatial Filters; Frequency

Domain- 2-D Fourier transform, Smoothing and Sharpening Frequency Domain Filtering; Convolution and Correlation Theorems;

Image Restoration

Inverse filtering, Wiener filtering; Wavelets- Discrete and Continuous Wavelet Transform, Wavelet Transform in 2-D;

Image Compression

Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Elements of Information Theory; Loss Less and Lossy Compression; Run length coding, Differential encoding, DCT, Vector quantization, entropy coding, LZW coding; Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression;

Image Segmentation

Discontinuities, Edge Linking and boundary detection, Thresholding, Region Based Segmentation, Watersheds; Introduction to morphological operations; binary morphology- erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations; Feature extraction; Classification; Object recognition.

Pattern recognition

Introduction to pattern recognition, Pattern Recognition Methods, Pattern Recognition System Design, Statistical Pattern recognition – Classification, Principle, Classifier learning, Neural networks for pattern classification.

Textbooks/References

1. Fundamentals of Digital Image processing- A. K. Jain, Pearson Education
2. Digital Image Processing- R. C. Gonzalez and R. E. Woods, Pearson Education
3. Digital Image Processing using MATLAB- R. C. Gonzalez , R. E. Woods and S. L. Eddins, Pearson Education
4. Digital Image Processing and Analysis- Chanda and Mazumdar, PHI

Course outcomes: Upon the successful completion of the course, students will be able to:

1. Explain the fundamentals of digital image and its processing.
2. Develop any image processing application.
3. Understand the rapid advances in Machine vision.
4. Understand digital image enhancement in spatial and frequency domain
5. Learn different causes for image degradation and overview of image restoration techniques.
6. Learn image edge detection techniques
7. Understand the need for image compression.
8. Apply the concept of image segmentation.
9. Stages of a pattern recognition system.
10. Understand feature extraction and pattern classification.

Elective VI Low Power VLSI Design (PG/ECE 125) (MVLSI)

Course Objectives:

1. To expose the students to the low voltage device modelling, low voltage, low power VLSI CMOS circuit design
2. To introduce the students to an exhaustive review of methods for power

estimation of digital VLSI subsystems.
3. To understand both dynamic and static (i.e., leakage) power.
4. To understand the problems of modeling, estimation of power consumption addressed at different levels of abstraction.
5. To introduce the students to the usage of industry standard tool for low power Design

Introduction

Need for low power VLSI chips, Sources of power dissipation in Digital Integrated circuits. Emerging low power approaches. Physics of power dissipation in CMOS devices.

Device & Technology Impact on Low Power

Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

Power Estimation

Simulation Power analysis- SPICE circuit simulators, Gate level logic simulation, Capacitive power estimation, Static state power, Gate level capacitance estimation, Architecture level analysis, Data correlation analysis in DSP systems. Monte Carlo simulation. Probabilistic power analysis- Random logic signals, Probability & frequency, Probabilistic power analysis techniques.

Low Power Design

Circuit level- Power consumption in circuits, Flip Flops & Latches design, High capacitance nodes, Low power digital cells library Logic level- Gate reorganization, Signal gating, Logic encoding, State machine encoding, Precomputation logic

Low Power Architecture & Systems

Power & performance management, Switching activity reduction, Parallel architecture with voltage reduction, Flow graph transformation, Low power arithmetic components, Low power memory design.

Low Power Clock Distribution

Power dissipation in clock distribution, single driver vs distributed buffers, zero skew vs tolerable skew, chip & package co design of clock network

Algorithm & Architectural Level Methodologies

Introduction, design flow, algorithmic level analysis & optimization, architectural level estimation & synthesis.

Text Books

1. Gary K. Yeap, Practical Low Power Digital VLSI Design, KAP, 2002
2. Rabaey and Pedram, Low power design methodologies, Kluwer Academic, 1997

References

1. Kaushik Roy, Sharat Prasad, Low-Power CMOS VLSI Circuit Design, Wiley,2000

Course outcomes: Upon the successful completion of the course, students will be able to:

1. Understand the concepts of low voltage, low power logic circuits.
2. Infer about the second order effects of MOS transistor characteristics
3. Analyse and implement various CMOS static logic circuits.
4. Learn the design of various CMOS dynamic logic circuits

5. Learn the different types of memory circuits and their low power design chips used for battery-operated systems and high-performance circuits not exceeding power limits.

Practical III Advanced VLSI Lab. PG/ECE 126P(MVLSI)
(0-0-3) (50+50=100)

Course objectives:

1. To design comparators, register, multipliers, microcontrollers, UART, DC motor interface, traffic controllers etc.
2. To verify the designed circuits in a software tool
3. To master both Verilog and VHDL design

Course outcomes: On completion of the course, the students will be able to

1. Verify the theoretical concepts by obtaining simulation results
2. Design , simulate and synthesize circuits in both Verilog and VHDL
3. Use efficient modelling techniques in the different levels of design
4. Understand and utilize test bench in programming

Practical III Advanced communication Lab. PG/ECE 126P(CESP)
(0-0-3) (50+50=100)

Course objectives:

1. Familiarizes the simulation and performance evaluation of different digital modulation schemes in MATLAB.
2. To demonstrate error detecting and error-correcting codes. Analysis of different communication channels. To understand and design adaptive filters.

Course outcomes: Upon the successful completion of the course, students will be able to:

1. Design Encoder and Decoder for single-bit error correction.
2. Simulate and Analyse Digital Signals.
3. Generate and Detect Passband modulation signals with Error controlling codes.
4. Analyse Performance of M-ary Digital Communication Techniques.
5. Analyse the error performance of Gaussian, Rician, and Rayleigh channels.
6. Design of LMS adaptive filter.

Term paper leading to thesis(PG/ECE 127P) (2-0-0) (50+50=100)

Course objective:

1. To develop their reading and writing skills needed for their project.
2. To advance their software and hardware with hands on experience.
3. To evaluate sources for relevance of their research topic,
4. To apply research methods.
5. To apply referencing rules.

Course outcomes:

Upon completion of the course, student will be able to

1. Understand specific knowledge and skills including a mastery of the fundamental and complex technical requirements of the research topic area.
2. To apply knowledge and skills to successfully solve technical design problems.
3. To conduct independent research or analysis activities.
4. To effectively present findings, problem solutions, and reports both orally and in writing.

Seminar (PG/ECE 128P) (0-0-4) (50+0=50)

Course objectives:

1. To acquire knowledge in their professional career.
2. To demonstrate depth of understanding, use primary and secondary sources.
3. To develop discussion skills.
4. To develop listening skills.
5. To develop argumentative skills and critical thinking.
6. Through asking appropriate questions, students will demonstrate their understanding of discussions.

Course outcomes:

5. Be able to show competence in identifying relevant information, defining and explaining topics under discussion.
6. Be able to judge when to speak and how much to say , speak clearly and audibility in a manner appropriate to the subject.
7. Can demonstrate that they have paid close attention to what others say can and respond constructively.
8. Will develop persuasive speech, present information in a compelling , well structure and logical sequence, respond respectfully to opposing ideas.

M.Tech in Electronics and Communication Engineering
3^{rd} Semester

Sl. No.	Subject Code	Subject Details	Periods/ Week			Marks Alloted				Credit/ hours
			L	T	P	PA*	CT	SE	Full Marks	
1	PG/ECE 231	Thesis Part-I	0	0	20	200	-	-	200	15
2	PG/ECE 232	Seminar	0	0	4	100	-	-	100	3
Total			**0**	**0**	**24**	**300**	**-**	**-**	**300**	**18**

*PA includes 5 marks for attendance
L-Lecture **T**-tutorial **P**-Practical **PA-**progressive Assessment
CT- Class Test **SE-** End Semester Examination

Thesis Part-I (PG/ECE231) (0-0-20) (200+0=200)

Course Objectives:

1. Develop the capabilities of a student in analysing and solving complex and possibly real case problems.
2. Train students with skills on systematic development and documentation of a significant piece of work.

Course outcomes:

1. Conduct literature survey to locate for materials and sources relevant to the selected problem area.
2. Understand the materials obtained and connect the materials with the problem to be solved.
3. Define and specify the problem precisely.
4. Assimilate and apply the knowledge learnt in generating good solutions to the problem.
5. Think critically the formulation of alternate models and solutions to the problem, in the analysis of approaches to the solution and their implementation.
6. Evaluate the final outcome in an objective.

Seminar (PG/ECE 232) (0-0-4) (100+0=100)

Course objectives:

1. To acquire knowledge in their professional career.
2. To demonstrate depth of understanding, use primary and secondary sources.
3. To develop discussion skills.
4. To develop listening skills.
5. To develop argumentative skills and critical thinking.
6. Through asking appropriate questions, students will demonstrate their understanding of discussions.

Course outcomes:

1. Be able to show competence in identifying relevant information, defining and explaining topics under discussion.
2. Be able to judge when to speak and how much to say, speak clearly and audibility in a manner appropriate to the project.
3. Can demonstrate that they have paid close attention to what others say can and respond constructively.
4. Will develop persuasive speech, present information in a compelling, well structure and logical sequence, respond respectfully to opposing ideas.

M.Tech in Electronics and Communication Engineering
4th Semester

Sl. No.	Subject Code	Subject Details	Periods/ Week			Marks Allotted				Credit /hours
			L	T	P	PA*	CT	SE	Full Marks	
1	PG/ECE 241	Thesis Part-II	0	0	20	200	-	100	300	16
2	PG/ECE 242	Seminar on Thesis	0	0	4	-	-	100	100	2
3	PG/ECE 243	Grand Viva	0	0	4	-	-	100	100	2
Total			**0**	**0**	**28**	**200**	**-**	**300**	**500**	**20**

*PA includes 5 marks for attendance
L-Lecture **T-**tutorial **P-**Practical **PA-**progressive Assessment
CT- Class Test **SE-** End Semester Examination

Thesis Part-II(PG/ECE 241) (0-0-20) (200+100=300)

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design solutions to complex problems utilising a system approach.
4. Communicate with others and the community at large in written an oral forms.
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Seminar on Thesis(PG/ECE 242) (0-0-4) (0+100=100)

1. Be able to show competence in identifying relevant information, defining and explaining about respective project.
2. Be able to judge when to speak and how much to say , speak clearly and audibility in a manner appropriate to the project.
3. Can demonstrate that they have paid close attention to what others say can and respond constructively.
4. Will develop persuasive speech, present information in a compelling, well structure and logical sequence, respond respectfully to opposing ideas.

Grand Viva (PG/ECE 243) (0-0-4) (0+100=100)

1. Able to gain comprehensive knowledge on their respective projects of one year
2. Able to understand on basis concepts of their respective project.
3. Able to focus to apply the knowledge and ideas gained in real world.