UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR
Course Description

Title of Course: Advanced Engineering Mathematics
Course Code: MVLSI101
L-T Scheme: 3-1 **Course Credits: 4**

Introduction:

The goal of this mathematics course is to provide high school students and college freshmen an introduction to basic mathematics and especially show how mathematics is applied to solve fundamental engineering problems. The Topics to be covered (tentatively) include:

Complex Variables

Numerical Methods

Optimization Techniques

Probability and Statistics

Course Objectives:

In this course, the students will learn differentiation and integration of Complex functions and mappings in the complex plane. They are introduced to Fourier Transforms to stimulate interest in communications, control and signal processing to prepare them for follow up courses in these areas. They also learn to extend and formalize knowledge of the theory of probability and random variables and get motivated to use of statistical inference in practical data analysis.

Course Contents:

Complex Variables: Elements of set theory, Set notations, Applications of set theory, Open & Closed Sets. Review of Complex variables, conformal mapping and transformations, Functions of complex variables, Integration with respect to complex argument, Residues and basic theorems on residues.
Numerical Analysis: Introduction, Interpolation formulae, Difference equations, Roots of equations, Solutions of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, Matrix Eigen value and Eigen vector problems.
Optimization Technique: 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.
Probability and Statistics: Definition and postulates of probability, Field of probability, Mutually exclusive events, Byes' Theorem, Independence, Bernoulli trial, Discrete Distributions, Continuous distributions, Probable errors, Linear regression, Introduction to non-linear regression, Correlation, Analysis of variance.

Text Books:

1.Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill
2. Khanna, V. K. and Ghamdri, S. K.- Course of Abstract Algebra, Vikash Pub.
3.Halmos, T. R.-Naïve Set Theory, Van Nostrand

Reference Books:

1.Scarborough, J. B.-Numerical Mathematical Analysis,Oxford University Press
2.Cone, S. D.-Elementary Numerical Analysis, Mc. GrawHill.
3.Mukhopadhyay ,P.-Mathematical Statistics ,New Central Book Agency

5.Kapoor, V. K and Gupta, S.C.-Fundamental of Mathematical Statistics, Sultan Chand and Sons.
6.Uspensky, J. V.-Introduction to Mathematical Probability, Tata Mc. Graw Hill
7.Dreyfus, S. E.-The Art and Theory of Dynamic Programming –Theory and Applications, Academic Press.
8.Rao, S. S.-Optimisation Theory and Application, Wiley Eastern Ltd., New Delhi

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR
Course Description

Title of Course:VLSI Devices & Modeling
Course Code: MVLSI 102
L-T Scheme: 3-1 **Course Credits: 4**

Introduction:
To introduce the technology, design concepts, electrical properties and modeling of Very Large Scale Integrated circuits.

Learning Outcomes:

Student will be able to model devices and study their performance in analog and digital, circuits.

Course Contents:

Semiconductors, Junctions and MOSFET Overview: Introduction, Semiconductors, Conduction, Contact Potentials, P-N Junction, Overview of the MOS Transistor.
Basic Device Physics:
Two Terminal MOS Structure: Flat-band voltage, Potential balance & charge balance, Effect of Gate-substrate voltage on surface condition, Inversion, Small signal capacitance;
Three Terminal MOS Structure: Contacting the inversion layer, Body effect, Regions of inversion, Pinch-off voltage
Four Terminal MOS Transistor: Transistor regions of operation, general charge sheet models, regions of inversion in terms of terminal voltage, strong inversion, weak inversion, moderate inversion, interpolation models, effective mobility, temperature effects, break down p-channel MOSFET,
CMOS Device Design: Scaling, Threshold voltage, MOSFET channel length
CMOS Performance Factors: Basic CMOS circuit elements; parasitic elements; sensitivity of CMOS delay to device parameters; performance factors of advanced CMOS device.
Bipolar Devices, Design & Performance:

Text Books:
1. Fundamentals of Modern VLSI Devices by Yuan Taur&Tak H. Ning (Cambridge)
2. The MOS Transistor (second edition) YannisTsividi's (Oxford)

Reference Books:
1. CMOS Analog Circuit Design (Second edition) Phillip E. Allen and Douglas R. Holberg(Oxford)

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Course Description

Title of Course:Digital IC Design
Course Code: MVLSI 103
L-T Scheme: 3-1 **Course Credits: 4**

Objectives:

This course covers several aspects of digital integrated circuit design. Starting with MOSFET equations, we will delve into several areas of digital circuit design, including recent changes in circuit design approaches. We will cover different design styles, memory design, as well as board level design concepts.

The broader goal of the class is to take you through a tour of the issues a present-day circuit designer deals with, and the design techniques they utilize. At the end of this class, you would have at your disposal an understanding of the analytical and practical techniques that are required for a VLSI circuit designer to effectively function in today's industry.

Course Contents:

1. **Specification Methods:** Language based methods including VHDL/Verilog, hierarchical state machine descriptions such as State Charts and Petri net based methods. Functional languages for formal verification.
2. **Synthesis tools:** High level synthesis; Scheduling allocation, communication and control
3. **Module Generation:** Finite State machines, state encoding, parameterized blocks PLA, RAM, ROM generation. Gate Level Synthesis; Binary Decision Diagrams, Logic minimization, optimization and retargeting
4. **Layout Synthesis:** Placement; simulated annealing, genetic algorithms, constructive methods. Routing; nets, layers, Lees algorithms, cost functions, channel routing. Examples of a channel router with placement expansion.
5. **Case Study:** Design of MSI chip using proprietary CAD system; use of circuit description language; layout considerations.
6. **Complex gates:** pseudo NMOS; dynamic logic; dynamic cascaded logic; domino logic; 2 and 4 phase logic; pass transistor logic. Control and timing; synchronous and asynchronous; self-timed systems; multi-phase clocks; register transfer; examples of ALU, shifters, and registers. Emerging concepts: Synchronizers s and arbiters, networks on a chip.
7. **Effects of scaling circuit dimensions:** physical limits to develop fabrication. Optional extended course work for final year students, using VLSI design software to produce a chip to meet a given specification; the chip may be fabricated if the design is successful. To study the different stages in the design of integrated chip using VLSI design software. The design is to meet a given specification

Text Books:

1. CAD for VLSI: Author: Russell, G, Kinniment, D.J., Chester, E.G., and McLauchlan, M.R. Notes: Van NorstrandRheinhold, 1985.
2. Tutorial on High Level Synthesis Author: McFarland, M.C., Parker, A.C and Camposano R Notes: Proc 25th ACM/IEEE Design Automation Conf pp330-336
3. CMOS VLSI Design A Ci r cui t s and Sys tems Per spective (3rd Edi t ion) Author Neil Weste and David Harris

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Course Description

Title of Course:Microelectronics Technology & IC Fabrication
Course Code: MVLSI 104
L-T Scheme: 3-1 **Course Credits: 4**

Objectives:
To make the students familiar with the properties behavior and applications and implementation ofmicroelectronic technology into integrated circuits

Course Contents:
Cleanroom technology - Clean room concept – Growth of single crystal Si, surface contamination, cleaning & etching.
Oxidation – Growth mechanism and kinetic oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, characterization of oxide films, Use of thermal oxide and CVD oxide; growth and properties of dry and wet oxide, dopant distribution, oxide quality
Solid State Diffusion – Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon dioxide diffusion systems.
Ion implantation – Range theory, Equipment's, annealing, shallow junction, high energy implementation. **Lithography** – Optical lithography, some advanced lithographic techniques.
Physical Vapor Deposition – APCVD, Plasma CVD, MOCVD.
Metallization - Different types of metallization, uses & desired properties. VLSI Process integration.

Text Books:
1. Semiconductor Devices Physics and Technology, Author: Sze, S.M.; Notes: Wiley, 1985
2. An Introduction to Semiconductor Micro technology, Author: Morgan, D.V., and Board,
3. K Electrical and Electronic Engineering Series VLSI Technology, Author: Sze, S.M. Notes: Mcgraw-Hill

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: Advanced digital communication **Course Code: MVLSI105**
L-T Scheme: 3-1 **Course Credits: 4**

Introduction:

This course will cover the current topics of interest in Advanced Digital Communications. In particular information theory fundamentals related to source and channel coding, modulation of signals and channel capacity are studied. Rate-distortion theory and quantization for uncorrelated and correlated signals are of particular interest.This course aims at introducing advanced topics in digital communications and providing students with up-to-date knowledge of the techniques used in modern communication systems and the principles underlying their design.
Topics include bandlimited channels, intersymbol interference and equalization, fading channel characteristics and models, the effect of fading on digital communication system, and the ways of mitigating this effect. The course will also discuss multicarrier communications, spread spectrum techniques and multiple access, with special emphasis on CDMA schemes and multiuser detection.

Objectives:

When a student completes this course, s/he should be able to:

1. Construct time- and frequency-domain models for digital communications systems with linear channels and additive noise.
2. Design the optimal receiver when the noise is Gaussian.
3. Design linear and decision-feedback equalizers.
4. Evaluate and compare the performance of the preceding techniques.

Learning Outcomes:

Knowledge:

The students will understand fundamentals as well as advanced concepts in digital communications. They will be able to quantify the bit rate that is theoretically needed to perform source coding of continuous-valued signals with some given maximum distortion. They will be able to explain the complexity-quality tradeoffs in practical systems and they will be able to quantify how close practical quantization and channel-coding algorithms can get to the theoretical limits given by information theory. They will be able to design scalar and vector quantizers and linear predictive coding schemes for practical signals and they will be able to understand and apply modern channel coding concepts and digital modulation schemes in a given practical problem setting.

The student is required to show the following skills to pass the course:

1. Acquired knowledge about of basics analog and digital communication.
2. Acquired knowledge about, quantization and coding.
3. Acquired knowledge about different M-ary modulation techniques.
4. Acquired knowledge about of inter symbol interference (ISI).
5. Acquired knowledge different estimation methods.
6. Identify and describe different techniques in modern digital communications with applications to wireless transmission, in particular in receivers and equalization, diversity, spread spectrum techniques, OFDM, coding for wireless communications, and CDMA and multiuser systems.
7. Identify and describe different standardized technologies in the field, in particular GSM, UMTS/WCDMA and different WLAN standards.

8. Describe and motivate the fact that the implementation and development of modern communication technology, in particular in wireless communications, requires mathematical modeling and problem solving.
9. Apply mathematical modeling to problems in wireless digital communications, and explain how this is used to analyze and synthesize methods and algorithms within the field.
10. Formulate a mathematical model which is applicable and relevant in the case of a given problem.
11. Use a mathematical model to solve a given engineering problem in the field, and analyze the result and its validity.

Course Contents:

Pre-requisites:
Fourier Expansion, Fourier transform, Normalized power spectrum, Power spectral density, Effect of transfer function on output power spectral density, Parseval's theorem.
Autocorrelation & cross correlation between periodic signals, cross correlation power.
Relation between power spectral density of a signal, its autocorrelation function and its spectrum.
Distinction between a random variable and a random process.
Probability, sample space, Venn diagram, joint probability, bay's theorem, cumulative probability distribution function, probability density function, joint cumulative probability distribution function, joint probability density function.,
Mean/average/expectation of a random variable and of sum of random variables.
Standard deviation, variance, moments of random variables, - explanation with reference to common signals.
Tchebycheff's inequality.,Gaussian probability density function – error function & Q function, Central limit theorem.

Unit 1: Spectral analysis of signals:
Orthogonal & orthonormal signals. Gram-Schmidt procedure to represent a set of arbitrary signals by a set of orthonormal components; - numerical examples.
The concept of signal-space coordinate system, representing a signal vector by its orthonormal components, measure of distinguishability of signals.

Unit 2: Characteristics of random variables and random processes:
Common probability density functions, - Gaussian, Rayleigh, Poisson, binomial, Rice, Laplacian, lognormal, etc.
Probability of error in Gaussian Binary symmetric channel.
Random processes – time average, ensemble average, covariance, autocorrelation, cross correlation, stationary process, ergodic process, wide sense stationary process.
Power spectral density and autocorrelation, power spectral density of a random binary signal.
Linear mean square estimation methods.

Unit 3: Revision of source coding: Sampling theorem, instantaneous/ flat top/ natural sampling, band width of PAM signal, quantization, quantization noise, principle of pulse code modulation, delta modulation & adaptive delta modulation.
Parametric coding/ hybrid coding/ sub band coding: APC, LPC, Pitch predictive, ADPCM, voice excited vocoder, vocal synthesizer.

Unit 4: Line codes:
UPNRZ, PNRZ, UPRZ, PRZ, AMI, Manchester etc.
Calculation of their power spectral densities.
Bandwidths and probabilities of error Pe for different line codes.

Unit 5: Revision of digital modulation: Principle, transmitter, receiver, signal vectors, their distinguish ability and signal band width for BPSK, QPSK, M-ARY PSK, QASK, MSK, BFSK, M-ARY FSK.

Unit 6: Spread spectrum modulation:
Principle of DSSS, processing gain, jamming margin, single tone interference, principle of CDMA, MAI and limit of number of simultaneous users.
Digital cellular CDMA system: model of forward link, reverse link, error rate performance of decoder using m-sequence chip codes.
Properties of m-sequences, their generation by LFSR, their PSDs, limitations of m sequences.
Gold sequence, Kasami sequence – generating the sequences, their characteristic mean, cross correlation and variance of cross correlation, their merits and limitations as chip codes in CDMA.

Unit 7: Multiplexing & multiple access:
TDM/TDMA, FDM/FDMA, Space DMA, Polarization DMA, OFDM, ALOHA, Slotted ALOHA, Reservation ALOHA, CSMA-CD, CSMA-CA – basic techniques and comparative performances e.g. signal bandwidth, delay, probability of error etc.

Unit 8: Noise:
Representation of noise in frequency domain.
Effect of filtering on the power spectral density of noise – Low pass filter, band pass filter, differentiating filter, integrating filter.
Quadrature components of noise, their power spectral densities and probability density functions.
Representation of noise in orthogonal components.

Unit 9: Characteristics of different types of channels:
Gaussian, Poisson etc,

Unit 10: Band limited channel:
Characteristics of band limited channel, inter symbol interference (ISI) - it's mathematical expression.
Nyquist's theorem for signal design for no ISI in ideal band limited channel, Niquist's criteria, raised cosine pulse signals.
Signal design for controlled ISI in ideal band limited channel, partial response signals, duobinary& partial duobinary signals - their methods of generation and detection of data.
Concept of maximum likelihood detection, log likely hood ratio.
Detection of data with controlled ISI by linear transverse filters.
Performance of minimum mean square estimation (MMSE) detection in channels with ISI.

Unit 11: Base band signal receiver and probabilities of bit error:
Peak signal to RMS noise output ration, probability of error.
Optimum filter, its transfer function.
Matched filter, its probability of error.
Probability of error in PSK, effect of imperfect phase synchronization or imperfect bit synchronization.
Probability of error in FSK, QPSK.
Signal space vector approach to calculate probability of error in BPSK, BFSK, QPSK.
Relation between bit error rate and symbol error rate.
Comparison of various digital modulation techniques vis-à-vis band width requirement and probabilities of bit error.

Text Books

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Course Description

1. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.
2. Principle of Communication Systems – Taub, Schilling, TMH
3. Digital and Analog Communication Systems, 7th ed. – Leon W. Couch, PHI.
4. Principles of Digital Communication – Haykin
5. Digital Communication – Zeimer, Tranter
6. Principle of Digital communication - J. Das, S. K. Mallick, P. K Chakraborty, New Age Int.
7. Communication Systems, 4th ed. – A. Bruce Carlson, Paul B. Crilly, Janet C. Rutledge, MGH International edition.

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: CAD Tools for VLSI Design
Course Code: MVLSI191
L-T-P scheme: 0-0-3 **Course Credit: 4**

Objectives: The overall course objective is to teach electrical engineering students fundamental concepts of hardware description languages and advanced techniques in digital system design. Specific objectives include the following:

1. Learn VHDL (Very high speed integrated circuit Hardware Description Language).
2. Utilize VHDL to design and analyse digital systems including arithmetic units and state machines.
3. Learn field programmable gate array (FPGA) technologies and utilize associated computer aided design (CAD) tools to synthesize and analyse digital systems.
4. Learn testing strategies and construct test-benches.
5. Conduct laboratory experiments using an FPGA based development board to prototype digital systems and to confirm the analysis done in class.
6. Prepare informative and organized lab reports that describe the methodologies employed, the results obtained, and the conclusions made in a laboratory experiment.

Learning Outcomes: The students will have a detailed knowledge of the concepts of IEEE and ANSI standard HDL. Upon the completion of Operating Systems practical course, the student will be able to:

- **Understand** and implement basic digital logic circuits of VLSI.
- **Model** complex digital systems at several levels of abstractions; behavioural and structural, synthesis and rapid system prototyping.
- **Developand Si**mulate register-level models of hierarchical digital systems.
- **Designand model** complex digital system independently or in a team
- Carry out **implementations** of registers and counter**s.**
- **Simulate and synthesize** all type of digital logic circuits used in VLSI.
- Finally **design** an ALU.

Course Contents:
Exercises that must be done in this course are listed below:
Exercise No.1: Design of basic Gates: AND, OR, NOT.
Exercise No. 2: Design of universal gates
Exercise No. 3: Design of XOR and XNOR gate.
Exercise No. 4: Design of 2:1 MUX.
Exercise No. 5: Design of 2 to 4 Decoder.
Exercise No. 6: Design of Half-Adder and Full Adder.
Exercise No. 7: Design of 8:3 Priority Encoder.
Exercise No. 8: Design of 4 Bit Binary to Grey Code Converter.
Exercise No. 9: Design of all Flip-Flops.
Exercise No. 10: Design of Shift register.
Exercise No. 11: Design of ALU.

Text Book:
1. J. Bhaskar, A VHDL Primer, 3rd edition, Prentice Hall.

Recommended Systems/Software Requirements:

1. Intel based desktop PC with minimum of 1GHZ or faster processor with at least 2GB RAM and 8 GB free disk space.
2. Xilinx ISE14.2software in Windows XP or Linux Operating System.

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: Embedded system Lab-II
Course Code: MVLSI-291
L-T-P scheme: 0-0-3 **Course Credit: 3**

Objectives:

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a kind of application device. Industrial machines, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines, and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system. Embedded systems that are programmable are provided with a programming interface, and embedded systems programming is a specialized occupation. Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Learning Outcomes: The students will have a detailed knowledge of the concepts ofembedded system and ARM processor. During this class students, can write a simple and complex assembly language programming using ARM controller. Upon the completion of this practical course, the student will be able to:

- **Understand** the ARM processor.
- **Using**this new processor, they can interface with another co-processor**.**
- **Study**the benefits to use ARM processor in our real life.
- **Analyze** and simulate the various program.
- **Interface**various hardware interface with ARM processor.
- **Implement and simulate** the application based program in proteus environment.

Course Contents:

Exercises that must be done in this course are listed below:

Exercise No.1: Write an assembly language program to add two 64 bit numbers by ARM processor,
Exercise No. 2: Write an assembly language program for addition two 32 bit numbers,
Exercise No. 3: Write an assembly language program to find smallest of N numbers
Exercise No. 4: Write an assembly language program to find largest of N numbers
Exercise No. 5: Write an assembly language program to convert Hex to ASCII
Exercise No. 6: Write an assembly language program to convert ASCII to hex
Exercise No. 7: Write an assembly language program to generate N Fibonacci numbers
Exercise No. 8: Write an ALPto find the factorial of a given number using subroutine
Exercise No. 9: Write an assembly language program to find the multiplication of two 32-bit number

Text Book:

1. William Hohl,"ARM Assembly Language: Fundamentals and Techniques", Second Edition, CRC Press
2. Vincent Mahout, "Assembly Language Programming: ARM Cortex-M3", Wiley publication

Recommended Systems/Software Requirements:

Minimum system requirement: -

Processor	:	AMD Athlon ™ 1.67 GH_z
RAM	:	256 MB
Hard Disk	:	40 GB
Mouse	:	Optical Mouse

Software requirement: - Windows 2007/8/10, keil simulator, ect.

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: Seminar
Course Code: MVLSI181
L-T-P scheme: 0-2-0 **Course Credit: 1**

The overall aim of the seminar series is to help develop an emerging field at the intersection of multi-disciplinary understandings of culture and education. It will build on the existing body of work on education and culture, but its aim is explore and develop new perspectives in this area.
The objectives of the six exploratory seminars are:

- **to explore new research from a range of academic disciplines which sheds light on the questions outlined above**
- **to showcase cutting edge research on education and culture from outstanding academic researchers from the UK and internationally**
- **to bring together seminar participants from different disciplines such as Sociology, Philosophy, Psychology, Human Geography, Media Studies as well as Education and Cultural Studies**
- **to encourage and financially support the participation of PhD students**
- **to actively involve practitioners and users from each venue**
- **to engage a core group of policy makers**
- **to use the seminars to develop links between academics and stakeholders in the arts, library, media, community and educational sectors**