Goa University

P.O. Goa University, Taleigao Plateau, Goa 403 206, India

Syllabus of M.Sc. (Electronics) Programme

Approved by the Board of Studies on April 07th 2010

A brief description of the course.

- **Purpose**: Program curriculum is designed to train the post graduate students in the area of Embedded System Designs and Smart Instrumentation which can augment the human resource requirements for the position of R&D Scientist, System Designers using embedded technologies and Academic Research.
- **Prerequisites**: Entrance test with 50% weightage at BSc Final for the student from affiliated colleges with other conditions as given in University handbook. While 100% weightage for entrance test for external candidate. Only the candidate having graduation in Physics/Electronics/Computer Science are eligible
- **Credits** (44 Theory, 8 Tutorials, 16 Practical's)
- **Number of semesters**: Four having 20 credits per semester
- **Dissertation**: 8 credit dissertation is encourage to have very advanced projects either in the Industries or which deals with designs of prototype working system dealing with the Embedded Systems and Signal Processing. To mention few leading dissertation were Design of LC3 processor, Quadrocoptor, Glucometer, Automatic pressure meter, TCP-IP control system, Online facial Surveillance system, Hyperspectral imaging.
- **Summer Internship** : Department encourage 2 credits under summer internship over a duration of 1-2 month wither in any research institute of national importance , industry , National or International Academic institute (One student visited 'Ecole Polytechnique Fédérale de Lausanne EPFL AA DAR GO Bâtiment PPH - Station 5 CH-1015 Lausanne).

The tables starting on the next page list the courses under the programme. The recommended semester-wise distribution of the courses is also given. Description of each of the courses is given in subsequent pages.

M. Sc. (Electronics) List of Courses

In the following tables, L refers to lectures, T to tutorials and P to practicals. Description of a course appears on the page number listed in the tables. The 'ELC' stand for compulsory subject, ELD stand for Department optional and 'UEL' stands for University Elective subject under Electronics. The 'ELC101' stands for compulsory first level course while ELC201 stands for Compulsory second level course.

Semester I				
Sr. No	**Course code**	**Title**	**Credits**	Type
1	ELC101	MICROELECTRONICS AND VLSI DESIGN	4	L
2	ELC102	NUMERICAL COMPUTATION AND ALGORITHMS	4	L
3	ELC103	EDA TOOLS-I	4	L
4	ELC104	ELECTRONICS PRACTICALS – I	4	P
5	UEL101	ADVANCED DIGITAL COMMUNICATION SYSTEMS	4	L
		Total	20	
Semester II				
1	ELC201	EMBEDDED SYSTEMS DESIGNS	4	L
2	ELC105	OPERATING SYSTEM AND RTOS	4	L
3	ELC202	OPTICAL COMMUNICATION SYSTEMS	4	L
4	ELC203	ELECTRONICS PRACTICALS- II	4	P
5	UEL102	MICROPROCESSORS ARCHITECTURES AND PROGRAMMING	4	L
		Total	20	
Semester III				
1	ELC204	INSTRUMENTATION & CONTROL THEORY	4	L
2	ELC301	ELECTRONICS PRACTICALS - III	4	P
3	**ELD201**	**SIGNALS AND SYSTEMS**	**4**	L
4	**ELD202**	**DIGITAL SIGNAL PROCESSING**	**4**	L
5	***ELD301***	***DIGITAL SYSTEM DESIGN USING HDL***	***4***	L
6	***ELD302***	***EDA TOOLS-II***	***4***	L
7	UEL103	INDUSTRIAL TRAINING, MINI-PROJECT AND SEMINAR	4	T
		Total	20	
Semester IV				
1	ELD401	ELECTRONICS PRACTICALS - IV	4	P
2	ELD203	***NANOELECTRONICS & NANOSYSTEMS***	4	L
3	ELD303	LASER SYSTEM ENGINEERING	4	L
4	ELD402	PROJECT	8	P
5	UEL104	PHARMACEUTICAL INSTRUMENTATION	4	L
6	UEL105	COMMUNICATION AND TECHNICAL SKILLS	4	T
		Total	20	

Semester I

ELC 101: MICROELECTRONICS AND VLSI DESIGN

4

An overview of VLSI, Modern CMOS Technology 5
Silicon Logic, Logic design with MOSFET. 4
Physical structure of CMOS Integrated circuits 7
Fabrication Technologies of CMOS Integrated Circuits 3
Elements of Physical Design 6
Electrical characteristics of MOSFETS 5
Electronic analysis of CMOS Logic gates 6
Advanced Techniques in CMOS Logic Circuits 4
System specifications using HDL, General VLSI components 4
Memories and Programmable Logic 4
VLSI Clocking and System Design 4
Reliability and Testing of VLSI circuits

Tutorials:

1. 2^{nd} order Butterworth filter using P-Spice student version.
2. Current Mirrors using P-Spice student version.
3. CMOS based Op-Amp using P-Spice student version.
4. Study of Lithography.
5. Compares various Static memories.

Reference Books:

1. Introduction to VLSI Circuits and Systems, John P. Uyemura, WILLEY.
2. Principles of CMOS VLSI Design, N.H.E. W. & Eshahiraghian, Addison Wesley
3. Modern VLSI Design System on Silicon, Pearson Education Asia. By W. Wolf.
4. VLSI Technology, S.M. Sze, McGraw-Hill (1995).
5. Basic VLSI Design, Douglas Pucknell, K. Eshraghian, Prentice Hall India.

ELC 102: NUMERICAL COMPUTATION AND ALGORITHMS **0**

Computer Programming: **8**

Introduction to Algorithms, Elements of Computer Programming language Basics of algorithm design, general model, Dynamic programming model, principle of optimality, backtracking models.

- Algorithm order and complexity
- Backtracking example.

Data Structures:

Introduction to Data Structures, Vectors and Lists, Binary Trees, Graphs, Hashing. **1**

- Implementation of Shortest path algorithm **0**
- Implementation of binary tree

Theory of Numerical programming: 2

Theory of numerical errors, Numerical Integration: Trapezoidal & Simpsons rule, Romberg method, Improper integrals; Numerical Solution of linear equations: Guass-Jordon elimination and Lu decomposition, Numerical Solutions of nonlinear equations: Bracketting, bisection,Secant & Regulafalsi method, Newton-Ralphson method; Numerical Solutions to Ordinary differential equations: Runge-Kutta method, Modified midpoint method, Richardson extrapolation. 5

- Trapezoid methods, Newtons Raphson methods
- Bisection and Regular falsi methods
- Runge Kutta

Database:

Basic Concepts, Relational Data Model, Database Design, DBMS storage structures and access methods, Query Processing, Transaction Processing, Security & Integrity, Distributed Databases, Client Server Computing. 06

- SQL for database
- Client Server data base query

Tutorials:

1. Implementation of Vector in C++.
2. Implementation of List in C++.
3. Implementation of minimum path algorithms in C++.
4. Simple Example of Database querying in C++.
5. Case study on the Emerging Trends in databases (Datamining).

Reference Books:

1. Data structures using C and C++ by Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum, Prentice Hall of India, 1995
2. Data Abstraction and Problem solving in Java by Frank M Carrano, Janet J Prichard ,Addison-Wesley, 2001
3. Numerical Recipes in C, William H. Press, Brain P. Flannery, William T. Vetterling, Saul A. Teulosky, Cambridge University Press, 1990.
4. Numerical Mathematical Analysis, J. B. Scarborough, Oxford and IBM Publishing Company (1979).
5. Numerical Recipes in C: The Art of Scientific Computing by William H Press, Brian P Flannery, Saul A Teukolsky - Mathematics – 1992.
6. Fundamentals of Database Systems, 4th Edition by R Elmasri, S Navathe Addison-Wesley, 2003

ELC103: EDA TOOLS-I

Study of EDA tools, EDA Structure; Various EDA tools in VLSI technologies; Bottom up (Full custom), Top Down (Standard Cell) approach; Various Simulations in VLSI EDA; Layout format (CIF, GDS), p-Spice code examples. 10

1. **Microwind /Cadence**
    a. 4:1 multiplexure. 25
    b. 3:8 decoder
    c. Design Shift Registers
    d. Design of Counters for digital clock
    e. Memory design using 6T cell.
    f. Dynamic Memory design.
    g. Radiofrequency circuit.
    h. Resistive circuit
    i. Differential amplifier

2. **p-Spice**
    a. 2^{nd} order Butter-worth Notch Filter.
    b. Clipper Circuit. 2
    c. Buffer design using SPICE. 0

Ref. Book:

1. Electronic Design Automation For Integrated Circuits Handbook, by Lavagno, Martin, and Scheffer, CRC.

2. The Electronic Design Automation Handbook, by Dirk Jansen et al., Kluwer Academic Publishers

3. p-Spice manual.

4. http://www.ecircuitcenter.com/index.htm

ELC 104: ELECTRONICS PRACTICALS –I

1. Design of 4-bit UP-DOWN Counter.
2. Design of variable voltage supply @ 2 Amps.
3. Temperature Controller using 741.
4. Design of Power Amplifier 10 Watts.
5. Design of Stepper driver using Monoshot & 555 Timer.
6. Design of Function Generator.
7. DS-CDMA simulation.
8. Error detection and correction Algorithm
    a. CRC
    b. Hamming code
9. Channel Coding methods.
    a. Convolution b. Block code
10. Implementation of MSK modulation and demodulation.
11. ASK, FSK, QPSK, modulation & demodulation.
12. QPSK, modulation & demodulation.

UEL101: ADVANCED DIGITAL COMMUNICATION SYSTEMS

Introduction to Mobile and Cellular Communication Systems: Main Definitions, impact of Mobile and Cellular Radio Communication Historical overview. Fundamental of Radio Mobile and Cellular Practices Radio mobile links and cells, Frequency re-use, Principles of Cellular Com. Mobile Telephone Switching Subsystem, The mobile frequency spectrum, Hand-off, Cochannel and adjacent channel interference limitations, Near-far problem, Power Control. 6

Mobile Communication Channel including antennas: The mobile wireless propagation channel, Notions on antennas especially the near and far field concept, Line of Sight (LOS) propagation, Multipath fading and shadowing and over the horizon propagation, outdoor and Indoor Propagation, Flat and selective fading, Special antennas for base stations and headsets, Deterministic, Empirical and Statistical Methods for propagation link computations. 1

Overview of Mobile and Cellular Radio Communication Modulation and Detection Techniques: Analog modulations and detection: AM, FM, PM, ACSB, Hybrid and Digital modulation: PCM, ASK, FSK, QPSK, QAM, MSK, etc, Coherent and noncoherent detection, C/N, S/N, Eb/No and BER relations, Probability concepts, Mobile Radio links parameters. 2

Overview of Multiple Accesses Techniques: Simplex, Duplex TDD and Time Division Duplex, Time division multiple access (TDMA) FDMA and OFDM, Code Division multiple access (CDMA), Hybrid multiple access, Management of voice, Data and Video (Multimedia) information. 11

Modern Digital Radio Systems: standards, proposals and comparisons GSM (Europe and all over the world) - TDMA, IS-54 (U.S.A.)- TDMA, IS-95 (U.S.A., Korea) CDMA-, PHS (Japan) - TDMA, Frequency Hopping (FH) (U.S.A.) - CDMA, Short Range Distance Nanocells and Picocells Systems, PCS, PCS Cordless telephone 2nd generation (CT-2), Cellular digital packet data (CDPD), and Wireless LAN, New standard trends Edge, 3rd and 4th generation beginning. 08

Mitigation Techniques for Mobile System: Overview of Natural and manmade external noise sources, Radiation hazards effects from base stations, Mobile and portable equipments. 05

Diversity Techniques for Mobile Radio Systems: Dispersive channels, Space diversity, Frequency diversity, Polarization diversity, Hybrid and quadruple diversity, Equalizer techniques

Trends in Mobile and Cellular Communications Multimedia: 3rd and 4th Generation. Global Mobile systems using GEO and LEO. SQSP Platforms and Terrestriel links. Novel Localization Techniques. 04

Tutorials:

1. Study of Global Positioning system working principle.
2. Study of mobile Service providers in Goa Region.
3. Study of AIR station Bambolim, Goa.
4. Study of Distance Education Infrastructure Setup (DEITE) at Goa University.
5. Study of various interfacing of mobile set eg. Bluetooth.

Reference Books:

1. Steele, R., Hanzo, L., "Mobile Radio Communication" 2nd Edition Wiley 1999.
2. Hess G.C., "Land Mobile Radio System Engineering", Artech 1997.
3. Rappaport, T.S., "Wireless Communications", J. Wiley 2nd edition, 1998.
4. Jakes WC., "Microwave Mobile Communications", J. Wiley 2nd edition 1998.
5. Vaughan, R., Bach - Anderson, J., "Propagation and Antennas for Mobile Communication" IEE Publishers 2002.

Gibson, E., "The Mobile Communications Handbook" CRC Press 2ndEdition 1999

Semester II

ELC 201: EMBEDDED SYSTEMS DESIGNS

Architectures: RISC/CISC and Harvard/Princeton Architectures(4); Types of Memories (3), Introduction to 8-bit Micro controllers (4), Timers/Counters, UART, SPI, PWM, WDT,(6) Input Capture, Output Compare Modes,(3) I2C, CAN, Interfacing LED, Switches, ADC, DAC, LCD, RTC,(8) Emerging Bus Standards (USB, Compact PCI) ,(4) Programming in Assembly and C (GNU Tools),(5) Introduction to 16/32-bit Processors,(4) ARM Architecture & Organization, (5)ARM/THUMB Programming Model, ARM/THUMB Instruction Set, ARM Exception Handling, ARM/THUMB Assembly & C Programming (GNU Tools)(8) .

Tutorials

1. Programming of EEPROM memory.
2. Subsystem SBI.

3. Communication of SPI with RTC Chip
4. ST Series Microcontrollers study.
5. Motorola Series Microcontrollers study.

Reference Books:

1. Jivan Parab etal., Exploring C for microcontroller (Springer 2007)
2. Lipovski G. J. Single and multiple Chip Microcontroller interfacing. Prentice Hall, USA 1998.
3. Malvano W. J. Embedded microcomputer system, Brooks / Cole, USA, 1999.
4. Embedded Systems Handbook Edited by: Richard Zurawski CRC Taylor & Francis Group.
5. Embedded Systems: Architecture, Programming and Design By Raj Kamal, McGraw Hill
6. Building Embedded Linux Systems, by Karim Yaghmour, O'Reilly

ELC 105: OPERATING SYSTEM AND RTOS

6

Introduction to Computer Organization and Architecture: hardware vs software - the virtual machine concept, concept of von Neumann architecture, hardware components and functions, trends in hardware development, system configurations and classifications.

5

Process Description and Control: Processes, process states, processor modes, context switching, 5
CPU scheduling algorithms, threads. 5
Concurrency Control: Concurrent processes, critical section problem and solutions, mutual exclusion solution requirements, semaphores and monitors. 3
Deadlocks: Characterization, detection and recovery, avoidance, prevention. 6
Inter Process Communication: classical IPC problems and solutions, IPC techniques.
The Input/Output and File Subsystem: I/O devices, controllers and channels, bus structures, 1/0 techniques (programmed, interrupt driven and DMA), I/O subsystem layers. Concepts of files and directories, issues and techniques for efficient storage and access of data. I/O and file system support for graphics, multimedia, databases, transaction processing and networking. 8
The Memory Subsystem : Memory types and hierarchy, module level Organization, cache memory. Memory partitioning, swapping, paging, segmentation, virtual memory.

6

The Central Processing Unit: CPU components, register sets, instruction cycles, addressing modes, instruction sets, concept of micro-programming ,Basics of RISC approach, pipelined and super-scalar approaches, vector processors and parallel processors, hardware support for the OS.
µCOS case study 3

4

Tutorial

1. Implementing Lower Level Shell
2. Implementing Signal in Unix
3. Hard disk partitioning in Linux

Text/Reference Books:

1. Operating system principles, 3rd Edition,by Willian Stallings –PHI(1998)
2. Operating system concepts by Silberchatz and Galvin -Addision wesley
3. Operating system by Tanaumbuam, PHI New Delhi

ELC207: OPTICAL COMMUNICATION SYSTEMS

Light Propagation in Optical Fiber: Geometric picture, Pulse spread due to material dispersion, loss mechanism, Theory of Optical waveguides, methods of waveguides analyses , modes in steps and graded index fiber, new types of optical fibers 1

Fiber Optics Technology: Glass fiber fabrication, cable design, coupling, splicing and connectors, splicing methods, connectors, fiber measurements. 2

Optical Sources: LED and LDs, development of Laser diodes structures, transmitter circuits, Coupling efficiency of source to fiber. 5

Optical detectors: Photodiodes, Avalanche diodes and other detectors. 6

Receiver sensitivity and BER: Receiver design, Noise in detectors. 8

Communication System design: System requirement, System design, Link analyses, Power budgeting. 7

Voice Transmission: Characteristics of Voice signals, TDM, Undersea fiber optics communication system , fibers in telephone network. 7

Tutorials: 8

1. Goa University network of Optical Fiber in LAN.
2. Coupling Efficiency in connectors.
3. Optical fiber as Sensor
4. Power budget calculation
5. Study of different detectors and comparison.

Reference Books:

1. Optical Fiber Communication by A. Selvarajan and etal TMH, 2002.
2. Optical Fiber Communication by Gerd Keiser , MGH , 1998.
3. Optical Electronics, 4th Edition by A. Yariv, HRW publication, 1991.
4. Optical Communication Systems, By J. Senior, Printice Hall India, (1992).

Optical Communication Systems, J. Franz and V. K. Jain, Narosa Publications

ELC 203: ELECTRONICS PRACTICALS II

1. LCD & LED Interfacing to ATMEL 89C52
2. 7-segment Interfacing to ATMEL 89C52 (BCD counter)
3. Display Temperature using ATMEL 89C52
4. Serial Transmission and reception PIC16F877
5. Configuring On-chip ADC PIC16F877
6. Waveform generation using I2C based Max5822 interfaced to PIC 16F877
7. Hex Keypad Interfaced to ARM controller
8. LCD & LED Interfacing using ARM controller
9. Switching of tasks using ARM controller
10. OS-I using ARM
11. OS-II using ARM
12. Coping the memory segment using 8086 Assembler
13. Sorting of numbers using 8086 Assembler
14. Multiplication & Division using 8086 Assembler
15. Shell programming -I
16. Shell programming -II
17. Shell programming -III

UEL102: MICROPROCESSOR ARCHITECTURE AND PROGRAMMING

Introduction and Historical Perspectives: Architecture basics, Complex Instruction Set Computers (CISC) and Reduced Instruction Set Computers (RISC) processors, Advantages and Drawbacks of CISC & RISC, Logical Similarity with example of a typical microprocessor, Short Chronology of Microprocessor Development with reference to CISC families such as INTEL, AMD and MOTOROLA, RISC families development of POWER PC, Alpha, Sparc. 1

Fundamental Architectures: Defining a Computer Architecture e.g. degree of pipelining, basic topology, technology used etc., Neumann and Haward Architectures, Single Processor Systems, Parallelism Implementation using pipelines and multiple units, Super-pipelining, Superscalar, Very Long Instruction Word (VLIW) architectures, Building multithreaded processors, Multiple Processor Systems - SIMD, MIMD and multi-computer approaches. 5

Implementation Considerations: Memory Hierarchy, pre-fetching techniques, coherent caches, pipelining, ternary logic, packaging considerations, wafer scale integration. 1
Implementation of Functional Units: Memory Management, Arithmetic Logic Unit, Floating Point Unit, Branch Unit, Vector Unit, Load/Store Unit. 5
Development Tools: Microcomputer Development Systems (MDS), In Circuit Emulator (ICE), Assembler, Editors, Logic Analyser 5
Case Study of INTEL X 86 families: Overview and Features in brief.
Tutorials: 5
1. Memory test problem. 5
2. Study of Z-80 microprocessor.
3. Study of Motorola Microprocessor family.
4. Coprocessor studies.
5. Cache memory and importance.

Reference Books:

1. Microprocessors and Interfacing, D.V. Hall, McGraw Hill (1986)
2. The Intel Microprocessors: Barry B. Brey, Prentice Hall Of India Ltd. (1997)
3. Microprocessors and Microcomputer Based Systems: M. Rafiqzzuman, Universal Book Stall (1990)
4. The Electronics Handbook Edited by Jerry C. Whitaker, Published by CRC, Press and IEEE Press (1996), Section VII: Microelectronics and Section XIX: Computer Systems

Semester III

ELC 204: INSTRUMENTATION & CONTROL THEORY

Introduction: Basic Concepts of measurements, calibrations and standards.
Transducers (Types and parameters) and Sensors: Displacement, strain, vibration, Pressure, Flow, Temperature, Force and Torque (linearity, accuracy, precision, bandwidth, repeatability) 4

Amplification: Simple ended, Differential and Instrumentation amplifier. 6
Sampling: An Anti-aliasing, Multiplexers, Sample and Hold, Track and Hold. 6
Computer Interfaces: Serial (RS-232), Parallel, GPIB (IEEE-488), Universal Serial Bus (USB) 4

Display Devices: Review of LED, LCD, CRT devices, segmental and dot matrix displays. 6

General purpose test equipments: CRO, Digital storage oscilloscope, Digital voltmeter, Wave Spectrum analysis, Lock-in-amplifiers, Pulse generators and waveform generators, Box-car averager. 2
Control System: Types of control system - open loop, closed loop, linear, non-linear, continuous, 8

discrete, time invariant, modes of linear systems, frequency and time response, sampled data system, open loop motor control, DC motor phase control.

1

Tutorials: 4

1. Study of Open loops control System.
2. Electronics Chocks.
3. Design of On/Off temperature controller using thermistor sensor.
4. Study of SEM.
5. Study of Scanning Probe technique.

Reference Books:

1. Industrial Control Electronics – John Webb, Kevin Greshok, Merrill Publications, 1990.
2. Elements of Electronic Instrumentation and Measurement, Joseph J. Carr, Prentice Hall India, (1996).
3. Modern Electronic Instrumentation and Measurement Techniques, Albert D. Helfnick, William D. Cooper, Prentice Hall of India, 1996.
4. Instrumentation Measurement by Northrop CRC 2001

ELC301: ELECTRONICS PRACTICALS – III

Hardware.

1. Design of S/C circuit for Strain gauge /Glucose strip @ 3.3V.
2. Design of S/C circuit for Thermistor sensor @ 3.3 V and interfacing with ARM.
3. Serial (Rs232) implementation with 89C52.
4. EO to OE Convector for Analog Signal.
5. EO to OE converter for PWM Signal.
6. Implementation of FIR BP using Xilinx XC3S400Cyclone II.
7. FFT using TMS 320.
8. Convolution using TMS 320.
9. Analysis of frequency components using Spectrum Analyzer

Software.

10. Simulink HPF & BPF Simulation
11. VHDL implementation for the Multiplexer & Demultiplexer
12. VHDL Implementation for Encoder & Decoder
13. VHDL implementation for the Counter.
14. Verilog implementation for the Memory Module.
15. Verilog implementation for the Latch.
16. Display Hello world and blinking Led's using NiosII soft core
17. Matrix Manipulation on NIOS II core (Multiplication, determinant, Inverse, Transpose)

ELD 201: SIGNAL AND SYSTEMS

Signal And Signal Processing: Characterization and classification of signal, Typical signal Operations. 4

Discrete time signal and Systems: Time Signal , Sequence representation, Sampling process, Simple Interconnection schemes, Correlation of Signal, Ramdom Signal. 6

Discrete Time Fourier Transform: Continuous Discrete-time FT, Energy Density Spectrum, Phase and Group Delays, Sampling of continuous tie signal, Low pass & Band pass Signal, Anti-Alising Filter design, Sample and Hold, A to D, D to A convertors, Effects of sample and hold. 1

2

Z- Tranform: Defination and properties, inverse Z-Tranform, The transfer function 5

Digital Filter Structure: Block diagram representation, FIR , IIR filter, Allpass filter, Tunable IIR Digital filter, Digital Sin-Cosine generator. Computational complexity. 7

FIR Digital Filter Design: Prelimnary considerations, FIR Design based on windowed FS, Design of minimum phase. 7

DSP Algorithm implementaion: Stucture simulation, Computation of DFT, DFT & IDFT using MATAB, Sliding DFT, Number represenation, Handling verflow, Tunable digital filters.

8

Application od Digital Signal Processing: Dual tone multifrequency tone signal Detection, Spectral analysis of sinusoidal Signal, nonstationary signal, random signal, Musical sound processing, Signal compression, Transmultiplexers. 6

Tutorials:

1. History of Fourier Transform.
2. Understanding Speech Spectral Analysis Problem.
3. Understanding FFT.
4. Study of TMS Series of processors.
5. MALAB program for generation of complex exponential sequence.

Reference books:

1. Sanjit K Mitra, Digital Signal Processing: A computer Based Approach
2. Discrete Time Signal Processing, Steven A. Tretter, Wiley(1976),
3. Digital Signal Processing, Johnny Johnson, PHI.
4. Digital Signal Processing, Prokis, PHI.
5. Boaz Porat, "A course in Digital signal Processing" First Edition, John Wiley & Sons 1996

ELD202: DIGITAL SIGNAL PROCESSING

Students have to design the following experiments in Matlab and Simulink and plot the characteristics of the signal processing system under design.

1. Filters 8
   a. Lp norm
   b. Ensemble averaging Filters
   c. Exponential moving average systems
   d. Median filter
   e. FIR
2. Demonstration of aliasing effect. 5
3. Oscillators 1
   a. Design using Van der Pol's equation 0
   b. Lorentz oscillators systems
   c. Gaussian oscillators systems
4. FFT
5. Image processing 5
   a. Interpolations 1
   b. Pattern recognition using PCA 5
6. Simulink

a. Transfer function design and study for impulse and finite sequence.
b. Convolution 10

ELD301: DIGITAL SYSTEMS DESIGNS WITH HDL

Introduction: About Digital Design, Analog versus Digital, Electronic Aspects of Digital Design, PLD's, ASIC, Digital Design level. 03

Digital Concept and Number System: General Positional number system conversions, Operation, BCD, Gray Code, Character Codes, Codes for Actions, Conditions, and States n-Cubes and Distance, Codes for Detecting and Correcting Errors, Error-Detecting Codes, Error-Correcting and Multiple-Error-Detecting Codes, Hamming Codes, CRC Codes, Two-Dimensional Codes, Checksum Codes, m-out-of-n Codes, Codes for Serial Data Transmission and Storage, Parallel and Serial Data, Serial Line Codes,

COMBINATIONAL LOGIC DESIGN PRINCIPLES: Switching Algebra, Combinational-Circuit Analysis, Combinational-Circuit Synthesis, and Timing Hazards. 12

HARDWARE DESCRIPTION LANGUAGES: HDL-Based Digital Design, ABEL Hardware Description Language, The VHDL Hardware Description Language, The Verilog Hardware Description Language, 05

COMBINATIONAL LOGIC DESIGN PRACTICES: Documentation Standards, Circuit Timing, Combinational PLDs , Decoders , Encoders , Three-State Devices , Multiplexers , Exclusive-OR Gates and Parity Circuits , Comparators , Adders, Subtractors, and ALUs , Combinational Multipliers . 06

SEQUENTIAL LOGIC DESIGN PRINCIPLES & PRACTICES: Bistable Elements, Latches and Flip-Flops, Clocked Synchronous State-Machine Analysis, Clocked Synchronous State-Machine Design, Designing State Machines Using State Diagrams, State-Machine Synthesis Using Transition Lists, Another State-Machine Design Example, Decomposing State Machines, Feedback Sequential-Circuit Analysis, Feedback Sequential-Circuit Design, ABEL Sequential-Circuit Design Features ,Sequential-Circuit Design with VHDL , Sequential-Circuit Design with Verilog, Sequential-Circuit Documentation Standards , Latches and Flip-Flops ,Sequential PLDs , Counters, Shift Registers, Iterative versus Sequential Circuits , Synchronous Design Methodology , Impediments to Synchronous Design , Synchronizer Failure and Metastability 08

MEMORY, CPLDS, AND FPGAS

Read-Only Memory, Read/Write Memory, Static RAM, Dynamic RAM, Complex Programmable Logic Devices, Field-Programmable Gate Arrays

Tutorials:

1. Design flow for the simple microprocessor in HDL 1
2. Study and compares types of RAMS. 2
3. Design of GRAY code circuit.
4. Study of ALTERA PLD's
5. Study of XYLINX PLD's.
6. Studying WEB Pack Xylynx tool. 06

Reference Books:

1. Digital Design Principles and Practices, by John F. Wakerly, Prentice Hall's Fourth Edition.
2. Digital Logic Applications & Designs by John M. Yarbough, CWS Publishing Co. Division of Thomson Learning,
3. Giovanni De Micheli, "Synthesis and Optimization of Digital Circuits," Tata McGraw-Hill, 2003.
4. Srinivas Devadas, Abhijit Ghosh, and Kurt Keutzer, "Logic Synthesis," McGraw-Hill, USA,

1994.
5. Neil Weste and K. Eshragian,"Principles of CMOS VLSI Design: A System Perspective,2nd edition, Pearson Education, 2000.
6. Kevin Skahill, "VHDL for Programmable Logic," Pearson Education, 2000.
M.N.O. Sadiku, Elements of Electromagnetics 2nd Edition) , Oxford University press, 1995.

ELD302: EDA TOOLS-II

Study of JTAG, Modelsim Syntax study.

1. Study of Phases of Quartus compilations.
2. Study of phases of ISE compilations
3. Testing logic using ChipScope-I.
4. Testing logic using ChipScope-II
5. Parrallel implementation of CRC.
6. Serial implementation of CRC.
7. FIFO implementation
8. pulse stretcher
9. Test bench using Modelsim-I
10. Test bench using Modelsim-I
11. Test bench using Modelsim-I
12. Test bench using Modelsim-I

Reference Books:

1. Design through Verilog HDL By T. R> Padmanabhan & Sundari. IEEE press, Wiley Interscience.
2. http://www.xilinx.com/itp/xilinx7/help/iseguide/html/ise_fpga_design_flow_overview.htm
3. http//www.altera.com/

UEL103: INDUSTRIAL TRAINING, MINI-PROJECT AND SEMINAR

Industrial training: A student has to undergo Industrial training equivalent to one credit for the period of minimum 1 month in the respective Electronics industries / Research Laboratory anywhere in India.
Mini-Project: A student has to carry out a mini-project equivalent to 2 credit in the areas of embedded system design.
Seminar: Each student has to present a power point presentation for total 20 minutes in the title suggested by DC equivalent to 1 credit. The participating students should participate in Q&A.

Semester IV

ELD401: ELECTRONICS PRACTICALS – IV

1. Reading from flash using DE2 board
2. LCD and 7 segment Interfacing using DE2 board
3. PS/2 Mouse Interface on DE2 board
4. UART Interface using DE2 board
5. Task switching LCD and 7 segments with uCOS.

6. RTOS-I with RTLINUX
7. RTOS-II with RTLINUX
8. Video processing on Altera DSP kit
9. Audio processing on Altera DSP kit
10. Multirate signal processing using Xilinx Spartan XC3S400
11. Echo implementation on Xilinx Spartan XC3S400
12. Obstacle detection for varying range using 89C52 based Robot
13. Line follower using 89C52 based Robot

ELD203: NANOELECTRONICS & NANOSYSTEMS

	5
Introduction: Development of microelectronics;	
Potentials of Silicon Technology; Basics of Nanoelectronics, some physical	6
fundamentals,basics ofinformation theory;	6
Biology Inspired Concepts.- Biological networks, Biology Inspired Concepts;	7
Bio-chemical and Quantum-Mechanical Computers.- DNA computer ,Quantum computer;	
Parallel Architectures for Nanosystems.- Architectural principles, Architectures for parallel	7
processing;	
Softcomputing and Nan electronics.- methods of soft computing, characteristics of neural	6
networks in nanoelectronics;	
Quantum Electronics; Bio and Molecular Electronics.- Bio electronics ,molecular electronics;	1
Nanoelectronics with Tunneling Devices;	0
Single Electron Transistor (SET); Nanoelectronics with Superconducting Devices;	5
The Limits of Integrated Electronics	3

Tutorials:
5. Laser tweezers.
6. Study of AFM.
7. Study of STM.

Reference Books:

1. NANOELECTRONICS AND NANOSYSTEM BY K. GOSER , P GLOSEKOTTER & J. DIENSTUHL SPRINGER
2. Introduction to Nanoelectronics Science, Nanotechnology, Engineering, and Applications By Vladimir V. Mitin etal ; From Cambridge
3. Handbook of Nanoscience, Engineering, and Technology, Second Edition by William A. Goddard CRC.

ELD303: LASER SYSTEM ENGINEERING

Wave Propagation: Wave Propagation in Isotropic and An-Isotropic media, Index Ellipsoid , Normal Index Surfaces, Half and Quarter wave Retardation Plates, Intensity transmission Using retardation plates, Circular Polarization.	7
Optical Resonators: Energies in resonator, Febry-Perot Etalon , Febry-Perot Etalon as Optical Spectrum Analyzer, Mode Stability Criteria , Resonance Frequency of Optical Resonator, Unstable Resonator.	9
Interaction of Radiation with Atomic System: Spontaneous transmission between Atomic layer, Homogenous and In-Homogeneous broadening , Line shape functions, Stimulated transmission , Absorption and amplification , gain saturation in Homogenous media .	8

Theory of Laser Oscillator: Febry Perot Laser , Three and Four Level Laser , Power in Laser Oscillator, Optimum Light coupling , Multimode Laser Oscillator and Mode Locking Methods of Mode locking , Pulse length Measurements , Q-Switching , methods of Q-Switching . 8

Laser Systems: Pumping and laser Efficiency, Ruby Laser, Flash Pumping ,Nd-YAG Laser , Nd-Glass Laser , Threshold for CW and Pulse operation , He-Ne Laser , CO2 Laser , Ar-Ion Laser , Excimer Laser , Dye Laser. 6

Non –Linear Optics: Origins of Non-Linear Polarization , relation between induced Polarization and Electric Field , Non – Linear Optical Coefficient , SHG , Phase Matching Experimental verification. 8

Interaction of Light and Sound: Scattering of Light by Sound, RamanNath and Bragg diffraction , Defration of light by Sound , Intensity modulation . 6

Optical Communication: Advances in optical Communication, Optical Network. 6

Tutorials:

1. Understanding Diffraction of Laser Light using grating
2. Comparison of resolving power of Prism and Grating.
3. Focusing of Laser Light.
4. Collimation of Laser Light.
5. Study of Raman Laser system.

Reference Books:

1. Optical Electronics, 4th Edition by A. Yariv, HRW publication, 1991.
2. OptoElectronbics , by Ghatak and Tyagarajan TMH Publication 1994.

ELD404: PROJECT

Student project of 200 marks of duration 6 months in the area of electronics hardware/software. Normally students are encouraged to undertake these projects in industrial/research organizations. In such case the student/batch of student will have one external guide and one internal guide

UEL104: PHARMACEUTICAL INSTRUMENTATION

Introduction to Chemical Instrumental Analysis, advantages over classical methods, classification, various units used in chemical analysis. Introduction to Electroanalytical methods, potentiometry, voltametry, coulometry. 5

Spectrometric Methods-I: A. Laws of Photometry, Instrument components, UV-visible instrument component, photocolorimeters, single and double beam instruments, various types of UV-visible spectrophotometers. 8

B. Atomic absorption spectrophotometer: Principle, working, hollow cathode lamp, atomizer, back-ground correction.

Spectrometric Methods-II: IR spectroscopy: Principle, IR sources, IR detectors, dispersive and Fourier , Transform IR spectroscopy. Atomic Emission Spectroscopy: Principle, types, Flame photometer, DC arc and AC arc excitation, plasma excitation. 8

Spectrometric Methods-III and Miscellaneous Instruments: Fluorimeters and Phosphorimeters: Principle, spectrofluorimeters, spectrophosporimeter, Raman effect, Raman spectrometer

Nuclear Magnetic Resonance (NMR) spectrometry: Chemical shift, principle, working of NMR, FT-NMR Gas analysers: CO, CO2, Hydrocarbons, O2, NOx 8

Separative Methods: Chromatography: Classification, Gas chromatography: principle, constructional details, GC detectors, High Performance Liquid Chromatography (HPLC): principle, constructional details, HPLC detectors 8

Radioactive instrumentation and Refractometry: X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer: Bragg's law, Auger emission spectroscopy, Electron spectroscopy for chemical analysis(ESCA). Radiation detectors: Ionisation chamber, Geiger-Muller counter, proportional counter, scintillation counters,
Refractometry: Principle, Abbe and Differential refractometer. 6

Electron microscopy:TEM & SEM- principles, instrumentation and analysis, scanning tunneling microscopy, atomic force microscopy, principles, instrumentation and analysis- applications 10

Tutorial:

1. Study of filter photometer.
2. Study of UV-visible spectrophotometer.
3. Study of ESR

Reference Books:

1. Instrumental Methods of Analysis, Willard, Merritt, Dean, Settle, CBS Publishers & Distributors, New Delhi, Seventh edition.
2. Instrumental Methods of Chemical Analysis, Galen W. Ewing, McGraw-Hill Book Company, Fifth edition
3. Introduction to Instrumental Analysis, Robert D. Braun, McGraw-Hill Book Company.
4. ***Principles of Instrumental Analysis, Skoog, Holler, Nieman, Thomsonbrooks-cole publications, 5th edition***

UEL105: COMMUNICATION TECHNICAL SKILLS

This will be self study module where students will be assigned case studies reading material in the areas of technical writing, Group discussion, Management & Communication Skills.
Here Students has to participate in the

- Group discussion in topic related to electronics (25%)
- Answer paper in the area of management and communication skills(25%)
- Has to write /compile technical papers & present (25%)
- Modeling of electronics systems (25%)

Reference Books

1. Essentials of Technical Communication Sunil Gokhale
2. Communication Skills By Leena, Sen, Prentice Hall of India.
3. http://owl.english.purdue.edu/;
4. http://owl.english.purdue.edu/workshops/hypertext/

Pre-Ph.D. Courses

ANNEXURE III

PAPER I: RESEARCH METHODOLOGY: EXPERIMENTAL

Methods of material Preparation: crystal growth, single crystal, zone melting, Epitaxy, compaction and sintering, methods of quenching, sol-gel process, deposition technique, chemical analysis.	8
Vacuum Technique: production and measurement of vacuum, Different types of vacuum systems and gauges, their working, limitation and leak Detection.	8
Methods of characterization: X-ray and neutron Diffraction, Raman, IR, Ultraviolet, Mossbauer Spectroscopy, Transport and Magnetic Measurement Techniques, NMR and ESR, Transmission Electron Microscopy, Differential Scanning Calorimetric etc. Principles and Applications.	8
Computer programming and Numerical Techniques: C/Fortran programming, error definition, Error propagation, Finite difference calculus, Interpolation and extrapolation, Roots of equations, solutions of simultaneous linear Algebraic equation, Linear and non linear least square curve fitting, Numerical differentiation and integration, Fourier transform techniques, numerical solutions of ordinary differential Equations, Matrix Eigen Value Problem, Monte Carlo and maximum entropy methods	30

References:

1. Numerical Receipes in fortan/C, W. Press, S.A.Teukolsky,W.T.Vetterling and B.P.Flannery, 2nd Edn., Cambridge University Press (1992).
2. Preparative method son solid state chemistry, P.Hagenmuller, Academic Press, London
3. Crystal growth, C.H.L.Goodman, Plenum press, New York
4. Elements of X-ray diffraction, B.D.Cullity, Addison-Wesley Publishing Co.Inc. London (1959)
5. Vaccum Technology ,A.Routh, North Holland, Amsterdam(1990)
6. Thin film phenomena, K.L.Chopra, Mcgraw- Hill, Newyork (1979)
7. Introduction to numerical analysis, F.B.Hilderband, 2nd, Tata Mcgraw-Hill Publishing co.ltd
8. Nuclear magnetic spectroscopy, R.M.Lynden-Bell and R.k.harries, nelson and sons ltd(1969)
9. Electron spin Resonance,C.P.Rolle, Interscience (1967)
10. Mossbauer effects: Principles and Applications, G.K.Wertheim, Academic press , London.

PAPER II-1: BOMEDICAL INSTRUMENTATION & MESUREMENTS

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION 8

Biometrics, Components of Man-Measurement system, Physiological system of body, problems encountered in measuring a living System, Basic transducer principle, Source of Bioelectric Potential, Skin contact Impedance, Electrodes: ECG, EEG, EMG, Microelectrodes

CARDIOVASCULAR MESUREMENTS. 6

Heart and cardiovascular system, characteristics of blood flow, Electrocardiography, measurement for Blood Pressure, Plethysmography.

NON-INVASIVE DIAGNOSTIC IMAGING 8

X-Ray, CT, MRI, fMRI, PET and SPECT, ULTRASOUND, Optical Tomography

BIOTELEMETRY 8

Introduction to Biotelemetry, Physiological parameters Adaptable to Biotelemetry, The components of Biotelemetry System, Implantable Units, Applications of telemetry in-Patient care.

INSTRUMENTATION FOR CLINICAL LABORATORY 7

The Blood, Test for Blood cells, chemical Tests, Automation of chemical Test

THE LASER APLLICATION IN BIOMEDICAL FIELD: 6

Pulse Ruby, ND-YAG, Helium-Neon, Argon, CO2 LASER.

NOISE REDUCTION TECHNIQUE IN ELECTRONICS SYSTEMS 1

Introduction, cabling, grounding, balancing and filtering, shielding, contact protection, Intrinsic Niose Source, Active device Noise, and Electrostatic discharge. 0

References:

2. Biomedical instrumentation and Measurements By Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer PHI (2^{nd} Edition)
3. Handbook of Biomedical instrumentation, R .S. Khandpur, Tata Mc GRAW Hill.
4. Noise reduction Technique in Electronic systems, By Henry W. Ott Wiley & sons (2^{nd} edition)
5. Biomedical Instrumentation by Cromwell-Prentice Hall of India, New Delhi
6. Foundation of Medical Imaging, By Z.H.Cho, J.P. Jones, M.singh, john and Wiley & sons

PAPER II-2: SYSTEM DESIGN USING ADVANCED MICROCONTROLLERS

- Architecture of 80C196 Family of Microcontrollers 6
- Programming of 80C196 Family of Microcontrollers 8
- Peripherals of 80C196 Family of Microcontrollers 6
- Architecture of ARM Family of Microcontrollers 1
- Programming of ARM Family of Microcontrollers 0
- Peripherals of ARM Family of Microcontrollers 8

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Device Platform implementation : Kiel and ARM based IDE Development Board & Windows based Wise-96 Software, ARM9TDMI boards and software development tools (Arm Developer Suite, ADS).

1
2

Programming Language: Assembly Language & 'C'

6

Reference

1. Microcontrollers: Architecture, Implementation, and Programming – Kenneth J Hintz, Daniel Tabak
2. Design with Microcontrollers – John B Peatman
3. Embedded Microcontrollers – Intel Hand Book

PAPER II-3: MODELING OF DIGITAL SYSTEMS USING HDL

Introduction to PLDs & FPGAs :ROMs, Logic array (PLA), Programmable array logic, GAL, bipolar PLA, NMOS PLA, PAL 14L4, Altera logic cell array (LCA) – I/O Block – Programmable interconnect – Xilinx – 3000 series and 4000 series FPGAs. Altera CPLDs altera FLEX 10K series PLDs, Cyclone , Startix. 1
0

Placement and routing : Mincut based placement – iterative improvement placement– Routing: Segmented channel routing – Maze routing – Routability and routing resources – Net delays. 1
0

Introduction to VHDL: Digital system design process – Hardware simulation – Levels of abstraction – VHDL requirements – Elements of VHDL – Top down design VHDL operators – Timing – Concurrency – Objects and classes – Signal assignments – Concurrent and sequential assignments. 1
2

Structural, Data flow & Behavioral description of hardware in VHDL :Parts library – Wiring of primitives – Wiring of iterative networks – Modeling a test bench – Top down wiring components – Subprograms. Multiplexing and data selection – State machine descriptions – Open collector gates – Three state bussing. - Process statement – Assertion statement – Sequential wait statements – Formatted ASCII I/O operations MSI based design.

1
2

Introduction to Verilog HDL :Lexical conventions – Data types – System tasks and Compiler Directives- Modules and Ports- Gate Level Modeling with Examples.

8

References Books:

1. P.K. Chan & S. Mourad, "Digital Design sing Field Programmable Gate Array" 1st Edition, Prentice Hall, 1994.
2. J. V. Old Field & R.C. Dorf, " Field Programmable Gate Array", John Wiley, 1995.
3. M. Bolton, " Digital System Design with Programmable Logic", Addison Wesley, 1990.
4. Thomas E. Dillinger, " VLSI Engineering", Prentice Hall, 1st Edition, 1998.
5. Douglas Perry, "VHDL", 3rd Edition, McGraw Hill 2001.
6. J. Bhasker, "VHDL", 3rd Edition, Addison Wesley, 1999.