## M. Sc. Electronics

### Electronic Devices (EL-101)

Course Objectives:

| | |
|---|---|
| *EL-101*.CO1 | To instill fundamentals of Semiconductors |
| *EL-101*.CO2 | To understand the physics of junction diodes and to learn to implement them in various applications |
| *EL-101*.CO3 | Learning different configurations of Bipolar junction Transistors and understanding the effect of various parameters on their performance. |
| *EL-101*.CO4 | To study the physics and construction of Field Effect transistors. |
| *EL-101*.CO5 | To study the modern day transistor technology involving MOS devices and explore their various applications. |

**UNIT 1** **( 7 Lec)**

**Physics of Semiconductors**

Introduction to semiconductors, Band Theory, Band formation, Crystal and Lattice structure, Kronning Penny model, E-K diagram, Density of states, Effective mass, Intrinsic and extrinsic semiconductor, direct and indirect band gap semiconductors, Carrier Transport phenomena, constituent equations of electron and hole transport.

**SCOPE: R & D positions in government and private organizations.**

**UNIT 2** **( 9 Lec)**

**Junction Diodes**

Introduction & construction of PN junction diode, Depletion region formation, junction capacitance, Diode characteristics, Junction breakdown mechanisms, special purpose diodes, metal-semiconductor contacts, Schottky effect, applications of diodes.

**SCOPE: Fabrication and Modeling positions in government and private organizations**

**UNIT 3** **( 10 Lec)**

**Bipolar Junction transistor and its applications**

BJT structure and operation, active mode –qualitative analysis, BJT configuration and small signal parameters, frequency response, Heterojunction BJT, Ebers-Moll model, Temperature effect: BJT width Modulation.

**SCOPE: Fabrication and Modeling positions in government and private organizations.**

**UNIT 4** **( 8 Lec)**

**Field effect Transistors: JFET & MESFET**

JFET structure and principle, JFET operation- qualitative analysis, Signal transfer, Gain, Small signal equivalent circuit, MESFET structure and its operational principle, applications.

**SCOPE: Fabrication and Modeling positions in government and private organizations**

**UNIT 5** **( 13 Lec)**

**Modern Day Transistor Technology: MOSFET, C-MOS & CCD, HEMT**

MOSFET structure, MOS capacitor band diagram-quantitative analysis, I-V characteristics, small signal equivalent circuit, C-MOS technology, CCD structure and its operational principle, CCD applications; HEMT structure, operational principle & application.

**SCOPE: Fabrication and Modeling positions in government and private organizations.**

Textbook/ Referencs


1. S M Zee, *Solid State Devices*, Wiley Publication
2. S M Zee, *Physics of Semiconductor Devices*, Wiley Publication
3. David A.Bell, *Electronic Devices and Circuits*, Prentice Hall of India, 4 th edition, 2003.
4. Jacob Millman, Christos C. Halkias, *Electronic Devices and Circuits*, Tata McGraw-Hill edition, 1991.
5. C Kittel, *Solid State Physics*, Wiley Publication
6. Robert. Boylestad, Louis Nashelsky, *Eelctron Devices and Circuit Theory*, Pearson Education, 9th edition, 2007.
7. Thomas L. Floyd, *Electronic Devices*, Pearson Education, 6 th Edition, 2002.
8. Albert Malvino, David J.Bates, *Electronic Principles*, Tata McGraw-Hill, 7th Edition, 2007.

## M. Sc. Electronics

### Signals and Systems (EL-103)

Course Objectives:

| | |
|---|---|
| *EL-103*.CO1 | To study various kinds of continuous and discrete signals and analogy of the two. |
| *EL-103*.CO2 | To learn fourier series and to imply it various problems |
| *EL-103*.CO3 | Understanding Z-transform and its applications |
| *EL-103*.CO4 | To realise continuous and discrete time systems |
| *EL-103*.CO5 | Learning to calculate probability and correlation of various random and distribution functions. |

**UNIT 1** **(12 Lec)**

Introduction to Signals and Systems**,** Description of continuous time and discrete time signals: Various type of signals, periodic and non-periodic signals. Operations on signals. Continuous time and discrete time convolutions. Linear Time Invariant systems. Stability of systems. Analogy between continuous time systems and discrete time systems

**SCOPE: Analog and Mixed Signal Design Engineer in government and private organizations.**

**UNIT 2** **(15 Lec)**

Fourier series (continuous & discrete) properties and its application, Continuous & Discrete time Fourier Transform, their properties & applications. Laplace Transform properties & its application.

**SCOPE: MRI System & Signal Processing Developer positions in government and private organizations.**

**UNIT 3** **(9 Lec)**

Sampling of continuous time signals, Z-transform and its application.

**SCOPE: Signal Integrity Engineer in government and private organizations.**

**UNIT 4** **(6 Lec)**

Realization of continuous time systems and discrete time systems.

**SCOPE: Radar Signal Processing Engineer in government and private organizations.**

**UNIT 5** **(11 Lec)**

Probability, Random Variable, cumulative distribution function. Probability distribution function, relation between probability and probability density. Joint cumulative distribution function. Average value of a random variable, error Function. Rayleigh Probability Density . Mean and variance of the sum of random variable. Probability density of Z=X+jY. Correlation between random variable, central-limit theorem. Random Process. Auto-correlation.

**SCOPE: Signal Integrity Engineer in government and private organizations.**

Textbook/ References


1. AV Oppenheim, A J Wilskey with S Hamid Nawab, " Signals and Systems" Prentice Hall of India
2. H Taub and D L Schilling, "Principles of Communication Systems" McGraw-Hill, New York
3. Edward W Kamen & Bonnie's Heck, "Fundamentals of Signals and Systems", Pearson Education, 2007
4. H P Hsu, Rakesh Ranjan" Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Indian Reprint, 2007.

## M. Sc. Electronics

### Computational method and computer programming (EL-202)

Course Objectives:

| | |
|---|---|
| *EL-202*.CO1 | To learn the fundamentals of C++ programming |
| *EL-202*.CO2 | To understand and implement interpolation and numerical differentiation using C++ |
| *EL-202*.CO3 | To study Numerical integration and integral equations through various methods |
| *EL-202*.CO4 | To understand the numerical solution of algebraic and transcendental equations and to perform curve fitting with the help of standard methods |
| *EL-202*.CO5 | To discuss the numerical solution of initial and boundary value problems |

**Unit 1** **(12 Lec)**

Programming Preliminaries, Features available in C++ over C, Concept of object oriented programming (OOP), Input/output statement, control statement , for loop, while loop, do-while loop, nested loops, continue and break statements, similar statements of C and C++, header files, differentiate with structured programming, arrays, functions, structures, use recursion and introduction to objects and classes.

**SCOPE: Software Developer and tester position in software industry.**

**UNIT 2** **(10 Lec)**

Review of Newton –Gregory, Guass Stirling, Laplace-everett and Bessel interpolation formulae; Aitkenand cubic spline interpolation, errors in interpolation, newton's divided difference and Lagrange interpolation formulae for unequal intervals, Inverse Interpolation using Lagrange's formula , Method of successive approximation, Double Interpolation; Numerical successive differentiation using forward, backward, central differenceInterpolation formulae and Newton's divided difference formula.

**SCOPE: Data Scientist and Production Technician positions in different organizations.**

**UNIT 3** **(8 Lec)**

General Quadrature formula, Review of Trapezoidal, Simpson's 1/3 and 3/8 rules; Numerica Integration using Boole and Weddle rules, Guass –Chebyshev, Radau, Guass-Legendre and Lobatto rules, errors in quadrature formulae, Romberg's Integration method using Trapezoidal and Simpson's 1/3 rules, Numerical double integration, Numerical solutions of Integral Equations using finite difference methods and Chebyshev series method.

**SCOPE: Analyst positions in different organizations**

**UNIT 4** **(15 Lec)**

Review of Regula-false position method, Newton-Raphson method, Ramanujan's method, Muller's method , Ferrari's method for polynomial equations in one variable, rate of convergence , error analysis of the methods, Newton- Raphson method for the solution of a system of non-linear equations, Guass-elimination and Guass- Jordan method using matrix approach, Guass-Seidal method fgor solution of a system of linear equations in 4 unknowns, curve fitting by the sum of exponentials using Moore's method.

**SCOPE: Data Scientist and Production Technician positions in different organizations**

**UNIT 5** **(10 Lec)**

Numerical solutions of a system of simultaneous ($1^{st}$ order) and higher order ordinary differential equations using Picard's method and Runge-Kutta $4^{th}$ order Method, Adams- Bashforth and Adams-Moulton methods, Solution of boundary value problems using finite difference method and cubic spline method, numerical solution od P.D.E using finite difference method, Jacobi and Guass-Seidal Methods, Crank- Nicholson and Bender-Schmidt methods.

**SCOPE: Data Scientist and Production Technician positions in different organizations**

**Textbooks and References:**


1. S. C. Chapra and R.P Canale: Numerical Methods for Engineers with Programming and Software Applications, $3^{rd}$ Edition, Tata McGraw Hill books Co., New Delhi-110001
2. M.K. Jain, S.R.K Iyengar & R.K. Jain: Numerical Methods for Scientific and Engineering Computation, $4^{th}$ Edition, New age International Publisher, Dariyaganj, New Delhi-110001
3. S.S.Sastry: Introductory Methods of Numerical Analysis, $4^{th}$ Edition, Prentice hall Of India, Jhilmil House, Patparganj, New Delhi.
2. J.H. Mathew and K.D.Fink : Numerical Methods Using MATLAB, $4^{th}$ edition 2009, Prentice Hall of India, New Delhi.
3. S. C. Chapra and R.P Canale: Numerical Methods for Engineers with Programming and Software Applications, $3^{rd}$ Edition, Tata McGraw Hill books Co., New Delhi-110001
4. M.K. Jain, S.R.K Iyengar & R.K. Jain: Numerical Methods for Scientific and Engineering Computation, $4^{th}$ Edition, New age International Publisher, Dariyaganj, New Delhi-110001
5. S.S.Sastry: Introductory Methods of Numerical Analysis, $4^{th}$ Edition, Prentice hall Of India, Jhilmil House, Patparganj, New Delhi.
6. J.H. Mathew and K.D.Fink : Numerical Methods Using MATLAB, $4^{th}$ edition 2009, Prentice Hall of India, New Delhi.

## M. Sc. Electronics

### Nanomaterials; Synthesis and Applications (EL-205)

Course Objectives:

| | |
|---|---|
| *EL-205*.CO1 | To instill fundamentals of nanomaterials and their classification. |
| *EL-205*.CO2 | To learn the synthesis of nanoparticles through chemical route. |
| *EL-205*.CO3 | To learn the synthesis of nanoparticles through physical deposition techniques. |
| *EL-205*.CO4 | To understand different types of lithography techniques and their applications. |
| *EL-205*.CO5 | To introduce to the nanocomposites and their applications |

**UNIT 1** **(12 Lec)**

Introduction to nanomaterials, Properties of material s and nanomaterials, role of size in nanomaterials , nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum well, conductivity and enhanced catalytic activity compared to the same material in the macroscopic state.

**SCOPE: R & D positions in different organizations**

**UNIT 2** **(10 Lec)**

Chemical Routes for Synthesis of Nanomaterials: Chemical precipitation and coprecipitation; metal nanocrystals by reduction, Sol-Gel Synthesis, Microemulusions or Reverse Micelles, Myle Formation; Solvothermal Synthesis; Thermolysis routes, Microwave heating Synthesis; Sonochemical Sysnthesis; Electrochemical Synthesis; Photochemical Synthesis; Synthesis in supercritical fluids.

**SCOPE: Material Scientist positions in different organizations**

**UNIT 3** **(12 Lec)**

Self Assembly and Catalysis: Process of self-assembly, Semiconductors islands, Monolayers, Nature of catalysis, Porous materials, Pillared clays, Colloids, Biometrics.

**SCOPE: Material and Chemical Scientist position in different organizations.**

**UNIT 4** **(12)**

Fabrication of nanomaterials by physical methods: Inert Gas Condensation, Arc Discharge, Plasma Arc Technique, RF plasma, MW Plasma, ION, sputtering, Laser ablation., Laser Pyrolysis, Ball Milling, Molecular Beam epitaxy, Chemical Vapour Deposition method and electro deposition.

**SCOPE: R & D positions in different organizations**

**UNIT 5** **(10 Lec)**

M based nanolithography and nanomanipulation, E beam lithography and SEM based lithography and nanomanipulation, ion beam lithography, oxidation and metallization, mask and its application. Deep UV lithogarpy, X-ray based lithography.

**SCOPE: Device Fab Engineer in different organizations**

**UNIT 6** **(8 Lec)**

Nanocomposites: an introduction: Types of nanocomposites (i.e., metal oxide, ceramic, glass and polymer based), core-shell structured nanocomposite, super hard nanocomposite: Synthesis, application and milestones.

**SCOPE: R & D positions in different organizations**

**Textbooks/References:**


1. Nanochemistry: A chemical approach to nano materials by G.A.OZIN, A.C. Aresnault, L. Cadematriri, RSC Publishing
2. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
3. Nanoparticales: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
4. Fabrication of fine pitch gratings by holography, electron beam lithography arnano-imprint lithography (proceedings paper) Authors(s); Darren Goodchild; Alex Bogdanov; Simon Wingar; Bill Benyon; Nak Kim; Frank Shephered.
5. A three beam approach to TEM preparation using in – situ low voltage argon ion FI milling in a FIBSEM.
6. Nanochemistry: A chemical approach to nanomaterials- royal society of chemistry Cambridge UK 2005.
7. Nanocomposite Science and Technologies – PM. Ajayan, L.S. Schadler,
8. PV Brawn, W New York.

## M. Sc. Electronics

### Embedded systems (EL- 206)

Course Objectives:

| | |
|---|---|
| *EL-206*.CO1 | To learn classification of embedded systems based on different parameters. |
| *EL-206*.CO2 | To study details of 8051 microprocessor and to learn assembly programs |
| *EL-206*.CO3 | Learning to program 8051 in C programming |
| *EL-206*.CO4 | To interface I/O devices with 8051 |
| *EL-206*.CO5 | To introduce with AVR microcontrollers |

**UNIT 1** **(10 Lec)**

Introduction to embedded systems: categories of embedded systems, overview of embedded systems architecture, Embedded systems vs. general computing systems, classification of embedded systems, Core of the embedded systems, Sensors and Actuators. Microcontroller programming and structure design, Factors to be considered in selecting a microcontroller, recent trends in embedded systems.

**SCOPE: Embedded Designer in different organizations**

**UNIT 2** **(15 Lec)**

Overview of 8051 microcontrollers. Designing with 8051, why 8051 microcontroller, programming with 8051 microcontrollers, 8051 assembly language programming: Inside the 8051, Introduction to 8051 assembly programming, the program counter and ROM space in the 8051, 8051 flag bits and the PSW register, 8051 register banks and Stack. Jump, loop and call instructions: Loop and Jump instructions, Call Instructions, Time delay for various 8051 chips. I/O programming: 8051 I/O programming, I/O bit manipulation programming.

**SCOPE: Embedded System Engineer in different organizations**

**UNIT 3** **(10 Lec)**

8051 Addressing modes: Immediate and register addressing modes, Bit addresses for I/O and RAM,
128 Byte on-chip RAM in 8052.Arithmetic, Logic instructions and programs: Arithmetic instructions, Logic and compare instructions, rotate instruction and data serialization.
8051 Programming in C:Data type and time delay in 8051 C, I/O programming in 8051 C,Logic operation in 8051 C.

**SCOPE: Embedded System Engineer in different organizations**

**UNIT 4** **(10Lec)**

Interfacing: LCD and Keyboard Interfacing, ADC, DAC, and Temperature Sensor Interfacing,

**SCOPE: Hardware Engineer in different organizations**

**UNIT 5** **(15 Lec)**

Embedded systems development environment: The Integrated development Environment(IDE),Introduction to AVR family of microcontrollers, Microcontroller, AVR CPU, system clock and clock option.

**SCOPE: Robotics and Embedded System Engineer in different organizations**

**Textbooks/References**


1. Muhammad Ali Mazidi, The 8051 Microcontroller and embedded systems, Pearson
2. Education 2nd edition, 2006
3. 2.Shibu K V, Introduction to Embedded systems, TMH education private limited.
4. Embedded C programming and the Atmel AVR,Barnett R,O Cull L,Cox S, Thomson Delmar learning,Canada.
5. Muhammad Ali Mazidi,SarmadNaimi, The AVR microcontroller and embedded systems using Assembly and C.Prentice -Hall of India 2011.

## M. Sc. Electronics

### Digital Signal Processing (EL-306)

Course Objectives:

| | |
|---|---|
| *EL-306*.CO1 | Understanding the details of DFT and its types. |
| *EL-306*.CO2 | Learning to design digital filters and their software implementation. |
| *EL-306*.CO3 | To study two dimensional signal processing and its application in filter designing. |
| *EL-306*.CO4 | To understand the finite word length effect and its effect on digital signal processing |
| *EL-306*.CO5 | To insist the details of multirate signal processing and different DS processors |

**UNIT 1** **(18 Lec)**

Frequency Domain Sampling: The Discrete Fourier Transform, Properties of the DFT, DFT as a linear Transformation, Relationship of DFT to other transforms, frequency analysis of signals using DFT, Computation of DFT and FFT algorithms.

**SCOPE: DSP Software Developer in different organizations**

**UNIT 2** **(12 Lec)**

Digital Filters:FIR and IIR filters, definition and design of digital filters, Implementation of discrete time systems, Structure for FIR and IIR systems, Software implementation.

**SCOPE: DSP Audio Engineer in different organizations**

**UNIT 3** **(10 Lec)**

Finite word length effects in digital filters Fixed point arithmetic, effect of quantization of the input data due to Finite word length, Product round off, need for scaling; Zero input limit cycle oscillations: Limit cycle oscillations due to overflow of adders, Table look up implementation to avoid multiplications.

**SCOPE: LTE Developer with DSP Physical Layer Engineer in different organizations**

**UNIT 4** **(8 Lec)**

Introduction of two dimensional signal properties and their operations, Convolution, Two dimensional Z-Transform, Two Dimensional DFT, Two dimensional windows, Two dimensional, FIR filter design

**SCOPE: DSP Software Developer in different organizations**

**UNIT 5** **(10 Lec)**

Multirate Digital Signal Processing: Decimation, Interpolation, Sampling rate conversion by a rational factor; Frequency domain characterization of Interpolator and Decimator; Polyphase decomposition;

Features of DSP processors - DSP processor packaging (Embodiments)- Fixed point v/s floating point DSP processor data paths - pipelining - TMS320 family of DSPs (architecture of C5x)- Memory architecture of a DSP processor (Von Neumann - Harvard) - Addressing modes.

**SCOPE: DSP Programmer in different organizations**

**Textbooks/References**


1. John G Proakis and Dimitris C Manolakis, Digital Signal Processing Principles,Algorithms and Applications, Pearson Education, 3rd Edition, 2006
2. Sanjit K Mitra, Digital Signal Processing - A Computer based approach, Tata McGrawHill, New Delhi, 2001
3. Oppenheim & Schafer, Digital Signal Processing, PHI (latest edition).
2. Alan V Oppenheim, Applications of Digital Signal Processing, Prentice hall Inc.,Englewood Cliffs, New Jersy (1978).

## M. Sc. Electronics

### VLSI Circuit Design and Device Modeling (EL-401)

Course Objectives:

| | |
|---|---|
| *EL-401*.CO1 | To insist the basics of MOS transistor and to implement various gates using it. |
| *EL-401*.CO2 | To study basic MOS circuits and major limitation to their performance |
| *EL-401*.CO3 | To learn the characteristics of MOS inverters and their different designs |
| *EL-401*.CO4 | Learning the fabrication of MOS transistors |
| *EL-401*.CO5 | To learn VHDL and to use it to model different circuits |

**UNIT 1** **(10 Lec)**

Introduction to IC technology, MOS and related VLSI technology, Basic MOS transistors – Enhancement and Depletion mode, n MOS fabrication process, CMOS fabrication – n-well, p-well and twin tub process, Latch up in CMOS, MOS transistor as switch, CMOS inverter, 2 input CMOS NAND and NOR gates, Complementary CMOS logic design – Pull Up Networks (PUN) and Pull Down Networks (PDN), Implementation of an arbitrary function using complementary logic.

**SCOPE: Digital Design and Layout design Engineer in different organizations**

**UNIT 2** **(15 Lec)**

Basic MOS Circuits: I – V relationship, , The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current Voltage Characteristics: Gradual Channel approximation Channel length modulation. MOSFET Scaling and Small-Geometry Effects: Full Scaling (Constant Field Scaling), Constant-Voltage Scaling, Short-Channel effect, Narrow-Channel effect. MOSFET Capacitances: Oxide related capacitances, junction capacitances.

**SCOPE: Physical Design Engineer in different organizations**

**UNIT 3** **(10 Lec)**

MOS Inverter Static characteristics: Voltage transfer characteristics (VTC), Resister load inverter, Power consumption and chip area,Inverter with n-type MOSFET load, CMOS inverter, Design of CMOS Inverters, Supply voltage scaling in CMOS inverters

**SCOPE: FGPA (Field Programmable Gate Array) Engineer in different organizations**

**UNIT 4** **(10 Lec)**

Crystal growth, crystal structure, crystal defects, raw materials and purification, electronic grade silicon, Czochralski crystal growth methods, Wafer preparation and specifications, Basic concepts, manufacturing methods and equipment, Measurement methods. Photolithography, Light sources, Photo resists, Wet and Dry oxidation, growth kinetics, Diffusion, Ion implantation, epitaxial growth, deposition of dielectrics and metals commonly used in VLSI, Wet etching, Plasma etching, Etching of materials used in VLSI, Contacts.

**SCOPE: Semiconductor Fab Scientist in different organizations**

**UNIT 5** **(15 Lec)**

Introduction to Verilog HDL, hierarchical modeling concepts, Lexical conventions, data types, system tasks and compiler directives, modulus and ports, variable, arrays, tables, operators, expressions, signal assignments, nets, registers, concurrent & sequential constructs, tasks & functions

Gate-level, Dataflow and behavioral modeling using Verilog HDL, , switch level modeling.

**SCOPE: RTL Design/Verilog Engineer in different organizations**

**Textbooks/References**


1. D. S. Pucknell & K. Esharghian, Basic VLSI Design, Third Edition, Prentice Hall, 2000.
2. Neil H. E. Weste & Kamram Eshraghian, Principles of CMOS VLSI Design, 2/e, Pearson Education.
3. S. M. Kang & Y. Leblebigi, CMOS Digital Integrated Circuits - Analysis and Design, 2/e,McGraw Hill.
4. Samir Palnitkar , Verilog HDL -A guide to Digital Design and Synthesis,SunSoft Press 1996.
5. Ming-Bo Lin, Introduction to VLSI Systems-A Logic, Circuit, and System Perspective, CRC Press.