University of Pune

Department of Electronic Science

Syllabus for M.Sc. Electronic Science (Part I)
(Credit System)
Revised 2012

Instructions

- **The M.Sc. course is divided into four semesters and students are to complete 100 credits in four semesters.**

- **Courses worth 30 credits have to be completed during each of the first three semesters. During Fourth semester a Project/ Internship worth 10 credits is to be completed.**

- **Courses worth 75 credits are to be completed from the credits offered by the Electronic Science Department**

- **Remaining 25 credits can be earned either by opting for equivalent credits from those offered by the Electronic Science Department or from credits offered by other departments of the University (subject to approval by departmental teaching committee)**

- **Each theory and practical course is equivalent to credits mentioned in front of them**

- **Project is equivalent to 10 credits.**

- **The grades for courses will be based on 50 : 50 ratio of Continuous Internal Assessment (CIA) and Semester End Examination (SEE)**

Course structure :

Sem I, II and III students should complete 90 credits + Sem IV Project / Internship 10 credits with distribution as follows

Sem I	**Common Courses**	**Credits**
EL – 103	Semiconductor devices and circuit design	4
EL – 104	Mathematical Methods in Electronics and Network Analysis	4
EL – 105	Foundation of Nano Electronics	4
EL – 109	Problem solving	2
EL – 110	Seminar	2
EL - 101	Lab 1 (General Electronics)	4
EL - 102	Lab 2 (Computer Programming)	4
		24
	Elective Courses (minimum 6 Credits)	6
		30
Sem II	**Common Courses**	
EL – 203	Electromagnetics, Microwave and Antenna	4
EL – 204	Digital Electronics and Microprocessors	4
EL – 205	IC Technology and CAD VLSI Tools	4
EL – 209	Problem Solving	2
EL – 210	Seminar	2
EL – 201	Lab 3 (Electronics Systems)	4
EL – 202	Lab 4 (Software Tools)	4
		24
	Elective Courses (minimum 6 Credits)	6
		30

Sem III	**Common Courses**	
EL -303	Communication	4
EL – 304	Embedded system design	4
EL – 305	Foundation Course in IPR	2
	Special Electives (<u>Any two</u> courses + Corresponding Lab)	
EL – 301	Lab5 (Special Electives Lab1)	4
EL – 302	Lab6 (Special Electives Lab2)	4
	EL -301/2 Special Elective Lab 0ptions	
	A RTOS B Wireless embedded C Advanced VLSI Design D IC Layout Design E Mobile and Data Communication Systems F MEMs Design	
EL – 311	RTOS	4
EL – 312	Wireless embedded	4
EL – 313	Advanced VLSI Design	4
EL – 314	Foundation Course in IC Layout Design	4
EL – 315	Mobile and Data Communication Systems	4
EL – 316	MEMs Design	4
		26
	Elective Courses (minimum 4 Credits)	4
		30
Sem IV	**Common Course**	
EL – 401	Internship/ Project	10
		===
		100

	General Electives	Credits
EL – E01	Technical Communication	2
EL – E02	Electronic Instrument Design	2
EL – E03	C programming	2
EL – E04	Transducers and Measuring Instruments	2
EL – E05	Power supplies	2
EL – E06	Computational Methods in Electronics	2
EL – E07	Industrial applications of Opto electronics	2
EL – E08	Fundamentals of Image processing	2
EL – E09	VHDL/Verilog testing and verification	2
EL – E10	C++ Programming	2
EL – E11	Theory of Industrial process control	2
EL – E12	Power electronic devices and Systems	2
EL – E13	Processes in device fabrication	2
EL – E14	Physics of semiconductor Devices	2
EL – E15	Properties of Electronic Materials	2
EL – E16	Mechatronics	2
EL – E17	Semiconductor foundry techniques	2
EL – E18	Optical Fiber Communication	2
EL – E19	Analytical Instruments	2
EL – E20	Processor Architecture & Design	2
EL – E21	DSP Systems: Processors & Applications	2
EL – E22	Analog RF Circuit Design	2
EL – E23	Foundation Course in Design IPR Management	2

Semester I

EL – 103	Semiconductor devices and circuit design	4
EL – 104	Mathematical Methods and Network Analysis	4
EL – 105	Foundation of Nano Electronics	4
EL – 109	Problem solving	2
EL – 110	Seminar	2
EL - 101	Lab 1 (General Electronics)	4
EL - 102	Lab 2 (Computer Programming)	4
		24
	Elective Courses (minimum 6 Credits)	6
		30

Electives

EL – E01	Technical Communication	2
EL – E02	Electronic Instrument Design	2
EL – E03	C programming	2
EL – E04	Transducers and Measuring Instruments	2
EL – E05	Power supplies	2
EL – E06	Computational Methods in Electronics	2
EL – E07	Industrial applications of Opto electronics	2
EL – E08	Fundamentals of Image processing	2

EL – 101 Practical I — Credits 4

Experiments covering following aspects:
Basic semiconductor material characterization
Electronic Device characterization
Basic Circuit Design
Circuit Design with Linear ICs
Familiarization with Test and Measuring instruments
Experimental techniques & observations
Documentation standards

EL – 102 Practical II — Credits 4

Programs/experiments covering following aspects:
C language familiarization and basics of C++
Numerical algorithms and Program logic development
String handling and File handling
Computer Graphics
Software testing and validation procedures
Documentation standards

EL – 103 Semiconductor Devices and Circuit Design — Credits 4

PN Junction, Diode equation and diode equivalent circuit, Breakdown in diodes, Operation and IV characteristics and applications of Rectifying diodes, Zener diodes, Tunnel Diodes, varactor diodes. BJT construction, pnp and npn, operation, input and out and transfer characteristics of CE,CC and CB configurations, equivalent circuits, Biasing of Bipolar junction transistors, Q point, Single stage amplifiers, Multistage amplifiers and their operational characteristics, frequency response, equivalent circuits. Feedback in amplifiers, amplifier oscillators, function generators, multivibrators Circuit design and analysis using PSPICE- Schematics attributes and types of analysis of PSPICE

JFET, n-type and p-type, operation and applications, input and out and transfer characteristics, Construction and operation of MOS capacitor, n-channel and p-channel MOSFETs, input, output and transfer characteristics, small signal circuit analysis. Information of commercially available semiconductor devices and their specifications. Amplifiers frequency response, equivalent circuits, Inverter, current sources, current mirrors.

Operational Amplifiers (OpAmp): Characteristics - gain, input impedance, output impedance, CMRR, bandwidth etc. Applications: Inverting and non-Inverting amplifier, Computational Applications, Integrator, Differentiator, Wave-shaping circuits, F to V and V to F converters. Active filters, Schmitt trigger, Phase locked loop.

Introduction to Fabrication of Semiconductor devices and Integrated Circuits

Text/Reference Books:

1. Electronic Circuit analysis and design: D.A.Neaman, McGraw Hill
2. Analog Circuit Design: Cedra and Smith
3. Microelectronic Circuits Analysis and Design: Rashid, PWS pub.
4. Electronic Devices and circuit theory: R.L Boylestad and L.Nashelsky,Pearson
5. Analysis and Design of Analog Integrated Circuits: Grey and Mayer
6. Operational Amplifiers: G.B.Clayton

EL – 104 Mathematical Methods in Electronics and Network Analysis Credits 4

Differential equations and their solutions, Bessel functions of first and second kind, utility in antenna design.

Discrete Time Signals: Sequences; representation of signals on orthogonal basis; Sampling and Reconstruction of signals; Discrete systems: attributes, Z-Transform, Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Implementation of Discrete Time Systems. Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters.

Superposition, Thevenin, Norton and maximum Power Transfer Theorems. Network elements, Network graphs, Nodal and Mesh analysis, Zero and Poles, Bode Plots, Laplace transforms. Time and frequency domain responses. Image impedance and passive filters. Two-port Network Parameters. Transfer functions, Signal representation. State variable method of circuit analysis. AC circuit analysis, Transient analysis

Text / Reference Books:

1. Mathematical methods for Physics: Arfken, A.G. Academic Press.
2. Digital Signal Processing: Sanjit Mitra
3. Mathematical methods for physicists and Engineers: M.A. Boas
4. Network Analysis: Von Valkenberg

EL – 105 Foundation of Nano Electronics Credits 4

Region of nanostructures, scaling of devices in silicon technology, estimation of technology limits, Uncertainty principle, Experiments on duality, Schrodinger's equation and its applications to square well potential, square potential barrier (1D).

Infinite array of potential wells, Barrier penetration, applications to tunnel diode, Josephson effect, Perturbation theory and its applications, Scattering. Binomial and related distributions, Phase space, Statistical ensembles, applications of classical statistical mechanics, Quantum statistics, Brownian motion, Random walk problem. Concept of Chemical potential, partition function and its applications in computing thermodynamic quantities.

Quantum electronic devices, electrons in mesoscopic structures, short channel MOSFET, split-gate transistor, electron wave transistor, electron spin transistor, quantum cellular automata, Bioelectronics, molecular processor, DNA analyzer as biochip, Molecular electronics, Fullerenes, nanotubes, switches based on Fullerenes and nanotubes , Nanoelectronics with tunneling devices, resonant tunneling diode(RTD), three terminal RTDS, RTD based memory, basic logic gates and dynamic logic gates,

Principle of single electron transistor, Coulomb blockade.

Text / Reference Books:

1.Nanoelectronics and Nanosystems: K.Goser, P. Glosekotter, J. Dienstuhl, Springer (2005).
2.Quantum Mechanics: Schiff L.I.
3. Fundamentals of Statistical Mechanics and Thermal Physics: Reif

EL – 109 Problem solving Credits 2

This course is based on practical problem solving exercises to be carried out in class. The problems will be based on applications of the concepts covered in other courses in the semester.

EL – 110 Seminar Credits 2

This course is intended for developing information collection, classification, compilation, and comprehension and communication skills. Each student is expected to prepare and deliver minimum 4 seminars during the semester on a chosen topic related to Transducers, test, measuring and analytical instruments and submit a report on the same.

EL – E01 Technical Communication Credits 2

English as a Second Language (ESL).Functional Grammar. Sentence clarity, sentence fragments, independent and dependent clauses, dangling modifiers, sentence punctuation patterns, subject/verb agreement. Transitions and transitional devices.

Technical Reading and Information grasping : Evaluating sources of information, resources for documenting sources in the disciplines, searching the world wide web. Documenting electronic sources. Making sense out of technical documents: research papers, technical reports, manuals, etc.

The Writing Process. Creating a thesis statement, developing an outline, pre-writing, refinement. Proofreading your writing; parallels in proofreading and debugging. Starting the writing process. Academic, Technical, and Scientific Writing. Adding emphasis in writing. Annotated bibliographies. Avoiding plagiarism. Conciseness and clarity. Establishing arguments. Logic in argumentative writing. Paragraphs and paragraphing. Quoting, paraphrasing, and summarizing. Sentence variety. Starting the writing process. The rhetorical situation. Transitions and transitional devices. Using appropriate language.

Writing a research paper, avoiding plagiarism, documenting electronic sources, quoting, paraphrasing, and summarizing. Effective workplace writing: accentuating the positives, prioritizing your concerns for effective business writing. memo writing, email etiquette, revision in business writing, tone in business writing, model letters for various purposes. Parallel structure in professional writing. Writing a white paper/technical report. Writing report abstracts. Manuals and documentation

Job Search Writing. Action verbs to describe skills, jobs, and accomplishments in employment documents. Accentuating the positives. Prioritizing your concerns for effective job search writing. Audience analysis: tailoring employment documents for a specific audience. Resume design: introduction to resumes, resume structure, when to use two pages or more, scannable resumes. Cover letters: quick tips, preparing to write a cover letter, writing your cover letter.Academic and business cover letters. Writing a job acceptance letter. Writing the curriculum vitae. Writing the personal statement/statement of purpose. Appearing for an interview.

Making Effective Presentations. Audience analysis. Presentation slides and their cognitive impact. Anticipating questions from audience. Handling questions from audience.

Text / Reference Books:

1.The Online Writing Labs (OWL) family of websites http://owl.english.purdue.edu/;
2. Specifically, http://owl.english.purdue.edu/workshops/hypertext/
3. Essentials of Technical Communication Sunil Gokhale

EL – E02 Electronic Instrument Design Credits 2

Development cycle of an Electronic Instrument – System engineering, architecting, concept development, documentation, teamwork, design development, validation, verification and integration, Rapid prototyping, Field testing, failure, iteration and judgment.

Circuit design, Circuit lay-out, power supplies, power distribution, Cooling – heat transfer, thermal management, cooling choices-heat sinks, heat pipes and thermal pillows, fans and forced air cooling, liquid cooling, evaporation and refrigeration, Tradeoffs in design. Instrument-human interface, user centered design, ergonomics, utility, principles of appropriate operation. Packaging and enclosures-design for manufacturing, assembly and disassembly, Wiring, temperature, vibration and shock, rugged systems. Grounding and shielding design, safety and noise. Integration, production and logistics.

Text / Reference Books:

1. Electronic Instrument Design: H.R. Fowler, Oxford
2. Principles of Instruments and systems: R.G. Gupta, TMH
3. Industrial Electronics: T.E. Kissell, PHI
4. Instrument Engineer's Handbook–Process Control: B.G. Liptak

EL – E03 C programming Credits 2

Introduction of High-level Programming Language, Revision of C fundamentals.

Pointers: fundamentals, pointer declarations, passing a pointer to a function, pointers and one dimensional arrays, operations on pointers, pointers and multidimensional arrays, arrays of pointers. Advanced pointer, Pointer to structures, pointer to functions, Command line argument, Symbol tables: Hashing techniques terminology and implementation Pointers in C, Handling characters and Arrays in C, Structure and union, User defined function,

Functions: Defining a function, accessing a function, passing arguments to a function. Graphics-video modes, video adapters, Drawing various objects on screen. Interfacing to external hardware via serial/parallel port using C, Applying C to electronic circuit problems. File (I/O): File operations-open and close a data file, creating a data file, processing a data file.

Data Structures: Multidimensional arrays definition implementation multidimensional arrays in control loops, pointers to multidimensional arrays. Stacks and queues array implementation: Definition of stacks and queues, Terminology, implementation using arrays, Link Lists, stacks and queues, Implementation of stacks and queues.

Text/Reference Books:

1. Let Us C: Yashwant Kanetkar, BPB Publication
2. Understanding pointers in C: Yashwant Kanetkar, BPB Publication
3. The C Language Programming: Kernighan and Ritchie, Prentice Hall
4. Data structures using C and C++: Yedidyah Langsam, Moshe Augenstein, Aaron Tenenbaum, PH

EL – E04 Transducers and Measuring Instruments Credits 2

Transducer types-Resistance, Inductance, Capacitance, Peizoelectric, Thermoelectric, Hall effect, Photoelectric, Tachogenerators, Measurement of displacement, velocity, acceleration, force, torque, strain, speed and sound temperature, pressure, flow, humidity, thickness, pH, position.

Introduction to Electronic Instrumentation and Measurements: Significant figures, scientific notation, units and physical constants, decibel, statistical data analysis (Average, variance etc), Factors in making the measurements- accuracy, precision, resolution, repeatability, reproducibility, hysteresis, sensitivity, range etc., Errors in measurement- theoretical, static, dynamic, instrument insertion.

Test and measuring instruments: Measurement of R, L and C, (Bridge and Potentiometers), voltage, current, power, energy, frequency/time, phase. Principle of operation, Block diagram and description, Specifications, Controls and use of the following instruments: DVMs, DMMs, Signal Generators - AF, function, RF, pulse, arbitrary waveform, Cathode Ray Oscilloscope (Analog, Digital), Digital Storage Oscilloscopes,

Text / Reference Books:

1. Sensors & Transducers: Patranabis
2. Measurement Systems (Application & Design): E.D.Doebelin
3. Transducers & Instrumentation: Rangan Mani Sharma
4. Silicon Sensors: Middlehock
5. T&M Instrument Catalogs and application notes of Agilent, Techtronis, Keithley, and L.G.Electronics etc
6. Elements of Electronic Instrumentation and Measurements: J. J. Carr, Pearson

EL – E05 Power supplies Credits 2

Power supply Basic block diagram and design considerations, Power Transformer, Rectifier, Filter and Voltage regulator, Information on commercially available power supplies.

Constant Voltage (CV) Power supplies: Building blocks, Design, characterization. Zener regulator, emitter follower regulator, series regulator, shunt regulator, current limiting techniques, Switching mode regulator. Constant Current (CC) and CV/CC Power supplies: Building blocks, Design, characterization. CC sources – using discrete transistor, monolithic transistors, controlled sources, Series regulator type CC supply, Guarded CC supply, Adjustable VL CC supply, Typical CV/CC supply

Power supplies using ICs: General purpose regulators, precision regulators, fixed voltage regulators, Switch mode regulators. Protection techniques: Protection against transients, RFI suppression, current limiting, voltage limiting,

Heat Sinks: Effect of temperature on leakage current, current gain and power dissipation of active devices, thermal runaway, operation with and without heat silks, heat sink ratings, capabilities, practical considerations and mounting, heat sinks for ICs.

Text / Reference Books:

1. Simplified design of linear Power supplies: John D. Lenk, Butterworth-Heinemann
2. Simplified design of switching power supplies: John D. Lenk, Butterworth-Heinemann
3. Regulated power supplies Irving M Gottlieb, TAB books
4. Practical Design of Power Supplies: Ron Lenk, IEEE press +McGraw hill
5. Electric Power Transformer Engineering: James H. Harlow, CRC Press

EL – E06 Computational Methods in Electronics Credits 2

Numerical methods for solution of simultaneous equations, LU factorization, Pivotal condensation and Gauss -Jordan methods of matrix inversion, applications in network analysis.

Iterative algorithms, solving equations and finding roots, practical considerations of convergence rate and accuracy. Probability, curve fitting and error analysis.

Numerical methods for solution of differential, partial differential and integral equations, Euler's method, Runge-Kutta method, cubic spline method, numerical integration, differentiation and interpolation, Simpson's 1/3 rule, Gauss quadrature formula, Euler Maclaurine formula, Finite difference and finite element methods, applications

Text / Reference Books:

1. Numerical Recipes: W.H. Press, B.P. Flannery, S.A. Teukosky, W.T. Vettering, Cambridge Univ. Press
2. Computer oriented numerical methods: V. Rajaraman
3. Applied parallel computing: J. J. Dongarra, Jerzy Waśniewski, Kaj. Madsen

EL – E07 Industrial applications of Opto electronics Credits 2

Revision of basics of reflection, refraction, transmission and absorption of light radiation, Ray-tracing through lenses, convex, concave and plane mirrors, prisms etc. Refractive index, total internal reflection.

Lamps and illumination systems, LEDs – working principle and applications, LED lighting, Display devices, indicators, numeric, alphanumeric and special function displays, Liquid Crystal Display elements, Plasma Displays, Multimedia projectors.

Gas and solid state LASERs, pulsed lasers, industrial applications of low power lasers. Alignment, Pointing, tracking and particle Size detection Instruments. Laser Level. Wire Diameter Sensor. Laser Doppler Velocimetry-Principle of Operation. Performance Parameters. Electronic Processing of the Doppler Signal.

Photodetectors types and applications, Optocouplers, Optointerruptors, LASCR. used in safety interlocks, power isolators, rotary and linear encoders and remote control. Intrinsic and Extrinsic Fiber optic sensors. Digital camera and automatic inspection systems.

Introduction to Optical computing and holography.

Text / Reference Books:

1. Optical Engineering Fundamentals B.H. Walker, PHI
2. Industrial Electronics T.E. Kissell, PHI
3. Electro-Optical Instrumentation Sensing and Measuring with Lasers: Silvano Donati, Pearson
4. Fiber optics and Optoelectronics: R.P. Khare, Oxford Press.

EL – E08 Fundamentals of Image processing Credits 2

Image acquisition, Image representations, Image digitalization, Sampling, Quantization, Histograms, Image Quality, Noise in Images

Basic operations on images, Image Enhancement, Pixel intensity transformations, Histogram equalization and matching, noise removal, Edge sharpening, Spatial Filtering, Convolution, Image smoothing , Morphological operations.

Image processing applications, Machine Vision, Blob analysis, Metrology, Feature extraction, Pattern Matching, Biometrics etc

Text / Reference Books:

1. Digital Image Processing Rafael C. Gonzalez , Richard E. Woods, Prentice Hall
2. Fundamentals of Digital Image Processing, A.K. Jain, Prentice Hall

Semester II

EL – 203	Electromagnetics, Microwave and Antenna	4
EL – 204	Digital Electronics and Microprocessors	4
EL – 205	IC Technology and CAD VLSI Tools	4
EL – 209	Problem Solving	2
EL – 210	Seminar	2
EL – 201	Lab 3 (Electronics Systems)	4
EL – 202	Lab 4 (Software Tools)	4
		24
	Elective Courses (minimum 6 Credits)	6
		30

Electives

EL – E09	VHDL/Verilog testing and verification	2
EL – E10	C++ Programming	2
EL – E11	Theory of Industrial process control	2
EL – E12	Power electronic devices and Systems	2
EL – E13	Processes in device fabrication	2
EL – E14	Physics of semiconductor Devices	2
EL – E15	Properties of Electronic Materials	2
EL – E16	Mechatronics	2

EL – 201 Practical III: Electronic Systems Lab Credits 4

Experiments covering following aspects
Sensing Principles and signal conditioning
Power Electronics
Optoelectronics
Digital Electronics
Circuits and systems design
Product development
Manufacturability, reliability and cost effectiveness

EL – 202 Practical IV: Software Tools Lab Credits 4

Experiments covering following aspects
Sequential circuits and Finite State Machines
Circuit simulation using **Pspice**
Digital circuit Simulations using **Xilinx** tools
Labview and Virtual Instrumentation tools
Software system analysis and design using **Matlab**
User interface and graphics
Familiarization with contemporary tools

EL – 203 Electromagnetics, Microwave and Antenna Credits 4

Vectors and Vector identities, Co-variant and Cotra-variant vectors

Maxwell's equations, correspondence of field and circuit equations, wave equation, Poynting vector theorem,, characteristic impedance and admitance, lossless and lossy Transmission lines, standing wave and standing wave ratio, impedance matching techniques like $\lambda/4$ transformer, single and double stubs use of Smith's chart. Skin depth, Wave reflection from interfaces.

Waveguides, propagation modes, dielectric waveguides and optical fibers. S-matrix, Magic 'T' microwave couplers, directional couplers, circulators and isolators, Klystron and Magnetron. Solid State Microwave devices; Basic Theory of Gunn, GaAs FET, Crystal Defector and PIN diode for detection of microwaves.

Short dipole antennas, antenna arrays, field pattern and radiation resistance in various cases, radar equation, Antenna types and parameters for isotropic, dipole, broadside and end fire arrays, Yagi-Uda, log periodic and rhombic antenna, microwave antennas, microstripline, slot antennas, parabolic reflector, Antenna design programs.
Concept of Synthetic aperture antenna.

Text / Reference Books:

1. Electromagnetics: J.D. Kraus, McGraw Hill.
2. Microwave devices and circuits: S.Y. Liao, Prentice Hall.

EL – 204 Digital Electronics and Microprocessors Credits 4

Logic families: Bipolar Logic Families (TTL + ECL), MOS logic families (NMOS and CMOS), and their characteristics. Gates, Boolean algebra and minimization techniques, Introduction to combinational circuit: Realization of basic combinational functions like comparison, code conversion, decoding, multiplexing, demultiplexing,. Arithmetic circuits, adder, subtraction, look ahead carry, binary multiplication and division, floating and fixed point arithmetic, ALU design. Delays and hazards in combinational circuits..

Introduction to sequential circuits. Flip-flops: different types, excitation table, timing, concepts of skew, meta stability etc Flip-flops, Multivibrators and clock circuits, Counters-Ring, Ripple, Synchronous, Asynchronous, Up and down shift registers, Finite state machines, Control Unit design Digital System design concepts, approaches, programmable logic devices PLAs ,PALs, CPLD, FPGA Architectures. PLD based System design applications like Washing machine, Wending machine, traffic lights etc, Memories, A/D and D/A converters

Basic concepts of Microprocessors; architecture of 8086, interrupts and its addressing modes, instruction set, interfacing memory and I/O devices, Programmable peripheral devices, serial communication protocols, Design of microprocessor based systems. Introduction of Microcontrollers (8 bit and 16 bit) and embedded systems

Text / Reference Books:

1. Digital Design: M.M. Mano,3'rd ed,Pearson Education
2. Digital system design and Principles: Wakerly,PHI
3. Digital Electronics: Fundamental Concepts and Applications: C. E. Strangio
4. Microcomputer Systems: The 8086/8088 Family: Liu, G. A. Gibson, Prentice Hall.
5. Microprocessor and Interfacing:2nd Edition, D. Hall, Tata McGraw Hill Publishing Company, 2006

EL – 205 IC Technology and CAD VLSI Tools Credits 4

CMOS Circuit principles. Fabrication flow of CMOS VLSIs, Masking stages and Mask layout design concepts , role of design center and foundry. Design methodologies, Hierarchical design of VLSIs, interception levels, behavioral description, RTL, Logic circuit, gate, circuits, device and process. The cost - volume trade-off, Power Delay tradeoff.

Custom and semicustom designs, standard cell, gate array, FPGA, CPLD and PLDs, FPGA Design Flow, ASIC Design Flow. Subsystem design concepts, Design for testability, Scan based designs, Boundary scan standards (JTAG), Signature analysis, Built in Self test (BIST), Built in logic block observer (BILBO).

CAD VLSI tools, simulators for logic, timing, circuit, device and process optimization, Xilinx, SPICE, MINMOS, SUPREM simulation tools

Floorplanning and Layout design, assignment, partitioning, placement, global and channel routing, compaction and verification algorithms and tools, Layout design verifiers, mask pattern generators.

Text / Reference Books:

1. Modern VLSI Design: W.Woulf, Pearson
2. Principles of CMOS VLSI Design: N. H.E. West and K.Eshranghian, PHI
3. Basic VLSI Design: D.A. Pucknell K. Eshraghian, PHI.
4. Essentials of VLSI Design: K.Eshrangian, D.A. Pucknell and Eshrangian, PHI
5. Integrated Circuit Engineering: Glasser, A.B Sharpe, S, McGraw Hill Int.

EL – 209 Problem Solving Credits 2

This course is based on practical problem solving exercises to be carried out in class. The problems will be based on applications of the concepts covered in other courses in the semester.

EL – 210 Seminar Credits 2

This course is intended for developing information collection, classification, compilation, and comprehension and communication skills. Each student is expected to prepare and deliver minimum 4 seminars during the semester on a chosen topic from recent advances in the field of Electronic Sciences and submit a report on the same.

EL – E09 VHDL/Verilog testing and verification Credits 2

Hardware description languages for VLSI design, VHDL and Verilog, programming and subsystem design concepts, design of multiplexer, parity generator leaf cell, adder, subtractor, multiplier, ALU, datapaths and control unit design

HDL Coding and Test Benches. Fault Modeling and Simulation, Functional testing, Verification and Test Methodologies.

Text / Reference Books:

1. VHDL: D. Perry,MaGraw Hill Int. Edition.
2. CMOS VLSI Design: N.H.E. Weste, K. Eshranghian, Addison Wesley
3. Digital Design Principles: J. Wakerley, Prentice Hall of India
4. Digital Sytems testing and testable design: Miron Abromovici, Melvin Breuer, Arthur Freedman, Jaico

EL – E10 C++ Programming Credits 2

Definition and Introduction of OOPS, elements of object oriented programming – Merits and demerits of OO methodology – C++ fundamentals – C++ Program Structure, Class Importance, Objects Creation, data types, operators and expressions, control flow, arrays, strings, pointers and functions. Inheritance: Concepts, Access Modifiers, Inheritance Types

Classes and objects – constructors and destructors, operator overloading – inheritance, virtual functions and polymorphism. Friend Functions, Friend Classes, Copy Constructors, Templates, Adding Graphics

File handling: C++ streams – console streams – console stream classes-formatted and unformatted console I/O operations, manipulators - File streams - classes file modes file pointers and manipulations file I/O – Exception handling

Text / Reference Books:

1. Mastering C++: K.R.Venugopal, Rajkumar Buyya, T.Ravishankar, TMH
2. Object oriented programming using C++: Ira Pohl, Pearson Education Asia
3. The C++ programming language: Bjarne Stroustrup, Addison Wesley,
4. Progranning with C++: John R.Hubbard, Schaums outline series, TMH,
5. Object Oriented Programming with C++: E.Balagurusamy, TMH 2/e

EL – E11 Theory of Industrial process control Credits 2

Introduction to functional elements of control system, control strategies, continuous and discrete state controller, Open loop control systems, Closed loop control systems - feedback, feed forward and adaptive control strategies. Data logger, supervisory and direct digital control systems.

Mathematical models of systems, state variable models, Transfer function, Block diagrams and signal flow-graphs, analysis of state variable models of open and closed loop systems, Mathematical modeling of Physical systems, equations of electric networks, modeling mechanical system elements.

Open-loop and close-loop control system, Error amplifier, on-off controller, Proportional (P), Proportional-Integral (PI). Proportional-Derivative (PD), PID controllers, Dynamic behaviour of control systems-servo mechanism, characteristics parameters of control systems-Accuracy, Sensitivity, Disturbances, Transient response

Stability of linear control systems. Methods of determining stability- Routh-Hurwitz stability criterion, root locus and frequency response methods of control system analysis, Bode and Nyquist plots.

Text / Reference Books:

1. Automatic Control Systems: B.C. Kuo PHI.
2. Modern Control Systems: R.C. Dorf and R.H. Bishop, Addison Wesley
3. Control Engineering Theory and Practice: M.N. Bandopadhyay, PHI
4. Fundamentals of Modeling and Analyzing Engineering Systems: P.D. Cha, J.J. Rosenberg and C.L. Dym, Cambridge Univ. Press

EL – E12 Power electronic devices and Systems Credits 2

Power devices : Construction, operating principles, ratings, characteristics, Triggering circuits and operating parameters of following solid state power devices–SCR, Thyristors types - phase control, inverter grade, asymmetrical (ASCR) reverse conducting, (RCT), Gate assisted Turn off (GATT), Bidirectional diode (DIAC), TRIAC, power transistors, power MOSFETS, IGBT's, Gate triggering circuits, series and parallel operations

Inverters, converters. AC regulators, speed control of a.c. and d.c. motors. Stepper and synchronous motors; Three phase controlled rectifier; Switch mode power supply; Uninterrupted power supply.

Text / Reference Books:

1. Power Electronics N.Mohan, J.M. Undeland, and W.P. Robbins, John Wiley
2. Power Electronics M.D. Singh, K.B. Khanchandani, TMH
3. Industrial Electronics T. E. Kissell, PHI
4. Fundamentals of Power Electronics R. W. Erickson, D. Maksimovic
5. Uninterruptible power supplies A, King and W. Knight, McGraw Hill
6. Uninterruptible power supplies J.Platts, J. S. Aubyn. P. Peregrinus, IEE power series.

EL – E13 Processes in device fabrication Credits 2

Crystal Growth and Wafer Preparation –Electronic Grade silicon, Czocharski Single Crystal growth technique, Zone refining, Silicon Shaping – from ingot to finished wafer, Defects in the crystal.

Epitaxial Growth, VPE, LPE and MBE techniques, Mechanism, Equipment, Methods of Evaluation, Epitaxial defects, Buried layersOxidation

Oxidation, Deal Grove model of thermal oxidation, dry, wet, rapid thermal, and pyrogenic oxidation, chlorine enhanced oxidation, anodic and plasma oxidation, dependence on process and substrate parameters, oxide properties – masking, oxide charges, oxide stress, quality of oxide, oxidation induced stacking faults, oxidation of Polysilicon.

Lithography, Types, Optical lithography – resists, contact, proximity and projection printing, mask making, Equipment, limitations, Electron Beam Lithography – Equipment, resists, pattern writing, mask generation, limitations, X-ray lithography - Equipment, X-ray sources resists, masks generation, limitations.

Characterization and analytical techniques: Thickness measurement, I-V measurement, C-V measurements, Resistance measurement – two probe and four probe, spreading resistance, Dielectric property measurements, XRD, XPS, FTIR, SEM, Ellipsometer, UV-VIS spectrometer, Raman spectroscopy.

Text / Reference Books:

1. VLSI Fabrication Principles: S.K. Gandhi, John Willey & Sons
2. VLSI Technology: S.M.Sze, McGrawHill
3. Integrated Circuit Engineering: A.B.Glasser, S.Sharpe
4. Semiconductor & Integrated Fabrication Techniques: P.E. Gise, R. Blanchard Restonn Pub.Co.Inc
5. Large Scale Integration: M.J. Hower, D.V.Morgan, JohnWiley

EL – E14 Physics of semiconductor Devices Credits 2

PN junctions: Equilibrium Conditions, Forward and reverse biased junctions, Steady Statecconditions, Reverse bias breakdown, Transient and A C conditions, Metal Semiconductor junctions, Heterojuctions Construction, principle of operation, and applications of Tunnel diode, PIN, Varactor and Zenner diodes.

Bipolar junction transistors : Fundamentals of operation, Amplification, Minority carrier distributions and terminal currents, Ebers-Moll model, Switching, transient and ac conditions, secondary effects, frequency limitations

Field Effect transistors: JFET, MOSFET, ideal MOS capacitor, control of threshold voltage, surface field effect transistors, Id-Vds characteristics, practical device effects.

Negative conductance devices – IMPATT, TRAPATT, Gunn diode, masers Power Devices: p-n-p-n diode, Semiconductor Controlled Rectifier

Text/Reference Books:

1. Solid State Electronics Devices Ben G. Streetman
2. Physics of Microwave Semi- conductors Devices of their Applications. H.A. Watson
3. Physics of Semiconductor Devices S.M. Sze

EL – E15 Properties of Electronic Materials Credits 2

Semiconductors : Intrinsic and extrinsic semiconductors, Carrier concentrations at equilibrium, Temperature dependence of carrier concentrations, Drift of carriers in electric and magnetic fields, conductivity and mobility, Carrier lifetime and photoconductivity, Diffusion of carriers, Steady state carrier injection, Gradients in quasi-fermi levels

Magnetic Properties of Materials: Dimagnetism, paramagnetism, various contributions to para and dia magnetism, Adiabatic demagnetization, Paramagnetic susceptibility, Ferromagnetism, ferrimagnetism, ferrites, antiferromagnetism, curie point. Coercive force, hysterisis , methods for parameters measurements.

Polymers: Structure of polymers, polymerization mechanism, characterization techniques, optical, electrical, thermal and dielectric properties of polymers.

Text/Reference Books:

1. Elementary Solid State Physics M. Ali Omar
2. Solid State Electronics Devices Ben G. Streetman
3. Introduction to Solid State Physics C.Kittle
4. Principles of Electronic materials & dev S.O. Kasap

EL – E16 Mechatronics Credits 2

Mechanical Systems Components, Dynamics and modeling, Mechanical systems and design: mechatronic approach, control, design process, Load conditions, flexibility, man machine interface

Sensors and instrumentation systems, embedded systems, Drives and actuator, Control Devices, Linear systems, Rotational Drives, Motion Converters – Levers, Gears, pulleys, screws, electromechanical drives Motion control devices and circuits: pilot devices, control circuits and load circuits, fuses and circuit breakers, enclosures, conductors, lockout, tag out safety

Robots and other motor control systems: Types of robot control, Types of Robot programs, CNC MACHINES, Parts of a Robot, robot actuators, IO modules

Case studies: Autofocus cameras, Floppy/CD ROM drives, Industrial Robots

Text /Reference Books:

1. Mechatronics: Bradley, Dawson, Burd and Loader Nelson Thornes
2. Industrial Electronics: Thomas Kissel Prentice Hall of India
3. Robotic Engineering: R.D. Klafter, T.A. Chmielewski, M.Negin, PHI