|| अंतरी पेटवू ज्ञानज्योत ||

(B -२.८८)
NAAC Re-Accredited

NORTH MAHARASHTRA UNIVERSITY,

JALGAON

SYLLABUS

FOR

M.Sc. ELECTRONICS

(SEMESTER I & II)

(With Effect from June 2010)

&

(SEMESTER III & IV)

(With Effect from June 2011)

[N.M.U. Dept. Only]

Semester	Course	Title of the course	Marks		Hours per week
			Internal	**External**	
I	EL-101	Semiconductor Devices	25	75	04
	EL-102	VLSI Tools and Techniques	25	75	04
	EL-103	Analog Circuit Simulation Techniques	25	75	04
	EL-104	Planning of Electronics Industries and Patent Writing	25	75	04
	EL-105	Practicals* Lab-I	25	75	08
II	EL-201	Optoelectronics	25	75	04
	EL-202	Java Programming and Web Technology	25	75	04
	EL-203	Microcontrollers and Applications	25	75	04
	EL-204	Advanced Communication Systems	25	75	04
	EL-205	Practicals* Lab-II	25	75	08
III	EL-301	Digital Signal Processing and logic controllers	25	75	04
	EL-302	Device Fabrication Techniques	25	75	04
	EL-303	Embedded Systems	25	75	04
	EL-304	Practicals* Lab-III	25	75	08
	EL-305	Projects-I	25	75	
IV	EL-401	Modeling and Simulation Techniques	25	75	04
	EL-402	CMOS Technology	25	75	04
	EL-403	Digital Image Processing and Mechatronics	25	75	04
	EL-404	Practicals* Lab-IV	25	75	08
	EL-405	Projects-II	25	75	

*** indicates workload for one batch (08 students)**

EL-101 Semiconductor Devices

Unit I: Basics of Semiconductor Electronics

Quantum Mechanical Concepts, Carrier Concentration, Transport Equation Bandgap: direct and indirect, Mobility and Resistivity, Carrier Generation and Recombination, compound semiconductors (III-V and II-VI group), diffusion of carriers and Einstein's relation, properties of degenerate and non- degenerate semiconductors and their applications, Measurement of effective mass of carriers by using cyclotron resonance experiment, measurement of energy gap, measurement of carrier life time, Haynes-Shockley experiment.

[10]

Unit II: Junction Devices

P-n junction diode, breakdown mechanism in p-n junction diode, junction and diffusion capacitance. P-I-N diode, intrinsic layer, principle of operation, P-I-N diode, applications of P-I-N diode. Zener diode:phenomenon of reverse bias breakdown, principle of operation and applications, Schottky diode, Varactor diode: structure, principle of operation and applications, Tunnel diode: principle of operation, structure and applications, BJT: fabrication, working principles and applications, uni-junction transistor, Hetero-structure transistors and applications.

[15]

Unit III: FET and MOSFET Devices

JFET: principle of operation, working, applications, MOSFET: accumulation, depletion mode, inversion mode and C-V characteristics of MOS capacitor, constructional details I-V Characteristics, and principle of operation of depletion type and enhancement type MOSFET, equivalent circuit of MOSFET, short channel and narrow width effect, MOSFET scaling and hot electron effect, charged coupled devices(CCD) types of charged coupled device(SCCD and BCCD) application of charged coupled devices. **[10]**

Unit IV: High frequency solid state Devices

Frequency dependence of power gain and noise in BJT, Transit time effects in BJT, Transit time effect in FET and Transit time effect in MESFET, Structure, Principle of operation and application of high electron mobility transistor (HEMT),Principle of operation and application of ballistic transistors. **[5]**

Unit V: Microwave and other advanced devices

Construction, Principle of operation and application of impact Avalanche Transit time (IMPATT) Diode, TRAPATT Diode, GUN Diode effect, the transferred electron mechanism, domain formation and various operating modes of GUN diode, TFT and Insulated Gate Bipolar transistor (IGBT), Basic concepts of Nano science and technology – Quantum wire – Quantum well – Quantum dot – Properties and technological advantages of Nano materials.

[10]

References:

1. **Solid State Electronic Devices** , B.G. Streetman and Sanjay Banerjee, IVth edition, Prentice-Hall of India, Pvt. Ltd., New Delhi.
2. **Solid State and Electron Devices**, Alton M. Ferendci, McGRAW-Hill Intrnational Editions, Electrical Engg. Series
3. **Physics Of Semiconductor Devices,** S. M. Sze, Willey Eastern Ltd.

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EL-102 VLSI Tools and Techniques

Unit I: Introduction to MOS Circuits

What is VLSI? MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Transistor Theory – Introduction MOS Device Design Equations, The Complementary CMOS Inverter-dc and transfer Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices. **[8]**

Unit II: Introduction to HDL

Importance and evolution of hardware description languages and VHDL; VHDL for design synthesis, Design tool flow; Capabilities, hardware abstraction; Basic terminology-design entity declaration, architecture body, configuration declaration, package declaration, package body; Hierarchical modeling-design methodologies, 4-bit ripple carry counter, modules, instances, components of a simulation. **[8]**

Unit III: Basic Language Elements

Lexical conventions- whitespace, comments, number specifications, strings, identifiers and keywords, escaped identifiers; Data Objects, Data Types- registers, vectors, integer, real, array, memories, parameters, operators- arithmetic, binary, unary, logical, relational, equality, bitwise, reduction, shift, concatenation, replication, conditional, operator precedence; modules and ports; conditional statements. **[10]**

Unit IV: Modeling

Gate level modeling- gate types, array of instances, example of a multiplexer, gate delays, examples; data flow modeling- continuous assignments; examples; behavioral modeling- structured procedure, procedural assignments, timing control, multiway branching, use of loops, sequential and parallel blocks, generate block; examples; Tasks and functions- declaration, invocation and difference; Automatic (recursive) functions, Constant functions,. Signed functions; **[9]**

Unit V: Packages, libraries and Features

Package- declaration, body; File, design libraries, order of analysis, implicit and explicit visibility, Entity statements, generate statements, aliases, qualified expressions; Test Bench- creation, converting real and integer to time, dumping results to a text file, reading vectors fro a text file, a test bench example, initializing a memory, variable file names; State machine modeling; Simulation examples- gates, flipflops, multiplexer-demultiplexer, shift register, ring counter, decade counter, synchronous counter, adder, multiplier; **[12]**

Unit VI: Programmable Logic Devices

FPGA, CPLD: Features and applications **[3]**

References:

1. **Digital Design**- Wakerly, PHI
2. **VHDL, (3/E**) Mcgraw Hill, Perry
3. **VHDL Primer**- Bhasker, Pearson Education

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EL-103 Analog Circuit Simulation Techniques

Unit I: Bipolar junction Transistor circuits

Common Emitter configuration, significance of input , output and transfer characteristic, load line concept, direct current and alternating current load line, Quiescent point, fixed bias, emitter bias ,voltage divider bias, maximum power dissipation in each bias **[8]**

Unit II: Analysis and applications of transistor amplifier circuit

Analysis of transistor amplifier, trans-conductance, small signal resistances, hybrid parameter analysis, current gain, voltage gain and power gain of an amplifier, switching characteristics and applications, circuits to improve switching time of transistor, applications, multistage amplifiers. **[7]**

Unit III: Frequency response of amplifier and applications

Actual mid-band current gain of amplifier, selection criteria for coupling capacitor and bypass capacitors, low frequency response, mid-band frequency response and high frequency response of CE amplifier, effect of source resistance on degradation of gain of an amplifier, reasons for degradation of gain at low and high frequency **[8]**

Unit IV: Field effect transistor circuits and applications

Output and transfer characteristics of FET, its significance, Biasing techniques; self bias, gate bias and voltage divider bias, FET as an amplifier MOSFET enhancement mode operation, depletion enhancement mode operation, output and transfer characteristics of MOSFET, its significance, biasing methods for MOSFET. **[7]**

Unit V: Feedback amplifier and oscillators

Concept of feedback and types of feedback configuration and corresponding analog circuit, effect of negative feedback on gain, input impedance output impedance and bandwidth, frequency response of feedback amplifier, Single pole and double pole response, Oscillators; Classification, phase shift oscillator, analysis, Wein bridge oscillator, analysis. **[7]**

Unit VI: Operational amplifier Circuits and applications

Differential amplifier. Instrumentation amplifier, compensated integrator and differentiator, analog computation, Quadrature oscillator, active filters: First and second order low pass and high pass active filter, transfer function, phase shifters, voltage control oscillator, phase locked loop. **[8]**

Unit VII: Tools for Analog Circuit Simulation

Pspice Models for Transistors, Analysis of Analog Circuits Using PSPICE. **[5]**

References:

1. **Integrated Electronics -** Millman Halkias
2. **Microelectronics -** Millman
3. **Electronics circuits -**Mottershed
4. **Operational amplifier -** Clayton
5. **Electronics for Scientists –**Brophy
6. **SPICE** – A guide to circuit simulation and analysis using PSPICE : Paul W. Tuinenga, PHI

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EL-104 Planning of Electronics Industries and Patent Writing

Unit I: Data processing in electronics industry

Need and utility of market research for the electronics products, Data types: Primary and secondary, Data collection methods: Dictated material, Questionnaire, observation and interview, Telephone messages, document, Sampling techniques, Data analysis techniques, Classifying information : alphabetically, Numerically, Chronologically, by subject, department or product. **[13]**

Unit II: Project Planning

Setting of new project, generation of alternative solutions, Evaluating the proposal, Feasibility report, Defining project plan, project report, registration procedure, Various catalyst organization, Raising finance, source of finance, finance proposal, assistance through SIDB, State government ,IDBI etc, Strategic planning ,system strategy, equipment acquisition, Developing the infrastructure, upgrading existing system. **[7]**

Unit III: Planning of new Electronics industry

Management concepts, planning, organizing, staffing, direct, co-ordination, control as applied to electronics industry, Environmental effects. Financial crises and their remedies, sales crises and their remedies, report preparation, importance of codification, Types of codes, Management report preparation, input and output forms, validation and data dictionary. **[13]**

Unit IV: Marketing strategy and management

Marketing strategy, product, packaging and new product development and pricing methods, promotion through advertising, Sales promotion, personal selling, publicity, distribution network for industrial product, export planning and management of electronics products, ISO certification series, TQM, Kaizen, Modern concepts of quality management, Customer satisfaction, Productivity, etc. **[7]**

Unit V: Patent and Report Writing

Patent format, types of patent, writing patents, Definition and importance of reports. Qualities of Reports, language and style in reports, type of reports, formats

[10]

References:

1. **Principle and Practices of Management.**
2. **Entrepreneurship and small-scale industries.**
3. **Marketing Management**
4. **Research Methodology**
5. **Operational research**

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EL-105 Practical- Lab I

Part-A

1. Determination of Hall coefficient using Hall method.
2. Measurement of E_g of semiconductor.
3. Measurement of resistivity of sample at various temperatures by four probe method.
4. Measurement of threshold voltage in linear and saturation region of MOSFET.
5. Measurement of c-v characteristics of MOS capacitor.

Part-B (using Altera/Xilinx tools and FPGA/CPLD kits)

6. Write VHDL code for full adder and simulate the waveforms.
7. Write VHDL code for 8:1 Multiplexer/1:8 demux and simulate the waveforms.
8. Write VHDL code for 3-bit binary counter and simulate the waveforms.
9. Write VHDL code for feedback counter and simulate the waveforms
10. Write VHDL code for RAM and simulate the waveforms.

Part-C

11. Simulation of I-V characteristics of BJT (CE) using PSPICE.
12. Simulation of I-V characteristics of JFET using PSPICE.
13. Simulation of I-V characteristics of MOSFET using PSPICE.
14. Simulation of second order active filters using PSPICE.
15. Simulation of RC oscillators using PSPICE.

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EL-201 Optoelectronics

Unit I: Heterostructures

Hetrojunction, light – current relationship in spontaneous emission, stimulated emission and gain ,optical gain in direct band gap semiconductor, the Febry-Perot cavity and threshold condition. **[7]**

Unit II: Laser diode and properties

LASER as an amplifier of light, necessary condition for amplification, special properties of LASER , Study of three & four level LASERs, study of tunable and semiconductor LASER, applications of LASER, Carrier confinement and injected carrier utilization, threshold current density and differential quantum efficiency, Temperature dependence of Jth , optical anomalies and radiation confinement loss in asymmetric hetrojunction lasers. **[11]**

Unit III: Light Detectors

Idea of light detectors, Natural and quantum specialized light detectors, Types of special light detector – thermal and quantum detectors, Types of quantum photo detectors- photo resistive, photovoltaic and photoelectric cell , photo multiplier tube , Important characteristics of light detectors-spectral response, efficiency material used for photodetectors. **[8]**

Unit IV: Optical Display

Necessity of optical displays, Different categories of optical displays-indicators, numeric, alphanumeric and special function displays, characteristics of displays-view ability ,response time, power dynamic , static and field effect LCDs, Dynamic display—necessity and principle of operation, Contrast improvance ratio, Consideration of displays. **[9]**

Unit V: Optical Fiber: Theory and Applications

Action of optical fiber as a waveguide, Advantages of optical fiber communications, Necessity condition for waveguide mechanism of optical fiber, Construction of a fiber, Material used for optical fibers, Construction of optical fiber cable, Role of strength materials, Types of optical fibers, step index and graded index ,comparison of waveguiding action, Numerical aperture, Time dispersion, Splicing and fiber connectors, Requirement and practical methods of splicing, Optical fiber connectors, Loss in optical fiber communication, Fiber losses, Intrinsic and extrinsic losses, comparison between losses, Modes of transmission and dispersion in optical fiber, Application of optical fiber

[15]

References:

1. **An Introduction of Optical Fiber:** Cherin A.H, Mc. Graw Hill, Int.Student.
2. **Optical Fiber Communication**: Keiser G., Mc. Graw Hill .
3. **Introduction of Optical Electronics**: K.A. Jones , Harper and Row.
4. **Optical Communication System** : John Grower,Prentice, India.
5. **The Laser**: Hecth ,Mc Graw Hill

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EL-202 Java Programming and Web Technology

Unit I: Introduction

Object-Oriented, Platform Independent, Safe. High Performance, Java is Multi-Threaded, dynamically linked, Garbage Collected, Saving files on Windows, compiling and Running, Increment and decrement operators, Print statements, variables and Data Types, Comments, Command line arguments, Objects, Static Fields, Methods, Passing Arguments to Methods; Returning values from methods. **[8]**

Unit II: Data types and arrays

Java Operators, Literals, Identifiers, key words, Addition of Integers, Multiplication and division, Remainder or Modulus Operator, Operator Precedence, Mixing Data Types, Converting Strings to Numbers, char data type, if, else, else-if statement, While loop, for loop, do while loop, Booleans, Relational Operators, Precedence, Break, Continue, switch statement, ? : operator in Java , Logical Operators in Java, Declaring Arrays, Creating Arrays, Initializing Arrays, System array copy (), Multi-dimensional arrays, Strings, Vectors, Exceptions, Catching multiple exception, throws keyword. Throwing exceptions **[13]**

Unit III: Object oriented programming, inheritance, multithread

Constructing objects with new, Methods, Invoking Methods, Member Variables vs. Local Variables, Passing Arguments to Methods, Returning Multiple Values From Methods, constructors, four Levels of Access Protection,
Inheritance: the superclass, Multilevel Inheritance, final and abstract keyword, Interfaces, Implementing Interfaces, Overriding Methods, Adding Methods, Subclasses and Polymorphism, siring() Methods, Static Members, Multithreaded programming: Creating threads, extending the thread class, Stopping and blocking a thread, Lifecycle of a thread, Using thread methods, thread exceptions, thread priority, Synchronization, Java Packages & Class Library, Wrapping Your Own Packages, Naming Packages, Documentation for the class library, Importing classes, Package Imports, Java util Random, java util Hash table java util date java util calendar. **[15]**

Unit IV: Web Technology

Introduction to World Wide Web (WWW), development of WWW, Graphical user Interface, Weaving the web, Introduction to Hyper Text Markup Language (HTML). **[7]**

Unit V: Java in Web Publishing

Preparing Java applets using the Abstract Windows Toolkit (AWT) framework, basic graphics features provided by Java Language. **[7]**

References:

1. **Computing concepts with java 2 essentials**, CAY HORSTMANN 2 Edition WILEY INDIA ISBN 81-265-0931-9.
2. **Big java** by CAY HORSTMANN, 2 Edition, WILEY INDIA ISBN 81-265-0879-5
3. **Web Design, The complete reference,** Thomas A. Powel, Tata McGraw Hill.

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EL-203 Microcontrollers and Applications

Unit I: Basics of Microcontrollers

Architectural features of different types of architectures used in Micro-controllers, like Van Neumann, Harvard, CISC, RISC, SISC architectures. Special features like watchdog timer, digital signal processors, clock monitor, resident program, loader, monitor, General applications of Micro-controllers.

[7]

Unit II: 16 bit MCS-96 Microcontrollers

Architectural block diagram, features, Data types, addressing modes, Instruction set, Arithmetic, data transfer, logical and other types of instructions, Programming, simple programs and loop programs. **[17]**

Unit III: 32 bit Arm Microcontrollers

Architectural block diagram, features, Data types, addressing modes, Instruction set and programming, simple programs and loop programs.

[8]

Unit IV: Interfacing Applications

Interfacing Light Emitting Diodes, 7-segment display, keypad, stepper motor and Analog to Digital Converter to arm processor. **[7]**

Unit V: Robotics and Applications

Introduction, physical configurations, Cartesian co-ordinate, polar co-ordinate, cylindrical and body and arm configuration, technical features, robotics motion, body and arm motions, wrist motions, programming languages, victors assembly language and machine control language, work cell control and interlocks, robotics sensors – vision sensors, touch sensors and voice sensors, Need of robotics in industries, material transfer, machine loading, spray painting, welding, processing operation, assembly and inspection.

[11]

References:

1. **The 16 bit Intel 8096 Programming, Interfacing, applications** by Ron Katz and Howard Boyet.
2. **CAD/CAM-computer Aided Design and Manufacturing,** M. P. Grover and E. W. Zimmers, Jr, PHI, New Delhi
3. **Microcontroller: Architecture, implementation and Programming** by Kenneth Hintz and Daniel Tabak, Tata McGraw Hill.
4. **www.intel.com**

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EL-204 Advanced Communication Systems

Unit I: Mobile Communication

Cellular concept. Mobile radio propagation. Co-channel interference. Diversity. Multiple access. Cellular coverage planning. Wireless networking. Wireless systems and standards. Fading channels, spreading codes, power control. WAP and other protocols for internet access. Data transmission in GSM and UMTS, TCP in wireless environment, multi-user detection and its performance analysis. Blue-tooth and other wireless networks, system comparison. Spread spectrum concept. Basics of CDMA. Applications of CDMA to cellular communication systems. Second and third generation CDMA systems/ standards. Multicarrier CDMA. Synchronization and demodulation. Diversity techniques and rake receiver. **[13]**

Unit II: Telecommunication Switching and Networks

Principles of circuit switching and signaling schemes, space time and space time division switching, single stage and multi stage switching network. Traffic engineering and tele-traffic theory. Markov processes representing traffic, calculation of blocking probability, **[7]**

Unit III: Advanced Optical communication

Analog and Digital communication link design. WDM, DWDM, optical couplers, Mach-Zehnder interferometer multiplexer, optical add/drop multiplexers, isolators, circulators, optical filters, tunable sources and tunable filters, arrayed waveguide grating, diffraction grating, optical amplifiers, optical integrated circuits, OTDR, SONET: frame format, overhead channels, payload pointer, multiplexing hierarchy. SDH: Standards, frame structure and features. Optical switching, WDM networks, Classification of optical sensors. Intensity modulated, phase modulated and spectrally modulated sensors. **[13]**

Unit IV: Satellite communication

Introduction: Orbital mechanics and launching, earth station and satellite sub systems, satellite link: design and analysis, multiplexing techniques, multiple accesses for satellite links: FDMA, TDMA CDMA and DAMA, propagation effects, DBS-TV, GPS. VSAT: Network architecture, access control protocol and link analysis **[9]**

Unit V: Internet Communication

Modem, Modem-computer interfacing, modulation schemes, computer networks and different topologies, application layer protocols, transport layer protocols, network layer and routing, link layer and local area networks, security in computer networks. **[8]**

References:

1. **An introduction to fiber optic systems** (IInd edition) By John Powers, Irwin Publications, Chicago (1993 & 1997)
2. **Understanding fiber optics** (IInd edition) By Jeff Hecht (BPB publications) 1997
3. **Principles and Applications of Optical Communications**, By Max Ming-Kang Liu, Irwin Publications, Chicago
4. **Mobile cellular Telecommunications: Analog and Digital Systems** (IInd edition) By William C.Y. Lee, McGraw-Hill, Inc. New York, 1995
5. **Optical Communication System**, John Gower, Prentice Hall, India

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EL-205 Practical- Lab II

Part-A

1. Characterization of Photodiode and phototransistor.
2. Measurement of NA and attenuation in optical fiber.
3. Study of Manchester coding and decoding
4. Study of pulse amplitude, width, position modulation
5. Study of time division multiplexing for analog and Digital Signals

Part-B

6. Write Java program for performing arithmetic operations.
7. Write Java script for performing string operations.
8. Write Java script for performing operations over file.
9. Write Java program for multidimensional array handing.
10. Write Java script for writing static web page.
11. Write Java script for writing web page with animation.

Part-C

12. Writing arithmetic programs using 80196.
13. Writing code conversion programs using 80196.
14. Interfacing of LED display/7-segment display to arm processor.
15. Interfacing of ADC to arm processor.
16. Interfacing of stepper motor to arm processor.

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EL-301 Digital Signal Processing and Logic Controllers

Unit I: Basics of Digital Signal Processing

Analog Vs. Digital Signal Processing, Block diagram of digital signal processor, Sampling Theorem, Sampling, Quantization, Aliasing, Applications. **[5]**

Unit II: Signals and Systems

Basic signals, representation of signals in various ways, types of signals, systems: classification of systems, properties of systems, LSI system, delta function, impulse response, linear convolution, properties of convolution, correlation, its type and applications. **[7]**

Unit III: Mathematical Transforms

Z-transform, Definition, region of convergence, properties of Z-transform, inverse Z-transform: various methods, DTFT, properties, DFT, properties, circular convolution, graphical method and matrix method, FFT. **[15]**

Unit IV: Filters

Types of filters, Infinite impulse response filters, Finite impulse response filters, various window functions, Implementation of these filters, Analog filters. **[10]**

Unit V: DSP Applications

Speech synthesis, mobile telephone, set top box and ECG monitoring. **[5]**

Unit VI: Logic controllers

Programmable logic controllers, types, programming and applications. **[8]**

References:

1. **Digital Signal Processors**- Kuo and Gan, Pearson Education
2. **Digital Signal Processing**: D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, J Wile and sons, Singapore.
3. **Digital Signal Processing**:Principle, Algorithms and Applications, John G. Proakis and D.G. Manolakis, Prentice Hall
4. **Theory and Application of Digital Signal Processing**: L.R. Rabiner and B. Gold, Prentice Hall
5. **Introduction to Digital Signal Processing**: J.R. Johnson, Prentice Hall
6. **Industrial Control Electronics** – Applications and Design, Michael Jacob Prentice Hall,

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EL-302 Device Fabrication Techniques

Unit I: Crystal Structures, growth and wafer preparation

Crystal structures of semiconducting materials, CZ and Bridgeman techniques, Zone refining, Ingot shaping, Polishing, Cutting, Wagering, Scribe lines, Cleavage, Diffusion: Nature of diffusion, the diffusion concentration, Field aided motion, Impurity behavior in silicon, substitutional diffusers. **[8]**

Unit II: Fabrication and Deposition Techniques

Epitaxy: Vapor phase epitaxy, reaction at the substrate, Elements of nucleation and growth, Doping and auto-doping, Formation of GaAs (reaction involved) liquid phase epitaxy, Tilt type growth furnace, Slider boat arrangement, Reactors for Si and GaAs growth, Molecular beam epitaxy (MBE), Silicon, Insulators, sapphire and amorphous substrates, Evaluation of Epi-layers, Sheet resistant, Mobility and carrier concentration and impurity profile measurements. **[10]**

Unit III: Lithography

Positive and negative resists, development, photo mask and its preparation, scaling, patterning, reticle masks, master mask, production mask, alignment mask. Optical lithography, contact printing, projection printing, proximity printing. Proximity effect and its corrections, vary figures, variable exposure, Electron beam lithography (EBL) step and repeat method, electro-beam mask fabricator (EBMF), (Telecantric effect) laser beam, ion beam lithography, X-ray lithography, future trends. **[8]**

Unit IV: Oxidation

Thermal oxidation of silicon, kinetics of oxide growth, network formers, network breakers bridging oxygen, Thermal Oxidation: Dry, Wet, Rapid thermal, pyrogenic oxidation, Halogenic low pressure oxidations, Techniques of oxidation (chlorine enhanced oxidation), Oxidation furnaces, high and low pressure oxidations. Techniques and difficulties in growing good quality thin oxide layers, Oxidation induced staking faults, Anodic Oxidation Systems: Thermal Oxidation of GaAs difficulties in growing oxide layer on GaAs with thermal oxidation, Plasma Oxidation: Deal grove model assumptions, segregation coefficient, impurity redistribution during oxidation, failure of Deal grove model in initial stages, Model micropores field enhanced oxidation, Properties of thermal, anodic and plasma oxides evaluation of oxide layers.

[13]

Unit V: Characterization Techniques

Physical Characterizations: Refractive Index measurement, XRD, SEM, TEM, Elliposometry, Taley step, Electrical Characterization: I-V, C-V measurement, impurity profile measurement, Bevelling grove methods, Hall probe technique, resistivity measurement, Four probe technique, Hall Measurement, Vander Pau method, breakdown strength measurement, Chemical Characterizations: Spectroscopic Techniques U-V, RHEED, ESCA. **[11]**

References:

1.**VLSI Fabrication principles,**,S. K. Gandhi, John Willey and Sons
2.**VLSI technology**,S, M. Szi, Mc Graw Hill Int. Book Co.
3.**Integrated Circuit Engineering**,B. Glasser and S. Sharpe
4.**Semiconductor Integrated Circuit fabrication techniques** : P. E. Gise and R. Blanchard

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EL-303 Embedded Systems

Unit I: Introduction

Embedded system, components of embedded system, processor, memory, microcontroller, DSP, Application specific system processor, power supply management, clock oscillator, reset circuit, Input/output ports, buses and interfaces, DAC and ADC, LCD and LED displays, keypad/keyboard, Types of interrupts, interrupt priorities, interrupt control system in 8051. **[10]**

Unit II: Embedded on chip Hardware

Memory, memory interface unit, programming the memory, embedded system input/output devices, timers, 8253, different operating modes, parallel ports, memory mapped Input/output, serial ports, UART. **[7]**

Unit III: Embedded Communication

Parallel data communication, GPIB and HPIB standards, serial data communication, Asynchronous communication and standards, PC-PC communication, modem, computer-modem interfacing,network communication, I^2C bus standard, wireless communication. **[7]**

Unit IV: Embedded System Software

Real time systems, model of real time systems, Characteristics of real time systems, Features of real time operating system, Unix as a RTOS, windows as a RTOS, Task scheduling in embedded systems: task scheduler, first in first out, shortest job first, round robin, priority based scheduling, Programming languages: assembly languages, high level languages. **[15]**

Unit V: Testing of Embedded Systems

Verification vs. testing, faults in embedded system, hardware fault models, software-hardware co-validation fault models, embedded software testing. **[5]**

Unit VI: Applications of Embedded Systems

Mobile phones, home appliances, microwave oven, washing machine, laser printer, Automated Teller Machines, Bluetooth communication, automated car assembly plant, chemical plant control, video conferencing and railway reservation system. **[6]**

References:

1. **Fundamentals of Embedded Software**- Daniel W Lewis, Pearson Education
2. **An embedded software primer**, David E Simon, Pearson education
3. **Embedded Micro-computer System: Real Time Interfacing,** J.W. Valvano

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EL-304 Practical- Lab III

Part-A

1. Implement moving average filter using MATLAB.
2. Write MATLAB program for the magnitude and phase response of the signal.
3. Study of low pass filter using DSP kit.
4. Study of PLC kit.
5. Simulation of bottle filling plant using PLC

Part-B

6. Study of wafer handling and cleaning.
7. Growth of Silicon dioxide layer for the microelectronics applications.
8. Photolithography using photo resist.
9. Studies on dry and wet etching processes for semiconductor thin films.
10. Studies on optical characterization techniques (ellipsometry/FTIR)
11. I-V characteristics of BJT using Keithley set up.

Part-C

12. Writing program for two digit decimal counter using arm processor.
13. A Temperature Monitoring and Acquisition System with LCD Output.
14. Converting 8-bit LCD communication to 4-bit
15. Interfacing of DAC to arm processor.
16. Implementation of I^2C bus

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. EL-401 Modeling and Simulation Techniques

Unit I: Introduction

Models and their types, need of modeling, physical models, analytical models, probabilistic and deterministic models, static and dynamic models, Common types of mathematical models used for engineering systems, Model determination from input- output observation, Basic principle of simulation, Analog and digital simulation techniques, material level simulation, physical level simulation, logic level simulation and behavioral level simulation, mixed level simulation. **[10]**

Unit II: Semiconductor device simulation

Materials used for light emitting devices, hetero-structure, double-hetero-structure, quantum-well, different recombination mechanisms, Maxwell's equations, Derivation of Poisson's and Laplace's equation, continuity equation for electrons and holes, current density expressions, simplification of these equations, drift-diffusion approximation, limitations of drift-diffusions, wave equations for TE and TM modes, modeling of semiconductor laser diode, self-consistent analysis. **[17]**

Unit III: Computational Techniques for device simulation

Finite difference methods, first order and second order derivatives obtained from Taylor's series, comparison with finite element method, solution of poison's equation, solution of steady state continuity equation for electrons and holes, discretization of these equations, analysis of simulation results, random number generation and testing, Monte Carlo integration, basic concepts.
[10]

Unit IV: Modeling of diodes and Transistors

P-n junction: contact potential, depletion width and current models BJT: small signal and large signal models, Eber-Moll's model
JFET: model of pinch-off voltage and drain current
MOSFET: small signal and large signal models **[7]**

Unit V: Nano-scale Electronics device modeling

Schrödinger's equation, quantum transport, Nanoscale devices: quantum well, quantum wire and quantum dots, transfer matrix formation for multiple quantum wells. **[6]**

References:

1. **System Simulation**, G.Gordon, Prentice Hall
2. **Modelling and Simulation**, R. Leigh, Peter Peregrims Ltd.
3. **Simulation Modelling and Analysis,** M.Law, W.D.Kelton, , McGraw Hill.

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EL-402 CMOS Technology

Unit I: Basic Electrical properties of MOS Transistor

Threshold voltage V_{th}, transconductance g_m for MOS,CMOS and Bi-CMOS transistors, Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits, Inverter principle, Depletion and enhancement load inverters, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, and Dynamic behavior, Propagation Delay, Power Consumption.

[15]

UNIT II: MOS Circuit layout

Scalable design rules, Floor planning methods, Stick diagrams, MOS device layout: Transistor layout, Inverter layout, CMOS digital circuits layout and simulation **[7]**

UNIT III: Logic gates and layouts

MOS transistor figure of merit, the pass transistor, the nMOS inverter, determination of pull-up to pull-down ratio for nMOS inverter driven by another nMOS inverter, determination of pull-up to pull-down ratio for an nMOS inverter driven by one or more pass transistors. Alternative forms of pull up, MOS transistor circuit model. Static complementary gates, switch logic, Alternative gate circuits, low power gates, Resistive and Inductive interconnect delays.

[15]

UNIT IV: Sequential Circuits

Static latches, Flip flops and Registers, Dynamic Latches and Registers, CMOS Schmitt trigger, Monostable sequential Circuits, Astable Circuits. Memory Design: ROM and RAM cells **[7]**

UNIT V: BiCMOS Logic Circuits

Introduction, BJT Structure and operation, Basic BiCMOS Circuit behavior, Switching Delay in BiCMOS Logic circuits, BiCMOS Applications **[6]**

References:

1. **Essentials of VLSI Circuits and Systems,** K. Eshraghian
1. **Digital Integrated Circuits,** Rabey, Pearson Education
1. **CMOS Digital IC Circuit Analysis and Design,** Kang and Leblebigi

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EL-403 Digital Image Processing and Mechatronics

Unit I: Introduction

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

[8]

Unit II: Image processing operations

Image Enhancement: Spatial Domain-Gray Level transformations, Histogram, Arithmetic/Logical Operations, Spatial filtering, Smoothing and Sharpening Spatial Filters.

Image Restoration: Inverse filtering, Wiener filtering; Wavelets- Discrete and Continuous Wavelet Transform, Wavelet Transform in 2-D.

Image Compression: Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression. **[13]**

Unit III: Image segmentation and color image processing

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

Color image processing: Color models, Different processing techniques, Color image filtering. **[10]**

Unit IV: Basics of Mechatronics

Evolution of Mechatronics, An overview of Mechatronics, Scope of Mechatronics, Transducers and Sensors, Signal conditioning theory, circuits and systems

[7]

Unit V: Actuators and Mechanism

Actuator types and application areas- Electromechanical actuators, Fluid power actuators and active material based actuators, Mechanism- Bearings, Belt, Chain, Pulleys, Gears, Rack and Pinion, Slider and Crank, Cams and Followers, Four-bar linkages. **[7]**

Unit VI: CNC systems

Principle of numerical control, types and features of CNC System, Constituent parts of CNC machines and assembly techniques, configuration, Interfacing, Monitoring and diagnostics. **[5]**

References:

1. **Digital Image Processing,** R. C. Gonzalez and R. E. Woods, Pearson Education
2. **Digital Image Processing using MATLAB,** R. C. Gonzalez , R. E. Woods and S. L. Eddins, Pearson Education
3. **Fundamentals of Digital Image processing,** A. K. Jain, Pearson Education
4. **Mechatronics,** W. Bolton, Addition –Wesley Longman Ltd.
5. **Mechatronics,** Denny K. Miu, Springer- Verlag

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EL-404 Practical- Lab IV

Part-A (Using MATLAB)

1. Finite difference discretization and solution of Poisson's equation.
2. Analysis of simple p-n junction diode using static model.
3. Random number generation and Monte carlo integration.
4. Simulation of Eber-Moll model for the BJT.
5. Simulation of large signal model for MOSFET.
6. Solution of wave equation for the field intensity distribution.

Part-B

7. Draw transistor schematic for 4 bit parallel binary adder and sketch layout using tools.
8. Draw transistor schematic for multiplier and sketch layout using tools.
9. Sketch layout and study RAM memory cell using tools.
10. Draw sticks diagram and layout for different flip flops.
11. Sketch layout and study modulo-27 counter using tools.

Part-C

12. Read a image and perform edge modification operations using MATLAB.
13. Perform erosion, dilation, opening and closing operation over image.
14. Perform skeletonization operation over finger print.
15. Color image filtering using MATLAB
16. Temperature controller using OPAMP
17. Actuating electromechanical relay using digital control.

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