Department of Electronics

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M.Sc. Electronics Syllabus

(With effect from June 2015)

(Total Credit : 88)

Semester	Course	Title of the course	Marks		Credit
			Internal	External	
I	EL-101	Semiconductor Devices	40	60	04
	EL-102	VLSI Tools and Techniques	40	60	04
	EL-103	Analog Circuit Simulation Techniques	40	60	04
	EL-104	Industrial Automation and Control	40	60	04
	EL-105	Practical* Lab-I	40	60	04
	EL-106	Tutorial – I (Audit Course)	40	-	01
	PS-001	Industrial Materials	40	60	04
II	EL-201	Optoelectronics	40	60	04
	EL-202	Java Programming and Web Technology	40	60	04
	EL-203	Microcontrollers and Applications	40	60	04
	EL-204	Advanced Communication Systems	40	60	04
	EL-205	Practical* Lab-II	40	60	04
	EL- 206	Tutorial – II (Audit Course)	40	-	01
	PS-001	Industrial Materials	40	60	04
III	EL 302	Device Fabrication Techniques	40	60	04
	EL-301	Digital Signal Processing and Applications	40	60	04
	EL-302	Semiconductor Devices Processing and Fabrication	40	60	04
	El-303	Embedded System Design and Applications	40	60	24
	EL-304	Practical's Lab III	40	60	24
IV	EL-305	Project I	40		02
	EL-306	Seminar – I (Audit course)	40	60	04
	EL-401(A)	Modeling and Simulation Techniques	40	60	04
	EL-401(B)	Micro-electromechanical Systems and Applications	40	60	04
	EL-402	CMOS Design and Applications	40	60	04
	EL-403	Digital Image Processing and Applications	40	60	24
	EL-404	Practical's Lab IV	40	60	24

*** Indicates workload for one batch (8 students)**

EL-101 Semiconductor Devices

Unit I: Basics of Semiconductor Electronics

Energy bands and classifications, Bandgap: direct and indirect, Atomic bonds in semiconductors, Commonly used semiconductors, Effect of temperature on semiconductors, Intrinsic and Extrinsic semiconductors, Carrier Concentration Mobility and Resistivity, Carrier Generation and Recombination, compound semiconductors (III-V and II-VI group), properties of degenerate and non- degenerate semiconductors and their applications, measurement of energy gap, Measurement of effective mass of carriers by using cyclotron resonance experiment, 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, 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.
4. **Principles of Electronics**, V. K. Mehta, R. Mehta, S. Chand.

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EL-102 VLSI Tools and Techniques

Unit I: Introduction to MOS Circuits

Basic concept about VLSI: MOS Transistors-MOS Transistor Switches-CMOS Logic-Circuit and System Representations, **MOS Transistor Theory**: Introduction to MOS Device-Design Equations, **The Complementary MOS Inverter:** dc and transfer characteristics, Static Load MOS Inverters, **Switch Logic:** Pass transistor-Transmission Gate-Tri State Inverter, **Bipolar Devices**. **[7]**

Unit II: Introduction to HDL

Importance and evolution of hardware description languages (HDL) and VHDL - Capabilities - hardware abstraction, **Using VHDL:** Basic terminology - design entity declaration - architecture body - configuration declaration - package declaration - package body. **[8]**

Unit III: Basic Language Elements

Identifiers and keywords-Escaped identifiers, **Data Objects:** Constants-Variables-Signal-File, **Data Types:** Scalar-Composite-Access-File, **Operators:** Logical-Relational-Shift-Adding-Multiplying-Miscellaneous **[8]**

Unit IV: Modelling

Behavioural Modelling: Entity Declaration-Architecture Body-Process Statement-Variable Assignment Statement-Signal Assignment Statement-Wait Statement-If Statement-Case Statement-Null Statement-Loop Statement-Exit Statement-Next Statement-Assertion Statement-More on Signal Assignment Statement-Inertial Delay Model-Transport Delay Model-Creating Signal Waveforms-Signal Drivers-Other Sequential Statements-Multiple Processes, **Dataflow Modelling-**Concurrent Signal Assignment Statement-Concurrent versus Sequential Signal Assignment-Delta Delay Revisited-Multiple Drivers-Conditional Signal Assignment Statement-Selected Signal Assignment Statement-Block Statement-Concurrent Assertion Statement **Structural Modelling:** Component Declaration-Component Instantiation-Resolving Signal Values **[12]**

Unit V: Packages, Libraries and Features

Package Declaration-Package Body-Design Libraries-Design File-Order of Analysis-Implicit Visibility-Explicit Visibility, **Model Simulation:** Test Bench-Creation-Converting real and integer to time-Test bench example-Initializing a memory-variable file names, **Simulation examples**- Gates, flip-flops, multiplexer-de-multiplexer, shift register, ring counter, decade counter, synchronous counter, adder, multiplier. **[12]**

Unit VI: Programmable Logic Devices

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

References:

1. **Basic VLSI Design-** Douglas Pucknell
2. **Digital Design-** Wakerly, PHI
3. **VHDL, (3/E) Mcgraw Hill, Perry**
4. **VHDL Primer**- J 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 (Actual Practice)

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: Industrial Automation and controls

Unit I: Logic controllers

Programmable logic controllers, types, Ladder programming and applications.

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Unit II: Basics of Mechatronics

Evolution of Mechatronics, An overview of Mechatronics, Scope of Mechatronics, Transducers and Sensors (Mechanical switches, Proximity switches, Photoelectric sensors and switches, Encoders, Temperature sensors, Position / Displacement sensors, Strain gauges, Pressure sensors, Relay, Solid State Relay (SSR), Liquid level detectors), Signal conditioning theory, circuits and systems **[10]**

Unit III: 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 IV: 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. **[6]**

Unit V: Industrial drives

Overview of servo control, Servo Hydraulic and Pneumatic Drive: Overview of Servo Hydraulic and Pneumatic Drive, Fundamentals of Hydraulic and Pneumatic Drives, Components of Fluidic Drives Systems, Basic Hydraulic Circuits, Electric Drives: Overview of Electric Drives, Electric Motors, Power Electronics, Sensors. **[9]**

Unit VI: Vacuum systems and controls

Overview of vacuum, Classification of vacuum pumps, Types of vacuum pumps: Diaphragm pumps, Rotary (vane pumps and Oil sealed rotary displacement) pumps, Rotary plunger pumps, Roots pumps, Oil Diffusion pumps, Turbo-molecular pumps, Sorption pumps, Sputter-ion pumps, Cryopumps. Vacuum gauges: Classification of gauges, Penning, Pirani and capacitance gauges. **[12]**

References:

1. **Mechatronics**, W. Bolton, Addition –Wesley Longman Ltd.
2. **Mechatronics**, Denny K. Miu, Springer- Verlag
3. **Drives and Control for Industrial Automation**, Tan Kok Kiong Andi Sudjana Putra, Springer.
4. **Precision Motion Control Design and Implementation**, Tan Kok Kiong, Lee Tong Heng, Huang Sunan, Springer.
5. **Vacuum Science and Technology**, V. V. Rao, T. B. Ghosh, K. L. Chopra, Allied Publishers Pvt. Ltd.
6. **Electronics Instrumentation,** H. S. Kalsi.

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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 and practically verification using circuit.
7. Write VHDL code for 8:1 Multiplexer/1:8 deMux and simulate the waveforms and practically verification using circuit.
8. Write VHDL code for 3-bit binary counter and simulate the waveforms and practically verification using circuit.
9. Write VHDL code for feedback counter and simulate the waveforms and practically verification using circuit.
10. Write VHDL code for RAM and simulate the waveforms.

Part-C

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

Part-D

16. Study of PLC system.
17. Study of vacuum pumps and measurement of pumping speed.
18. Control the speed and direction of DC motor.
19. Control the speed and direction of AC motor.
20. Control the speed and direction of servo motor.

Note: *The student has to perform at least 04 practical's from each part.*

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EL-201 Optoelectronics

Unit I: Heterostructures

Hetro-junction, 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

Java Evolution History, Java Features: Compiled and interpreted-Platform Independent and portable-Object Oriented-paradigm-Objects and classes, Robust and secure-Distributed-Simple small and familiar-Multi threaded and interactive-High Performance-Dynamic and extensible-Easy and development-Garbage Collected-Java support systems-Java environment-Java development kit-Java runtime environment, **Classification of Java Statement**, **Installation and Configuration of Java**, **Java virtual machine**, **Overview of Java language:** Class declaration-Main line-Output line-Simple java program, **Java Program Structure:** Documentation section-Package statement-Import statement-Interface statement-Class definitions-Java keywords **[11]**

Unit II: Java components

Constants, Variables and Data type: Declaration and initialization of constants & variables- Scope of variables-Data types, **Java Operators and Expression:** Arithmetic-Relational-Logical-Assignment-Increment & decrement-Conditional-Bitwise-Special, **Decision Making and Branching:** if statement-if else statement-Nesting of if else statement-else if ladder-switch statement-"? :" operator, **Decision Making and Looping:** while statement-do while statement-for statement-Jump in loop-Labelled loop, **Arrays and String:** One, two, multi-dimensional array-Creating an array-Strings [**12]**

Unit III: Object Oriented Programming, Inheritance and Interface Programming

OOPs: Defining class-Fields declaration-Method declaration-Creating object-Accessing class members-Invoking method-Member variables vs. Local variables-Passing Arguments to Methods-Returning multiple values from methods-Constructor-Method overloading-Static member-Nesting of method, Final variables and method-final class-finalizer method-abstract method and class-Dynamic method dispatch-Visibility control. **Inheritance:** Types of inheritance-Extending a class-Super class-Multilevel inheritance-final and abstract keyword-Overriding Methods, **Interfaces:** Implementing interfaces, Accessing interface variable **[11]**

Unit IV Multithreaded Programming and Java Packages

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:** Java API packages-Using system package-Naming conventions-creating package-accessing package-Using package-adding a class to package-hiding classes-Static import. **[9]**

Unit V: Java in Web Technology

Introduction to World Wide Web (WWW)-Development of WWW-Graphical user interface-Weaving the web-Introduction to Hyper Text Markup Language (HTML)-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.
4. **Programming with JAVA primer,** E. Balagurusamy, 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 Microcontrollers, 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.
1. CAD/CAM-computer Aided Design and Manufacturing, M. P. Grover and E. W. Zimmers, Jr, PHI, New Delhi
2. Microcontroller: Architecture, implementation and Programming by Kenneth Hintz and Daniel Tabak, Tata McGraw Hill.
3. 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 signalling 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.
17. Study of ARM processor kit.

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EL-301 Digital Signal Processing and Applications

Unit I: Basics of Digital Signal Processing

Analog Vs. Digital Signal Processing, Block diagram of digital signal processor, Sampling Theorem, Sampling, Quantization, Aliasing. **[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. **[12]**

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. **[17]**

Unit IV: Filters

Types of filters, Infinite impulse response filters, Finite impulse response filters, various window functions, Implementation of these filters, Analog filters. **[12]**

Unit V: DSP Applications

Audio compression and decompression, audio equalization, audio noise cancellation, audio echo cancellation, video compression, video stabilization, image compression, face finding, image resizing, data modulation and demodulation, speech synthesis, mobile telephone, set top box and ECG monitoring. **[5]**

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 Semiconductor Devices Processing and Fabrication

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. **[8]**

Unit II: Fabrication and Deposition Techniques

Diffusion: Nature of diffusion, the diffusion concentration, Field aided motion, Impurity behavior in silicon, substitutional diffusers, ion implantation, 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. **[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, 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, Sheet resistance, Mobility and carrier concentration and impurity profile measurements, 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. Sze, 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 System Design and Applications

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. **[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 and testing of systems

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

[20]

Unit V: 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. **[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 Auto-correlation using MATLAB.
4. Study of Liner and Circular convolution techniques using MATLAB.
5. Study of low pass filter using DSP kit.

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.
11. Studies on optical characterization techniques FTIR.
12. I-V characteristics of BJT / MOSFET devices.

Part-C

13. Write program for Arithmetic operations using ARM processor.
14. Write code conversion program using ARM processor.
15. Interface Relay to ARM processor.
16. Interface DC motor to ARM processor.
17. Interface DAC to ARM processor.

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EL-401(A) Modeling and Simulation Techniques

Unit I: Introduction

Models and their types, need of modeling, physical models, analog 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-heterostructure, 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, selfconsistent 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 of 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. **Modeling and Simulation**, R. Leigh, Peter Peregrims Ltd.
3. **Simulation Modelling and Analysis**, M. Law, W. D. Kelton, McGraw Hill.

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EL-401(B) Micro-electromechanical Systems and Applications

Unit I: Introduction to Micro-electromechanical systems and MEMS design

What is MEMS? MEMS technology, brief history of MEMS, MEMS design tools, bulk-micromachining based MEMS design, surface-micromachining based MEMS design. **[10]**

Unit II: Material issues for microsystems

Failure mechanisms of materials used in Microsystems, methods for measuring mechanical properties of materials used in Microsystems, structure materials for Microsystems, materials for microtribological application. **[11]**

Unit III: MEMS processing and fabrication techniques and technology

Silicon based micromachining, surface micromachining technology: standard surface micromachining technology and multilayer polysilicon, metallization, isolation, monolithic integrated surface micromachining technology, 3D surface machining, other materials, bulk micromachining.

[12]

Unit IV: Micro-electromechanical sensors

Physical sensors, chemical sensors, biological sensors, resonant pressure sensors, resonant accelerometers, resonant gas flow sensors, silicon based electrostatic field sensors, MEMS based microgas sensors: micro-hotplate gas sensor, micro-gas sensor array, nanofiber based gas sensing materials.

[14]

Unit V: MEMS Packaging

MEMS packaging fundamentals, contemporary MEMS packaging approaches, bonding processes for MEMS packaging: fusion bonding, anodic bonding, epoxy bonding, eutectic bonding, solder bonding, localized heating and bonding, Vacuum packaging: integrated micromachining, post packaging, hybrid approach.

References:

1) **Microsystems and nanotechnology**, Zhaoying Zhou, Zhonglin Wang, Liwei Lin, Springer.
2) **MEMS AND Microsystems: Design And Manufacture 1st Edition**, Tai-Ran Hsu, Mcgraw Hill Education.
3) **Mems and Nems**, Lyshevski, CRC press.
4) **Advanced Mechatronics and MEMS Devices 1st Edition**, Dan Zhang, Springer New York.
5) **MEMS**, MAHALIK N P, Mcgraw Hill Education.

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EL-402 CMOS Design and Applications

Unit I: Basic Electrical Properties of MOS Transistor

Threshold Voltage V_{th}, Transconductance gm for MOS, MOS Transistor Circuit Model, CMOS and Bi-CMOS Inverters, Inverter Principle, Depletion and Enhancement Load Inverters, The Basic CMOS Inverter, Transfer Characteristics, MOS Transistor Figure of Merit, Latch-up in CMOS Circuits, Noise Margins, Dynamic Behavior, Power Dissipation, Determination of pull-up to pull-down Ratio for nMOS Inverter Driven by Another nMOS Inverter. **[15]**

UNIT II: MOS Circuit Layout

MOS Layers, Stick Diagrams: nMOS Design Style, CMOS Design Style. Scalable Design Rules: Lambda Based Design Rules, Contact Cuts, Double Metal MOS Process Rules, CMOS Lambda Based Design Rules. MOS Device Layout: Transistor Layout, Inverter Layout, CMOS Digital Circuit Layouts and Simulation. **[10]**

UNIT III: Sub System Design, Layouts and Process

Switch Logic: Pass Transistor and Transmission gate, Gate Logic: The Inverter, NAND Gate, NOR Gate, Others form of CMOS Logic. Structured Design: A Parity Generator, Multiplexer, 4 Bit Shifter, 4 Bit Adder. **[12]**

UNIT IV: Basic Circuit Concepts

Sheet Resistance, Sheet Resistance for MOS Transistor and Inverters, Area Capacitance of Layers, Standard Unit of Capacitance, Area Capacitance Calculation, The Delay Unit, Inverter Delay, Propagation Delay. **[6]**

UNIT V: Sequential Circuits

Static Latches, Flip Flops and Registers, Dynamic Latches and Registers, CMOS Schmitt Trigger, Monostable Sequential Circuits, Astable Circuits. Memory Design: RAM Cells **[7]**

References:

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

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EL-403 Digital Image Processing and Applications

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. **[10]**

Unit II: Image processing operations

Image Enhancement: Spatial Domain-Gray Level transformations, Histogram, Arithmetic/Logical Operations, Spatial filtering, Smoothing and Sharpening Spatial Filters, Frequency domain filtering and smoothening operation. **[13]**

Unit III: Image segmentation and Thresholding

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. **[12]**

Unit IV: Image Restoration and compression:

Inverse filtering, Wiener filtering; Wavelets- Discrete and Continuous Wavelet Transform, Wavelet Transform in 2-D, Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression. **[8]**

Unit V: Color image processing:

Color fundamentals, color models, Pseudocolor image processing, basics of full color image processing, color transformation, Color image filtering: smoothening and sharpening, color segmentation: segmentation in HSI color space, segmentation in RGB color space, color edge detection. **[7]**

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

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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.

OR

Part-A

1. Study the principle and working of electromechanical actuators.
2. Study the principle and working of electromechanical sensors.
3. Study the principle and working of bimetal actuators.
4. Study the principle and working of hydraulic actuators.
5. Study the principle and working of Pneumatic actuators.

Part-B

7. Sketch layout and study CMOS inverter using tools.
8. Draw transistor schematic for two/three input logic gates and sketch layouts using tools.
9. Draw transistor schematic for parity generator and sketch layout using tools.
10. Draw sticks diagram and layout for different flip flops.
11. Sketch layout and study multiplexer using tools.
12. Sketch layout and study S-RAM using tools.

Part-C (Using MATLAB)

13. Read an image and perform edge modification operations using MATLAB.
14. Perform erosion, dilation, opening and closing operation over image.
15. Perform skeletonization operation over finger print.
16. Color image filtering using MATLAB
17. Perform histogram operation on images having different contrast levels.
18. Study the basic grey level transformations.
19. Perform image compression using MATLAB.

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