M.Sc. (Electronics)

Syllabus of the Course for M Sc I

Semester	Course	Title of the Paper	Marks	Hours per week
I	EL 101	**Semiconductor Devices**	100	04
	EL 102	VLSI Design Tools and Techniques	100	04
	EL 103	Analog Circuit Design Techniques	100	04
	EL 104	Planning and Management of Electronic Industries	100	04
	EL 105	Practical	100	08
II	EL 201	Optoelectronics	100	04
	EL 202	Numerical Methods in Electronics	100	04
	EL 203	Digital Circuits Design Techniques and DSP	100	04
	EL 204	Advanced Microprocessors and their applications	100	04
	EL 205	Practical	100	08

North Maharashtra University, Jalgaon

Syallabus For M.Sc. Electronics.
(Sem.1 and 2)
EL-101: SEMICONDUCTOR DEVICES.

1. **Properties Of Semiconductors**:
   Properties of direct and indirect semicoductors with their applications, energy band diagrams of compounds semiconductors (III-V and II-VI group), diffusion of carriers and Einstein's relation, properties of degenerate and non-degenerate semiconductors and their application.
2. **Mesurment of semiconductor properties:**
   Measurment of effective mass of carriers by using cyclotron resonance expreriment, measurements of energy gap, mesurment of carrier life time,resistivity mesurment ofsemicoundutor by using four probe method, of carrier concentration, carrier types by Hall effects and mesurments of Hyness-schckly experiment.

3 Junction Devices:
p-n junction diode and its current-voltage characteristics, Design of abrupt and graded p-n junction diode structure, breakdown mechanism in p-n junction diode, junction and diffusion capacitance of a p-n junction diode.P-I-Ndiode:interinsics layer, principle of operation and behaviour of forword and reverse bias, equivalent circuit of P-I-N diode, appliction of P-I-N diode. ZENER DIODE: phenomenon of reverse bias breakdown,principle of operation,and appliction.VARACTOR DIODE:

structure,principle of operation, equivalent circuit, power relation, and appliction of varactor diode. TUNNEL DIODE: principle of operation, structure and application

4. **Bipolar junction Transistor and Power semiconductour Devices**:
   fabrication,working principles and application of microwave transitor,power transistor, switching transistor and unijunction transistor. Hetrostructor transistors and their application, principle,fabrication and appliction SCR and Insulalated Gate Bipolar transistor(IGBT).
5. **Metal Semiconductor junction Diode:**
   Metal- semicondutor junction , energy band digram ,I-V characteristics and operation principle of rectifying(Wm>WsandWm<Ws) and ohmics metal – semiconductor junctions, barrier formation, principle and operation of schottly barrier diode, current transport theory for schttly barrier diode. Operational characteristics,I-V charecterstics principle of operation ,fabrication,Drain current and pinch –off voltage of JFET&MESFET.
6. **Mos Devices:**
   Energy band digram, accumulation ,depletion mode, inversion mode and C-V characteristics of MOS capictor,constructional details IV-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.
7. **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.
8. **Negative Conductance microwave Devices:**
   Construction, Principle of operation and application of impact Avelanche Transit time (IMPATT) Diode, TRAPATT Diode, GUN Diode effect, the transferred electron mechanism, domain formation and various operating modes of GUN diode.

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. **Semiconductor and Electronic Devices,**
   Adhir Bar-Lev, Prentice-Hall of India, Pvt. Ltd., New Delhi.
4. **Physics Of Semiconductor Devices,**
   S. M. Sze, Willey Eastern Ltd.
5. **Semiconductor Devices, Basic Principles,**
   Jaspreet Singh, John Willey & Sons, Inc., NEW YORK, 2001
6. **Physics Of Microwave Semiconductors Devices and their application**
   W.A.Watson
7. **Electrical Properties Of Materials,**
   L. Solymer and D. Walsh, VI th Edition, Oxford Science Publications-1998.

8. **Physics Of Semiconductor Devices,**
Michael Sure, Prentice-Hall of India, Pvt. Ltd., New Delhi.
9. **Semiconductor Devices, Circuits,**
Henry Zanger, John Willey and Sons
10. **Solid State Physical Electronics,**
Van Der Ziel, Second Edition, Prentice-Hall, Inc., Englewood Cliffs, N. J.

EL-102: VLSI DESIGN: TOOLS AND TECHNIQES

1. **Basic IC components and their performance estimation**
Resistance estimation , résistance of nonrectangular, regions, capacitance estimation , MOS capacitor characteristics , MOS devices capacitances , Diffusion capacitance, routing capacitance , distributed RC effect , capacitance design guide , wire length design guide , switching characteristics, fall time determination of conductor size , power consumption, static dissipation , dynamic dissipation ,charge sharing Yield. [09]
2. **MOS Transistor Theory**
Metal oxide semiconductor (MOS) and Related VLSI technology, basic MOS transistors , Enhancement and depletion mode transistor action, Threshold voltage, V_{th} adjustment , Body effect, MOS Device design equation , MOS transistor, MOS switches. [07]
3. **Basic electrical properties of MOS circuits**
Drain to source current I_{ds} versus voltage V_{ds} relationships Aspects of MOS transistor threshold voltage V_t , Transconductance g_m and output conductance g_{ds} , 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.
[10]
4. **Study for CMOS circuits**
The CMOS inverter, DC Characteristics, influence of β ratio on transfer characteristics , noise margin , transmission gate- DC characteristics, latch-up in CMOS circuit, CMOS logic : The inverter , Combinational logic , NAND gate, NOR gate, Ex-OR gate, Complex gate, compound gates , Multiplexers , memory.
[09]
5. **Optimization techniques of CMOS parameters**
Silicon semiconductor technology-wafer technology, oxidation , selective diffusion , lithography , positive and negative photo resist, mask preparation , The silicon gate process, CMOS technologies : The P-Well Process, the N-well process, twin tub process, Silicon on insulator. [07]
6. **MOS Circuit design process**
MOS layers , stick diagrams, nMOS design style, design rule and layout, λ-Base design rules ,contact cuts, double metal MOS process rules, A double metal-single poly CMOS rules, Floor planning, Layout diagram-a brief introductions.
[08]

Reference Books:

1. **Principle of CMOS VLSI Design :** A system perspective by Neil H. E. Weste and Kamaran Eshraghian

2. Basic VLISI design: system and circuits by
   Douglas A. pucknell and kamran Eshranghian, PHI,Pvt.Ltd.New Delhi.
3. Introduction to VLSI System by
   C.Mead and L. Conwy, Additison Wesley publication co.1985
4. Introduction to NMOS and VLSI system design
   A.Mukharjee, prentice Hall,1986

EL-103: Anolg circuit Design Techniques:

1.Bipolar junction Transistor circuits:

Common Emitter configurtion, signfication of input , output and transfer characteristis, load line concept, direct current and alternating current load line,Quisent point, fixed bias,emmiter bias ,voltage divider bias, maximum power dissipation in each bias

2.Analysis and application of transistor amplifier circuit:

Analysis of transistor amplifier, trans-conduductance,small signal resistances, hybrid parameter analysis, current gain, voltge gain and power gain of an amplifier, switching characteristics and applications, circuits to improve switching time of transistor, applications.

3.Frequency response of amplifier and applications:

Actual midband current gain of amplifier, selection criteria for coupling capacitor and bypass capacitors, low frequency response , midband 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 , tuned amplifier, synchronus and stagger tuning.

4.Field effect transistor circuit 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 charact. Of MOSFET, its significance, biasing methods for MOSFET

5. Feedback amplifier and oscillators:

Concept of feedback and types of feedback configuration and corresponding analog ckt, effect of negative feedback on gain ,input impedance output impedance and bandwidth frequency response of feedback amplifier, Singlepole and double pole response, Oscillators;

Classification, phase shift oscillator, analysis, Wein bridge oscillator, analysis, crystal oscillator

6.Operational amplifier Circuits and applications:

Differential amplfier. Instrumentation amplifier, compensated integrator and differentator, analog computation, Qudrature oscillator, active filters: First and second order low pass and high pass active filter, transfer function , band pass and band reject filters, phase shifters, voltage control oscillator phase locked loop.

Reference

1. **Integrated Electronics - Millman Halkias**
2. **Microelectronics - Millman**
3. **Electronics circuits -Mottershed**
4. **Operational amplifier - Clayton**
5. **Electronics for Scientists -Brophy**

EL-104: Planning & Management of Electronics industries

1. **Data processing in electronics industry**
   Need & utility of market reaseach for the electronics products, Data types: Primary and secondary , Data collection methods : Dictated material , Questionnaire , observation & interview , Telephone messages, document, Sampling techniques , Data analysis techniques ,Classifying information : alphabetically, Numerically, Chronologically ,by subject, department or product.
   [10]
2. **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. [07]
3. **Planning of new Electronics industry**
   Management concepts, planning, organizing, staffing, direct,co-ordination, control as applied to electronics industry, Environmental effects. Financial crises & their remedies , sales crises & their remedies , report preparation , import ants of codification , Types of codes. Management report preparation , input & output forms, validation & data dictionary . [08]
4. **Marketing strategy and management:**
   Marketing it's 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 & management of electronics products. [07]
5. **Quality management in Electronics industry:**
   ISO certification series , TQM , Kaizen, Modern concepts of quality management , Customer satisfaction ,Productivity, etc [06]
6. **Optimization techniques :**
   Assignment problems , Transportation problems, Optimal solutions, Simplex method, minimization & maximizations by simplex method , Criticle path method and PERT. [12]

Reference Books :

1. Principle and Practical of Management.
2. Entrepreneurship and small-scale industries.
3. Marketing Management
4. Research Methodology
5. operation research

EL-201:**OPTO-ELECTRONICS**

1. **LASER:**
   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 ,application of LASER [07]
2. **p-n JUNCTION AND HETROJUNCTION :**
   Junction capacitance, 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. [07]
3. **ELECTRICAL AND OPTICAL PROPERTIES OF LASER DIODES:**
   Carrier confinement and injected carrier utilization, threshold current density and differential quantum efficiency, Temperature dependence of J_{th} , optical anomalies and radiation confinement loss in asymmetry hetrojunction lasers.[06]
4. **LIGHT DETECTORS:**
   Idea of light detectors, Natural and quantum specialized light detectors, Types of special light detector – thermal & 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 photo detectors. [07]
5. **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. [08]
6. **OPTICAL FIBER: THEORY AND APPLICATION**
   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]

Reference Books:

1. **An Introduction of Optical Fiber:** Cherin A.H, Mc. Graw Hill, Int. Student.d.
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

EL-202:Numerical Method in Electronics

1. **Fundamentals of C** [05]
2. **Iterative methods**
   Introduction, Beginning an iterative method , the method of successive bisection , the method of false position , Newton –Raphson iterative method, Scant method, comparison of iterative methods. Implementation strategies. [07]
3. **Solution of Simultaneous Equations**
   Introduction, Existence of solution, solution by elimination , the Gauss elimination method, pivotal condensation , Ill condition equation , Gauss-Seidel iterative method, Gauss-Jorden method, Matrix method , Gauss-Jordan Matrix inversion , Implementation strategies. [08]
4. **Interpolation**
   Introduction, Linear interpolation , Polynomial interpolation, Lagrange interpolation, Newton interpolation, difference tables, truncation errors in interpolation, Implementation strategies. [08]
5. **Numerical Integration**
   Introduction, Trapezoidal rule, Simpson's 1/3 rule, Simpson's3/8 rule,Gaussian quadrature , Implementation strategies. [06]
6. **Numerical Differentiations**
   Introduction, Differentiation by polynomial fit, higher order Derivative , errors in Numerical Differentiation, Implementation strategies. [04]
7. **Solution of Differential equations**
   Introduction, Solution by Taylor's Series, Euler's Method, Modified Euler's Method, Predictor-Corrector Method, Runge-Kutta Method, Implementation strategies. [06]

Reference Books:

1. **Introduction Methods of Numerical Analysis:**
   S S Sastry, PHI Publications
2. **Computer oriented Numerical Methods:**
   V Rajaraman, PHI Publication.
3. **Computer oriented Statistical and Numerical Methods:**
   E Balagurusamy, Macmillan India Ltd.

EL-203:Digital Circuit Analysis & Digital Signal Processing

1. **Boolean Algebra and K-map**
   Postulates, identities, De-morgan's Theorem, Simplification of some logical expression using Boolean expression from given circuit, Literal, Minterm, Maxterm, Standard product of sum & sum of product . Three four & four to five variable K-map and simplification. Numericals POS & SOP obtaining logic systems K-map Arithmetic & code converters circutits . [12]
2. **Sequential & Combinational Logic circuit**
   Different types of FFs, Designing of Synchronous & Asynchronous counters, Natural & trancated counters, regular & irregular counters, Design of counters using chips, Designing of Presettable counters, Serial to Parallel converter & Parallel to serial converter using registers, Multiplexer & Demultiplexer & their application. [12]

3. **Digital Applications**
   Decimal counting, Multiplexed display, Dynamic display, Frequency measurement using counter, speed measurement. Digital voltmeter, sound recording & play back system. [06]
4. **Digital signal Processing**
   Advantage of DSP, application areas, Basics of DSP operations, convolutions, correlations, digital filtering, discrete transformation & modulation DSP chips, real world application of DSP, e.g. Audio application, telecommunication application, Biomedical application. [07]
5. **Analog Interfacing using Digital Signal Processing**
   Block diagram of real time system, Sampling of low pass & high pass signals, Uniform & Nonuniform quantization and encoding , over sampling in A/D conversion , D/A conversion process , Anti-imaging filtering, over sampling in D/A conversion, limitation of real time signal processing with analog signals, Applications. [07]
6. **Digital Signal Processing Applications**
   Digital Audio Mixing, Speech synthesis and recognition, Compact Disk Audio system, Digital cellular Mobile Telephone, Set-top box Television reception , Fetal EGC monitoring, DSP base closed controlled anesthesia. [07]

Reference Books:

1. **Digital Signal Processing (IInd Ed):**Emmanuel C. Ifeachor & Barriew.
2. **Digital Electronics & Logic Design:** N.G.Palan , Technova Publications.
3. **Digital Design:** M. Morris Mano, Pearson Publication.
4. **Digital Electronics :** D. C. Green, Pearson Education , Asia.

EL-204: ADVANCED MICROPROCESSORS and THEIR APPLICATIONS

1. **Introduction**
   Historical background, Architecture of 8-bit, 16-bit and 32-bit Intel microprocessors, segmentation, bus interface unit, execution unit, management unit, decoding unit, operating modes, and comparative study. **[07]**
2. **Addressing Modes and Assembler directives**
   Addressing modes of 8086, Data and branch type addressing modes, immediate, register, direct, register indirect, register relative, base indexed, relative based indexed, intra segment, inter segment, Addressing modes in advance processor, Data and branch addressing modes, Directives and operators, EQU, ORG, DB, DW, DD, DQ and DT, Attributes and values returning operators, structures and records, segment definition and related directives. **[06]**
3. **Instruction set and Programming**
   Instruction set of 8086, and its comparison with advanced microprocessor, data transfer, arithmetic, logical, flag manipulation, packed BCD, unpacked BCD, branch, stack, input/output, miscellaneous, assembler instruction format, label field, op-code, operands, comment, simple programs, arithmetic programs, code conversion, stack related programs, procedures, nested and recursive procedures, macros and use of repeat prefix for string processing, use of interrupts. **[15]**
4. **Interfacing applications with computer**

Interfacing of I/O devices and decoding techniques, interfacing of keyboards, displays, printers, stepper motors, data acquisition and processing, digital data transmission using MODEM and standard phone lines, Hardware and software debugging techniques, flowchart for the program development. **[11]**

5. **Co-processors**

   8087 math co-processors, its need, data types-integer, word integer, short and long integer, packed decimal, short real, long real and temporary real, instruction set-data transfer, arithmetic, processor, interconnection and signals and its applications. **[06]**

6. **Robotics**

   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 robot, walk through, lead through, manual, off line programming, programming languages, victors assembly language and machine control language, work cell control and interlocks, robotics sensors – vision sensors, touch sensors and voice sensors. **[07]**

7. **Robotics applications**

   Need of robotics in industries, material transfer, machine loading, spray painting, welding, processing operation, assembly and inspection.

References:

1. **Microprocessor and interfacing programming and hardware**
   Douglas Hall, Mc. Graw Hill
2. **Microcomputer systems-The 8086/8088 family, architecture, programming and design.**
   Yu-Cheng Liu, G. A. Gibson, PHI, New Delhi
3. **Microprocessor Based process control**
   C. D. Johnson, PHI, New Delhi
4. **CAD/CAM-computer Aided Design and Manufacturing**
   M. P. Grover and E. W. Zimmers, Jr, PHI, New Delhi
5. **Microprocessors with application in process control**
   S. I. Ahson, TMH Co. Ltd.
6. **Computer controlled Industrial machines: process and Robots**
   Gupton, PHI, New Delhi
7. **Microprocessor and Microcomputer based system design**
   M. Rafiquzzaman, Universal Book Stall, New Delhi

Syllabus of the Course For M.Sc. II

Semester	Course	Title of the Paper	Marks	Hours per week
III	EL 301	Automatic Process Control Systems	100	04
	EL 302	Micro controller and Applications	100	04
	EL 303	Advanced Communication Systems	100	04
	EL 304	Practical	100	08
	EL 305	Project	100	--
IV	EL 401	Modeling and Simulation Techniques	100	04
	EL 402	Design Fabrication Techniques	100	04
	EL 403	VLSI Design Methods for ASICs	100	04
	EL 404	Practical	100	08
	EL 405	Project	100	--

i) M.Sc. (Electronics) –

EL-301 Automatic Process Control Systems

Chapter-1: Physical Parameters Measurement

Types of Sensors, Temperature Sensors-RTD, Thermistor, Thermocouple, Lead Compensation Techniques, Pressure Sensors, Flow Sensors, Humidity Sensors, Density Sensors, Viscosity Sensors, Thickness Sensors, Proximity Sensors (only sensors which produces electrical output need to be cover).

Chapter-2: Control System Introduction

Basic Concepts of Control System, Open Loop System and Close Loop System, Examples, Effect of Feedback on the gain, Stability, Sensitivity Noise, Types of Feedback Control Systems- Linear Vs Non-Linear, Continuous, Discrete, Position Control and Velocity Control.

Chapter-3: Mathematical Analysis of Control Systems

S-plane, Poles and Zeros of Function, Differential Equations, State Equations, Transfer Functions – Examples, Block Diagrams, Bock Diagram Types, Simplification Rules, and Reduction Techniques – Examples, Signal Flow Graphs, Basic Elements, Basic Properties, Definition of Terms, Gain Formulas, Stability Analysis, Characteristics Equations, Methods of Determining Stability, Hurwitz Criteria, Routh's Tabulation.

Chapter-4: Time and Frequency Domain Analysis

Steady State Errors, Unit Steps Response, Transient Response, Frequency Response, Niquist Satabity Criteria, Stability Analysis with Magnitude Phase Plot, Constant M and Constant N Circles, Nichol Chart.

Chapter-5: Root Locus Techniques

Introduction, Basic Properties, Construction of Root Loci, Asymptotes, Number of Branches, Intersection of Asymptotes, Root Loci on Real Axis, Intersection of Root Loci with Imaginary Axis, Break Away and Saddle Point, Calculation of K on Root Loci.

Chapter-6: Controllers

Specification, Configuration, Fundamental Principle, Proportional, Proportional Integral, Proportional Derivative, Proportional Integral Derivative, Phase Lead, Phase Leg, Lead Leg, Notch Filter, Forward and Feed Forward Controllers, ON-Off Controllers, Analog Controllers using Operational Amplifier, Digital Amplification of Analog Controllers, Digital Controllers.

References:

1) Process Control System, By C. D. Johnson.
2) Modern Control Engineering, By K. Ogata.
3) Automatic Control System, By Benzamin . C. Kuo

EL-302 Microcontroller and Applications

Chapter 1: Introduction

[7]

Single Chip Controllers, Design and testing of software for Micro-controllers, Architectural features of different types of architectures used in Micro-controllers, like Van Neuman, Harward, CISC, RISC, SISC architectures. Special features like watchdog timer, digital signal processors, clock monitor, resident program, loader, monitor, General applications of Micro-controllers.

Chapter 2: Characteristics Features of MCS 96 Family:

[7]

Comparison of Intel MCS 51/251 and MCS 96 Microcontroller Families, Overview and features of MCS 96(HSIO) family, Intel 80C196 CHMOS 16 bit Microcontroller, Pin configuration, Architectural block diagram, Signal descriptions, memory and address space, registers, buses, and data transfers, different modes of operation.

Chapter 3: Intel 80C196 Instruction Set and Programming:

[15]

Instruction set : different types of instructions, instruction significance and execution, Addressing modes, effective address, simple programs, loop programs, subroutines and examples, Memory Management, Programming the Microcontroller for different applications, Synchronous Serial Port, Serial port wave forms (shift register mode), Interrupts handling and priority, External Memory Interfacing.

Chapter 4: Input/Output Interfacing and interrupts:

[7]

Serial and parallel ports and software control of ports, port I/O registers, synchronization in data transfer and handshaking, interrupt management, interrupt service routines, and interrupt examples keeping time and parallel port transfers, A/D control and status registers and applications.

Chapter 5: **Interfacing Applications**

[9]

Interfacing of LEDs, Switches and 7- segment displays, keyboard interfacing, RS-232 interfacing, DC motor interfacing, Stepper motor interfacing, DAC, Data acquisition system, real world interfacing.

Tutorials

Study of Developments Tools for Microcontroller based system:

Simulators, resident debuggers, emulators, Java on embedded systems

References:

1. The 16 bit Intel 8096 Programming, Interfacing, applications by Ron Katz and Howard Boyet.
2. The 8051 Microcontroller, 3rd Ed., Scott MacKenzie,1999, Prentice Hall.
3. The 80251 Microcontroller, Kenneth Ayala, 2000 Prentice Hall.
4. The 8051 Microcontroller: Hardware, Software, and Interfacing, 2nd Ed, James Stewart and Kai Miao, 1999, Prentice Hall.
5. The art of programming embedded systems by Jack G. Ganssle.
6. Design with Microcontrollers by John B. Peatman.
7. Microcontroller: Architecture, implementation and Programming by Kenneth Hintz and Daniel Tabak, Tata McGraw Hill.

EL: 303 **Advanced Communication Systems**

Chapter-1: Optical Fiber Communication System Design

[10]

Introduction, Block diagram of communication system, Base band and pass band signal, Analog and digital signals, Advantageous of optical fiber communication, Transmitter design, Receiver design, Digital optical receiver, Analog optical receiver, Optic fiber link design, Variables used for design of a fiber optic system, Modulation and data coding, Power budgeting, Source selection (matching LEDs to fibers and Lasers source), Fiber choice, Single mode fibers, Fiber loss, Fiber to receiver coupling, Receiver sensitivity, other Losses, System margin, Bandwidth budget, Over all-time response, Fiber response time, receiver response time, Constant performance trade-offs, Coherent optical fiber receiver system.

Chapter-2: Optical Fiber Communication Network

[10]

Introduction, Network topologies, **Network design trade-offs:** Data bus power budget, Star network, Linear bus network, Ring network, Standard fiber networks, Local area network (LAN) systems, Fiber distributed data (FDDDI) network: Frame and token formats, Network

operation, Station types, Prioritization schemes, Station management, FDDDI optical components, Synchronous optical network (SONET)/Synchronous digital hierarchy **(SDH):** SONET optical specification, SONET rate and format specification, SONET overhead channels, SONET payload pointer, Broadband signal, Handling, Virtual tributaries, ATM and SONET.

Chapter-3: Optical Fiber Communication Systems using WDM and DWDM
[10]

Introduction, Wavelength selective WDM vs. broad band WDM: Wavelength selective WDM, Broadcast and select techniques, Multiplexers: Angularly dispersive devices, Filtering devices, Sources for WDM, Nonlinear effect on WDM link, WDM and optical amplifiers, Multipoint, Multiwavelength networks.

Chapter-4: Cellular Mobile Systems
[12]

Necessity of cellular mobile telephone system, Mobile and base transmission frequencies, Trunking efficiency, A basic cellular system, Performance criteria of cellular telephone system: Voice quality, Service quality, Special features, Uniqueness of mobile radio environment: Propagation attenuation of mobile radio transmission medium, Model of transmission medium, Mobile fading characteristics, Direct wave path, Line-of-sight path and obstruction path, Noise level in cellular frequency band operation of cellular systems, marketing image of hexagonal shaped cells, Overview of digital cellular systems: Architecture of Global System for Mobile (GSM) and Code Division Multiple Access (CDMA) system

Chapter-5: Design of Cellular Mobile Radio System
[10]

Introduction, Maximum number of cellular hour per cell, Maximum number of frequencies, Channels per cell, Concept of frequency reuse channels: Frequency reuse schemes, Frequency reuse distance, Number of customers in the system, Co-channel interface reduction factor, Cell spitting consideration of the components of cellular systems: Antennas, switching equipments, Data link, Design of Global System For Mobile (GSM) and Code Division Multiple Access (CDMA) system

Tutorials

Operational Techniques and Technologies of Cellular Mobile System:

Adjustment of the parameters of a system: coverage for a noise-limited system, Reduction of the interference, Traffic capacity, coverage-Hole filler: Enhancer (repeaters), Passive reflector, Diversity, Co-phase technique, Leaky Feeder: Leaky waveguides, Leaky Feeder radio communication, Cell-splitting: Transmitted power after splitting, Cell Splitting technique, Small cells (microcells), Narrow beam concept, separation between Highway cell sites, Low density small market design **Digital Mobile Communication Systems:** Advantages of digital systems, Analogy to modulation schemes, Digital detection, Carrier recovery, Carrier

phase tracking, Phase equalization circuits for cophase combining, bit synchronization, modulation for digital systems, Modulation schemes

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. Fiber Optic Communication, By D C Agrawal, a. h. Wheeler and Co. Pvt. Ltd. Publication, Allahabad
6. Optical Communication System, John Gower, Prentice Hall, India
7. Optical fiber communication, Keiser G., McGraw-Hill, Publication
8. Optical Electronics in Modern Communications, by Amnon Yariv, Vth edition, Oxford University Press, 1997, New York
9. Optical and Wireless communications, By Matthew N.O. Sadiku, CRC Press, 2002

EL-304 Practicals

Part-A

1. Temperature monitoring and control using thermistor and thermocouple.
2. Thickness measurement using ellipsometer
3. Measurement of humidity by using humidity sensor.
4. Flow measurement by using mass flow controllers.
5. .Studies of analog controllers using operational amplifier.
6. Study of Digital ON-OFF control.

Part-B

1. Study of 16 bit microcontroller kit.
2. Writing arithmetic programs using 80196.
3. Writing code conversion programs using 80196.
4. Writing programs using 80196 for the string processing.
5. Monitoring physical parameter using ADC and microcontroller.
6. Speed control of dc motor by interfacing DAC with microcontroller.
7. Interfacing stepper motor using microcontroller.
8. Interfacing key switches and displays with microcontroller.
9. RS232 interface with microcontroller.

Part-C

1. Setting up fiber optic Analog and Digital link
2. Study of pulse amplitude/width modulation
3. Study of time division multiplexing for analog and Digital Signals
4. Study of losses in optical fiber Communication
5. Measurement of numerical aperture of given Optical Fiber
6. Study of framing/marker in time division multiplexing
7. Study of Manchester coding and decoding
8. Study of PCM voice coding and code chip
9. Study of pulse position modulation

***Note: Student has to perform total 12 Practicals (at least four practical from each part)**

EL-401 Modeling and Simulation Techniques

Chapter 1: Introduction [7]

Models and their applications, Common types of mathematical models used for engineering systems, Derivation of models from physical relations, Model determination from input- output observation, Basic principle of simulation, Analog and digital simulation techniques, Models: Structural, Process, Continuous, Discrete, Deterministic, Random, input/output, static, dynamic, multilevel.

Chapter 2: Classical and Semi-classical models: [7]

Boltzmann transport equation, classical semiconductor equations- drift diffusion approximation, generation and recombinations, different generation and recombination mechanisms, limitations of drift-diffusions, energy transport, semiclassical and hot electron models, hydrodynamic and semi-classical semiconductor equations, modeling of semiconductor laser diode, general aspects, static models and dynamic models, model verification and validation.

Chapter 3: Numerical Techniques: [10]

Finite difference methods, first order and second order derivatives and discrimination, finite element method, solution of poison's equation, solution of steady state continuity equation for electrons and holes, advantages and disadvantages of finite element method, Monte Carlo simulation techniques, basic concepts, Random variables, random number generation and testing, analysis of simulation results, confidence intervals, variance reduction techniques. Case studies of analytical and simulation studies

Chapter 4: Modeling of Semiconductor Devices [17]

p-n junction, p-n junction C-V characteristics, breakdown, Schottky diodes, Hetero-structure diodes, Simulation of above device characteristics in graphical format, Simulation of simple laser diode and plot its characteristics by considering appropriate materials and parameters, PIN diode, Avalanche Photodiode, Quantum transport modeling, 1D models, discretized Schrodinger equation, Transmission matrix formation, I-V characteristics.

Chapter 5: Universal FET modeling

sub threshold regime, unified charge control model, short channel effects, I-V modeling. Capacitance modeling (Ward Dutton and Meyer models) Universal models for MOSFET, MESFET, HFET and TFT.

Tutorials:

1. Modeling of different types of diodes e.g. LED
2. Modeling of CMOS

References:

1. G.Gordon, 'System Simulation', 2nd ed., Prentice Hall
2. Narsing Deo, 'System Simulation with Digital Computers', Prentice Hall
3. R. Leigh, 'Modelling and Simulation', Peter Peregrims Ltd.,. 1983.
4. M.Law, W.D.Kelton, 'Simulation Modelling and Analysis, Mcgraw Hill, 1982.
5. Raj Jain, The Art of Computer Systems Performance Analysis, John Wiley and Sons, New York, USA, 1991
6. Trivedi, K.S, Probability and Statistics with Reliability, Queueing and computer science Applications, Prentice Hall of India, Reprinted in 1990.

EL-402: Device Fabrication Techniques

Chapter 1: Crystal Growth, Wafer Preparation and Diffusion

CZ and Bridgeman techniques, Zone refining, Ingot shaping, Polishing, Cutting, Wagering, Scribe lines, Cleavage, Diffusion: Nature of diffusion, Interstitial and substitutional gradient, the diffusion concentration, Field aided motion, Iteration with charged defects, the dissociative process, Impurity behavior in silicon, substitutional diffusers, Interstial substitutional diffusers.

Chapter 2: Fabrication and Deposition Techniques

Epitaxy: Vapor phase epitaxy, Basic transport process and reaction kinetics, reaction at the substrate, Elements of nucleation and growth, Doping and autodopping, Process selection and capabilities, buried layer epitaxial defects, 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.

Chapter 3: Lithography

The lithographic process**:** 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, variable does stitching errors. 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.

Chapter 4: Oxidation

Thermal oxidation of silicon, intrinsic and extrinsic silica-glass, oxide formation, 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, the agreement with experimental results, segregation coefficient, impurity redstribution 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

Chapter 5: Characterization Techniques

Physical Characterizations: Refractive Index measurement crystal imperfections, strength, 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, break down strength measurement, **Chemical Characterizations:** Spectroscopic Techniques U-V, IR photoacaustic spectrophotometry, LEED, LEPD, RHEED, ESCA.

NOTE: Though characterization technique are shown here as separate block, they would covered at appropriate place, while dealing with other processing techniques.

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 : Reston publication Co. PHI, 1987
5.Large Scale Integration, M. J. Hower and D. B. Morgen, John Willey and Sons Ltd.
6.Introduction to VLSI systems, Mead C. and Conway L. , Addison Pub. Co., USA
7.VLSI Design for analog and Digital circuit: R. L. Geiger, P. E. Allen , N. R. Strader, Mc. Graw Hill
8.Basic VLSI Design, D. A. Pucknell and K. Eshragian, PHI
9.Analysis and design of digital integrated circuit: Hodges D. A. and Jackson H. G.
10. SPICE – A guide to circuit simulation and analysis using PSPICE : Paul W. Tuinenga, PHI

EL-403: VLSI Design Methods for ASICs

Chapter 1: CMOS Subsystem Design

Adders and related functions: Combinational adders, dynamic Combinational adders, transmission gate adder, carry lookahead adder, Manchester carry adder, binary lookahead adder, carry select adder, parity generator, comparators, **Binary Counters:** asynchronous counters, synchronous counters, **Multipliers:** serial multipliers, serial / parallel multipliers, Parallel Multipliers, other multiplier structures, Random access multipliers, **Programmable logic arrays:** Introduction, electrical & physical on CMOS PLAs, pseudo nMOS nor gate, dynamic CMOS–2phase clocking, dynamic CMOS 4 phase, detailed PLA layout, PLA design points, programmable logic paths (PPL's)

Chapter 2: Structured Design and Testing

Design Style: Introduction, structured design strategies, Hand crafted mask layout , gate array design, slandered cell design, Symbolic layout methods, Automated Synthesis procedural module definition, silicon compilers, **The custom design tool box:** Introduction, circuit level simulation, timing simulation, logic level simulation, switch level simulation, timing verifiers, schematic editors, net list comparison, layout editors, design rule checkers, circuit extractors, **Testing:** introduction, fault models, design for testability, ad hoc testing, structured design for testability, self test & built in test, Layout for improved testability.

Chapter 3: Symbolic Layout System

Introduction, Coarse grid symbolic layout , gate matrix layout, sticks layout, devices, contacts, wires, pins, instances, representations, Symbolic Design tools – overall organisator, file organization, software organization, chip design process, cell design process, interactive, graphics editors, circuit interpreter, virtual grid Compaction, graph based compaction, mask generation, module assembly, Future direction – flexi cells, Expert systems.

Chapter 4: CMOS System case studies

Dynamic warp processor: Introduction, the problem, the algorithm, a functional overview, detailed functional specification, structural floor plan, physical design, fabrication

pixels-planes graphic engine: introduction, raster scan graphic fundamental, pixels-planes system overview, chip electrical design, chip organization and layout, clock distribution, **Hierarchical layout and design of single chip 32 bit CPU:** Introduction ,design methodology, technology updatability and layout verification.

Chapter 5: Practical Realities and Ground Rules

Further thoughts on floor plans / layout, Floor plan layout of the four bit processor, input / output (I/O) pads, "Real estate", further thoughts on system delays, Ground rules for successful design, Scaling of MOS circuits.

References:

1. Basic VLSI Design :Systems and Circuits, Douglas A. Pucknell & Kamran Eshraghian, Prentice Hall of India Private Ltd. , New Delhi , 1989
2. Principles of CMOS VLSI Design : A System Perspective, N. Westle & K. Eshraghian , Addison – Wesley Pub.Co.1985
3. Introduction to VLSI System,C. Mead & L. Canway, Addison Wesley Pub Co.1990
4. The Design & Analysis of VLSI Circuits, L. A. Glassey & D. W. Dobbepahl, Addison Wesley Pub Co. 1985
5. Introduction to NMOS & VLSI System Design, A. Mukharjee, Prentice Hall, 1986
6. VLSI Design techniques for analog and digital circuits,R. L. Geiger, P. E. Allen & N. R. Streder, McGraw Hill Int, 1990
7. Digital Integrated Circuits: A Design Perspective,Jan A. Rabey, Prentice Hall of India Pvt Ltd 1997

EL-404 Practicals

Part-A Modeling and Simulation Techniques

1. Finite difference discretization and solution of Poisson's equation using MATLAB/C.
2. Finite difference discretization and solution of Continuity equation for electrons/holes using MATLAB/C.
3. Finite difference discretization and solution of carrier density equation using MATLAB/C.
4. Finite element analysis and solution of Poisson's equation using MATLAB/C.
5. Analysis of Bolzmann transport equations using MATLAB/C.
6. Studies of different kinds of generations and recombination in compound semiconductors.
7. Studies on classical and semi classical models.
8. Analysis of simple p-n junction diode using static model.
9. Random number generation and testing.
10. Monte carlo integration for accurate solution.
11. Studies on quantum transport modeling.
12. Discretization of Schrodinger equation.
13. Analysis of Eber-Moll model for the BJT.
14. Transmission matrix formation.
15. Study of Effective index method for waveguide analysis.
16. Solution of wave equation for field intensity distribution.

Part-B VLSI fabrication Techniques

1. Study of wafer handling and cleaning.
2. Surface morphology of undpoed and clean wafer.
3. Study of batch processing in semiconductor industry.

4. Thermal diffusion of impurities in silicon substrate..
5. Study of LPE system for growth of compound semiconductors.
6. Studies on PECVD system for growth of thin and thick films.
7. Photolithography using positive photo resist.
8. Studies on dry and wet etching processes for semiconductors.
9. Growth of Silicon dioxide layer for the microelectronics applications.
10. Studies on electrical characterization techniques of diode and transistor.
11. Studies on optical characterization techniques (ellipsometry/FTIR)
12. Determination of bandgap using photoluminescence.
13. Determination of V_{th} of MOSFET.
14. C-V characteristics of MOSFET and measurement of carrier density.
15. I-V characteristics and hot electron effect of MOSFET.

Part-C VLSI Design Methods for ASICs

1. Preparation of transistor layout for different kind of adders.
2. Preparation of physical layout for different kind of adders.
3. Studies of different custom tools for VLSI.
4. Studies of different types of faults and defects in semiconductors.
5. Testing processes for effective layout generation.
6. Use of gate arrays for modular construction.
7. Net list generation and analysis for the circuit extraction
8. Grid and graph compaction techniques for the effective layout.
9. Physical layout generation for the microprocessor/microcontroller chip.

***Note: Student has to perform total 12 experiments from any two parts (6+6).**