REVISED COURSE CURRICULUM FOR 3RD SEMESTER

(IC Manufacturing OF ENGINEERING COURSES)

W.E.F.2023-24

BOARD OF TECHNICAL EDUCATION

MUNI MAYA RAM MARG

PITAMPURA, DELHI-110034

Second Year (III Semester)

Curriculum Structure for Diploma in Engineering course of

IC Manufacturing

STUDY SCHEME / CREDIT (SEMESTER – III)

BRANCH: IC MENUFACTURING

Sl.	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs./ week	Credits	Internal Marks	External Marks
									Time	Time
				L	T	P			1:30 Hrs. (Each sessional)	3:00 Hrs.
1	Program Core Course	**23EC-PC201**	Electronics Devices & Circuits I	3	0	0	3	3	50	100
2	Program Core Course	**23EC-PC203**	Digital Electronics	3	0	0	3	3	50	100
3	Program Core Course	**23EC-PC205**	Electronic Measurements Instruments & Troubleshooting	3	0	0	3	3	50	100
4	Program Core Course	**23EC-PC207**	Electric Circuits & Networks	2	1	0	3	3	50	100
5	Program Core Course	**23IM-PC209**	Introduction To VLSI Fabrication	3	0	0	3	2	50	100
6	Program Core Course	**23EC-PC251**	Electronics Devices & Circuits I Laboratory	0	0	2	1	1	50	50
7	Program Core Course	**23EC-PC253**	Digital Electronics Laboratory	0	0	2	1	1	50	50
8	Program Core Course	**23EC-PC255**	Electronic Measurements Instruments & Troubleshooting Laboratory	0	0	2	1	1	50	50
9	Program Core Course	**23IM-PC257**	Semiconductor Fab Familiarization Laboratory	0	0	4	4	2	50	50
10	Summer Internship	**23IM-SI-259**	Summer Internship- I*	0	2	0	2	2	50	50
	Total Credits							**20**	**500**	**750**
	Grand Total of Marks								**1250**	

Note: * Students have to compulsory undergo 04 weeks of internship during summer vacation after 2nd Sem Exams and have to submit report and presentation for 3rd Sem Final examination evaluation.

SEMESTER – III

DetailedCurriculumContents

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23EC-PC201**
Course Title	:	Electronic Devices and Circuits-I
Number of Credits	:	3 (L:3, T:0, P:0)
Course Category	:	Program Core Courses

Course Objectives: The course provides the students with basic understanding of the principles of common electronic devices and circuits of importance. The knowledge regarding application of various circuits and devices. Practical experience in the design, fabrication and testing of circuits.

Course Content:

1. Semiconductor Diodes [8 Hrs.]

a) P – N Junction Diode, Mechanism of current flow in P- N Junction, P – N Junction Diode characteristics, Zener and Avalanche Breakdown, Diode Resistance, Concept of Junction Capacitance in forward and reverse bias condition, Ideal Diode, P-N junction diode as a Rectifier, Half wave, Full wave and Bridge rectifier. Harmonic components in a rectifier circuit, Inductor and Capacitor filer, L-section and Pie Filter Circuits.

b) Special Purpose Diodes: characteristics and applications of the following diodes: Schottky Diode, Varactor Diode, LED, Photodiode, voltage regulation using Zener Diode. Familiarization with Data sheets of all the above diodes.

2. Bipolar Junction Transistor [8Hrs.]

Device Structure, NPN and PNP Transistor, Modes of Operation, Transistor Current Components, CE, CC and CB Configurations, Input – Output Characteristics and Comparison. Concept of DC Load Line and Operating Point. Transistor as a switch.

3. Transistor Biasing & Single stage Amplifier [8 Hrs.]

a) Need for Biasing, Stabilization, and Stability factor. Various biasing circuits: Analysis, Merits and Demerits. Design of a voltage divider biasing circuit with numerical.

b) Transistor as an amplifier, Single stage amplifier circuit, Analysis of Transistor circuit using resistance model, Gains: current, voltage and power. Input and Output Impedance. Phase reversal, AC load line, Numerical on load line, current, voltage and power gains.

4. Low Frequency and High frequency Operation of BJT [9 Hrs.]

Transistor as a two-port device; h-parameter model for CE, CB and CC configurations; approximate h-parameter model for CE, CB and CC configuration; small signal performance analysis using h-parameter model and approximate h-parameter model; Hybrid-Pi CE transistor model; justification of various circuit components in model; Miller effect; CE short circuit current gain at high frequency; gain-bandwidth product; overall frequency response of CE amplifier

5.Field Effect Transistor [6Hrs.]

Construction, Operation, characteristics, equivalent circuits and application of the following: JFET, Depletion type MOSFET and Enhancement type MOSFET. Comparison of JFET with BJT. FET as an amplifier. Familiarization with Data sheets of typical JFET and MOSFET.

Text Books:

1. Electronics Devices & Circuits by Salivahanan S, N.Suresh Kumar, A.Vallavaraj
Tata McGraw Publication 3rd Edition 2016

2. Electronics Devices and circuit theory by Boyestad & Nashelsky, PHI , New Delhi 2009

Books:

1. Electronic Devices and Circuits -1 -M.L. Anand, Katson Books
2. Electronic Devices and Circuits-J.B. Gupta, Katson Books
3. Basic Electronics and linear Circuits - N. N. Bhargav D. C. Kulshreshta, S. C. Gupta, Tata McGraw Hill, New Delhi
4. Micro Electronics - J. Millman, Arvin Grabel, Tata McGraw Hill, New Delhi.
5. Integrated Electronics - J. Millman, & C. C. Halkias, Tata McGraw Hill, New Delhi

Course Outcomes:

1. After Completion of the course the student will be able to:
2. To acquire a basic knowledge in passive components and solid-state electronics including diodes, BJTand FET.
3. To develop the ability to analyses and design analog electronic circuits using discrete components.
4. To observe the amplitude and frequency responses of common amplification circuits.
5. To design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23EC-PC251**
Course Title	:	Electronic Devices and Circuits-I Lab
Number of Credits	:	1 (L:0, T:0, P:2)
Course Category	:	Program Core Courses

Course Objectives: The course provides the students with basic understanding of the principles of common electronic devices and circuits of importance. The knowledge regarding application of various circuits and devices. Practical experience in the design, fabrication and testing of circuits.

List of Practical (Perform any Eight Practical)**:**

1. Familiarization with digital multimeter, analog multimeter, DSO, regulated power supply, signal generator and measurement of voltage, current, resistance and frequency using them.
2. Study of symbols for various Electrical & Electronic Components, Devices, Circuit functions.
3. Plotting VI characteristics of PN diode and Zener diode.
4. Plotting of output voltage waveform using half wave rectifier without and with filters.
5. Plotting of output voltage waveform using centre tapped rectifier without and with filters.
6. Plotting of output voltage waveform using bridge rectifier without and with filters.
7. Plotting of input and output characteristics and calculation of voltage gain, current gain, output impedance, input impedance of a transistor in CE configuration.
8. Plotting of input and output characteristics and calculation of voltage gain, current gain, output impedance, input impedance of a transistor in CB configuration.
9. Measurement of operating point (Ic and VCE) for a potential divider biasing circuit Plotting of FET VI characteristics and determining the input and output impedance, voltage gain, current gain.
10. Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ OrCAD/ Multisim.

Open-source software and website address:

1 https://www.vlab.co.in

2 http://www.electroschematics.com

3 http://bestengineeringprojects.com

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23EC-PC203**
Course Title	:	Digital Electronics
NumberofCredits	:	3 (L:3,T:0,P: 0)
CourseCategory	:	Program Core Courses

Course Objectives: The objective of this course is to acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits and to prepare students to perform the analysis and design of various digital electronic circuits.

Course Content:

1. Introduction [2Hrs.]

(a) Basic difference between Analog signal and Digital signal and Analog System and Digital System.
(b) Advantages and Disadvantages of digital over Analog System.
(c) Concept of Positive and Negative Logic System. Concept of Zero and One involtage form.

2. Number Systems [6 Hrs]

(a) Decimal, Binary, Octal and Hexadecimal Number System, conversion from one number system to another.
(b) Concept of code, Weighted and Non-Weighted codes, BCD Code (8421 code only), Excess-3 and Grey code.
(c) Error Detection Codes (Parity and Checksum Method), Error Detection and Correction Code (Hamming Code)
(d) Alphanumeric Code (ASCII), EBCDIC Code.
(e) Binary Arithmetic (Addition, Subtraction, Multiplication and Division), BCD Addition, 1's Complement, 2's Complement, Subtraction using 1's and 2's complement method.

3. Logic Gates [3Hrs.]

(a) Definition, Symbols and Truth Table of NOT, AND, OR, NAND, NOR, XNOR gates.
(b) Working of Basic Gates using simple diode circuits.
(c) NAND and NOR as Universal Gates.

4. Logic Simplification [4 Hrs.]

(a) Postulates of Boolean Algebra, De-Morgan's Theorems, Various identities, Formulation of Truth table and Boolean Equation for Simple Problems, Implementation of Boolean (Logic) Equations with Logic Gates.
(b) Karnaugh map (up to 4 variables) and simple application in developing combinational logic circuits

5. Logic Families [3 Hrs.]

(a) Logic family classification: -
  (i) Definition of SSI, MSI, LSI, VLSI, ULSI
  (ii) Comparison of TTL and MOS family characteristics with respect to delay, speed, noise margin, logic levels, power dissipation, fan-in, fan- out, power supply requirement.
(b) Logic Circuits: Totem Pole Output circuit operation (qualitative) for TTL NAND Gate, CMOS NAND Gate

6. Arithmetic Circuits [3Hrs.]

(a) Half Adder and Full Adder Circuits, Design and implementation with the help of Logic Gates, NAND Gate only, NOR Gate only.
(b) Half Subtractor and Full Subtractor Circuits, Design and implementation with the help of Logic Gates, NAND Gate only, NOR Gate only.
(c) 4-bit Adder/Subtractor circuit using 2's Complement representation.

7. Multiplexers, De-multiplexers, Encoder and Decoders [3 Hrs.]

Basic Functions and Block Diagram of Multiplexer, Demultiplexer, Encoder and Decoder. Detailed functioning of 16:1 Multiplexer, 1:8 Demultiplexer, Decimal to Binary/BCD Encoder, 4 Bit Binary to Decimal decoder

8. Display Devices **[3 Hrs.]**

(a) Basics of LED, LCD, Seven Segment Displays,
(b) Basic Operation of Common Anode and Common Cathode types of Displays.
(c) BCD to 7-segment decoder (using K-Map),

9. Flip-flops **[5Hrs.]**

(a) Difference between Latch and Flip Flop.
(b) Difference between Combinational Circuit and Sequential Circuit.
(c) Different Types of Triggering in Flip Flops.
(d) Operation of SR, D, JK, Edge Triggered JK, Master/Slave JK and T flip-flops using circuit or Block Diagram, Truth Tables and Timing Diagram.
(e) Applications of Flip Flops.

10. Shift Register **[4 Hrs.]**

(a) Introduction and basic shift operation including shift left and shift right register.
(b) Serial in - parallel out, serial in - serial out, parallel in - serial out, parallel in - parallel out shift register.
(c) Universal shift register.
(d) Applications of Shift Register.

11. Counters **[4 Hrs.]**

(a) Asynchronous counters:
  (i) Binary counters
  (ii) Modulus of a counter, Ripple Counter, Mod-10 or Decade counter
  (iv) Down counter, 3 Bit Up/Down counter.
(b) 3_Bit Synchronous counters
(c) Difference between asynchronous and synchronous counters
(d) Ring counter and Johnson counter with timing diagram.
(e) Applications of Counter.

Books:

1. "Digital Electronics: Principles and Applications" by Roger L. Tokheim
2. Basic Digital Electronics by M.V Subramanyam&Bhupesh Bhatia, Laxmi Publications
3. Digital Principles and application by Leech & Malvina, McGraw Hill, 5th Edition
4. "Digital Fundamentals" by Floyd and Jain
5. Modem Electronics by R.P Jain, TMH, 4th Edition
6. A Textbook of Digital Electronics by R.S.SedhaPublisher : S.chand

CourseOutcomes:

- To have a thorough understanding of the fundamental concepts and techniques used in digital electronics.
- To realize all the logic functions with the help of Gates, NANO gate only and NOR gate only.
- To understand and examine the structure of various number systems and its application in digital design.
- The ability to understand, analyse and design various combinational and sequential circuits.
- To understand the concept of Adder, Subtracter, Multiplexer, Demultiplexer, Encoder, Decoder, Flip-Flop, Shift Register and Counters.
- To understand Boolean Function Minimization using Boolean Algebra and Karnaugh Map.
- To develop skill to build, and troubleshoot digital circuits.

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23CE-PC253**
Course Title	:	Digital Electronics Laboratory
Number of Credits	:	1 (L:0, T:0, P:2)
Course Category	:	Program Core Courses

Course Objectives: The objective of this course is to acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits and to prepare students to perform the analysis and design of various digital electronic circuits.

List of Practical(Perform any Eight practical)**:**

1. Verification and interpretation of truth tables for AND, OR, NOT, NAND, NOR, EX-OR and EX-NOR gates.
2. Realization of logic functions with the help of NAND and NOR gates only.
3. Construction of half adder using NAND gates only and verification of its operations.
4. Construction of a full adder using Ex-OR and NAND gates and verification of its operations.
5. Construction of 4-bit adder/ subtractor circuit. using a 4-bit adder IC and an Ex-OR and verify the operation of the circuit.
6. Verification of truth tables for Multiplexer.
7. Verification of truth tables for De-multiplexer.
8. Verification of truth table for decoder.
9. Verification of truth table for D flipflop.
10. Construction and operation of a 4-bit ring counter.
11. Study of different memory ICs.

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23EC-PC205**
Course Title	:	Electronic Measurements Instruments & Troubleshooting
Number of Credits	:	3 (L:3, T:0, P:0)
Course Category	:	Program Core Courses

Course Objectives:

To introduce students to the use of various electronic/electrical laboratory instruments their construction, applications, and principles of operation.

To understand the basic concept of maintenance and the various challenges in maintenance.

To enable students to know about the various practical approaches to troubleshooting.

Course Content: **[5Hrs.]**

1. **Basics of Measurements and Bridges**
   Accuracy & precision, Resolution
   Types of Errors
   DC Bridges – Wheatstone and Kelvin Double Bridge
   AC Bridges - Maxwell's Bridge, Hay's Bridge, Anderson Bridge, De-Sauty's Bridge
2. **Potentiometer** **[5Hrs.]**
   Basic DC slide wire Potentiometer
   Crompton's DC Potentiometer
   Applications of DC Potentiometer
   AC Potentiometers
   Applications of AC Potentiometers
3. **Measuring Instruments** **[6Hrs.]**
   Permanent Magnet Moving Coil Instruments (PMMC)
   Moving Iron type Instruments (MI)
   Electro Dynamo Type Instruments
   Single Phase Energy Meter
4. **Electronic Instruments** **[6Hrs.]**
   Electronic Voltmeter and Digital Voltmeter
   Electronic Multimeters
   Q – Meter
   Vector Impedance Meter
5. **Oscilloscopes** **[6Hrs.]**
   Cathode ray tube: construction, operation, screens, graticules
   Vertical deflection system, Horizontal deflection system, Delay line,
   Measurement of frequency, time delay, phase angle and modulation index (trapezoidal method)
   Oscilloscope probe: Structure of 1:1 and 10:1 probe
   Multiple Trace CRO
6. **Introduction to Troubleshooting of Electronics Instruments** **[6Hrs.]**
   Fault Finding Aids: - service manual, test and measurement equipment, Multimeter, CRO, AC/DC and GND, SignalGenerator. IC Packages, Digital Test Instruments: - Logical Probe, Logic Pulser, Logic Clip, Digital IC Tester, current Tracer, faults in digital circuits, combination faults, precautions during digital troubleshooting.
7. **Troubleshooting various Electronics Equipment** **[5Hrs.]**
   Power Supplies, SMPS, Troubleshooting of oscilloscope, Troubleshooting of PA(Public Address) system, Troubleshooting of Signal Generator, troubleshooting of digital multimeter, Troubleshooting of Function Generator.

Books:

1. Modern Electronic Equipment: Troubleshooting, Repair and Maintenance by Khandpur, TMH2006.
2. Electronic Instrumentation by A. K. Sawhney.
3. Troubleshooting & Maintenance of Electronic Equipment by K. Sudeep Singh, S.K Kataria& Sons.
4. Electronic Instrumentation by H.S Kalsi, MC Graw Hill

Course Outcomes:

After Completion of the course the student will be able to:

1. Use digital and analog multimeters in the laboratory for measuring various electrical parameters.
2. Understand the basic concept and use of CRO, DSO, Function Generator, AF and RF signal generators.
3. Make use of CRO, DSO, Function Generator, AF and RF signal generators for assembly and test purpose

In the laboratory.

4. Refer service manuals of various test and measuring instruments.
5. Trace faults in digital circuits using Logical Probe, Logic Pulser, Logic Clip, Digital IC Tester etc.
6. Repair typical electronic equipment like Power Supplies, SMPS, PA system etc.

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23EC-PC255**
Course Title	:	Electronic Measurements Instruments & Troubleshooting Laboratory
Number of Credits	:	1 (L:0, T:0, P:2)
Course Category	:	Program Core Courses

Course Objectives:

- To introduce students to the use of various electronic/electrical laboratory instruments their construction, applications, and principles of operation.
- To understand the basic concept of maintenance and the various challenges in maintenance.
- To enable students to know about the various practical approaches to troubleshooting.

List of Practical:

1. Measure unknown inductance using following bridges (a) Anderson Bridge (b) Maxwell Bridge
2. Measure Low resistance by Kelvin's Double Bridge
3. Calibrate an ammeter using DC slide wire potentiometer
4. Calibrate a voltmeter using Crompton potentiometer
5. Measure low resistance by Crompton potentiometer
6. Study the working of Q-meter and measure Q of coils
7. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (iii) C.R.O. Probes
8. Identification of functional blocks / sections, assembly and testing of a PA system.
9. Identification of functional blocks / sections, assembly and testing of a servo voltage stabilizer or DC regulated power supply.
10. To determine output characteristics of LVDT and measure displacement using LVDT.

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23EC-PC207**
Course Title	:	Electric Circuits and Networks
NumberofCredits	:	3 (L:2,T:1,P: 0)
CourseCategory	:	Program Core Courses

Course Objective: This course develops the skill of solving circuits containing resistors, capacitors and inductors excited with various types of sources.

Course Content:

Unit – 1: Basics of Network and Network Theorem: **[10 Hrs.]**
Definition and unit for voltage, current, power, resistance, conductance, resistivity- Ohm's law Kirchoff's current law and voltage law. Series circuits –parallel circuits, series parallel circuits. Mesh Method (simple problems) Thevenin's - Norton's theorems, Super position and Maximum power transfer theorem – Statement and Explanation (simple problems) Maximum Power transfer theorem, Reciprocity Theorem, Principle of Duality
Numerical problems solving using above theorems.

Unit– 2: DC and AC Time Domain Circuit Analysis: **[10 Hrs.]**
Definition and concept of cycle, frequency, Time period, amplitude, instantaneous value, average value, RMS value, peak value, form factor, Peak factor. Phase and phase difference, representation of alternating quantities by phasor, addition and subtraction of alternating quantities.
DC transient Analysis: Basics of Transient Response of Series RL, RC and RLC Circuits under DC Excitation.
AC Circuit Analysis: Voltage-Current Relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Sinusoidal Circuit Analysis for RL, RC, Series and Parallel RLC Circuits, Power in AC Circuits, Instantaneous Power, Average Power, Reactive Power, Power Factor

Unit– 3: Trigonometric and exponential Fourier series and transform: **[7 Hrs.]**
Spectrum of signals. Trigonometric and exponential Fourier series representation of common waveforms.
Fourier transformation. Fourier transforms of basic signals. Spectrum of basic signals.
Laplace Transformation, Analysis of electrical circuits using Laplace Transform for standard inputs (Ramp, Step)
Basics of Steady state response.

Unit 4: Three phase networks: **[7 Hrs.]**
Basics of three phase networks and applications, Complex Power in sinusoidal steady state. Steady state analysis of three-phase three-wire and four-wire unbalanced Y circuits, Unbalanced Delta circuit, Neutral shift.

Unit- 5: Two Port Network: **[5 Hrs.]**
Two Port Network, Open Circuit Impedance Parameters, Short Circuit Admittance Parameters, Transmission Parameters, Hybrid Parameters
Interrelationship of Two Port Network, Inter Connection of Two Port Network

Reference Books:

S.No.	TitleofBook	Author	Publication
1	NetworksandSystems	AshfaqHusain	KhannaPublishingHouse
2	NetworkAnalysis	M.E.VanValkenburg	PrenticeHallofIndia
3	EngineeringCircuitAnalysis	W.H.Hayt,J.E.KemmerlyandS.M.Durbin	McGrawHill
4	ElectricalCircuits	JosephEdminister	Schaum'sOutline,TataMcGrawHill
5	BasicCircuitTheory	LawrenceP.Huelsma	PrenticeHallofIndia
6	Network&Systems	D.RoyChoudhury	WileyEasternLtd
7	LinearCircuitAnalysis	DeCarloandLin	OxfordPress

Lectures: NPTEL (http://nptel.iitm.ac.in) SC Dutta Roy, Circuit Theory, http://nptel.iitm.ac.in/video.php?subjectId=108102042

CourseOutcomes:

1. Apply circuit theorems to simplify and solve complex DC and AC electric networks consisting of independent
2. anddependent current and voltage sources.
3. Reduce bigger electrical circuits into simpler circuits.
4. Time and frequency domain analysis of circuits containing resistor, capacitors and inductors.
5. Analysis of two port networks.
6. Solve circuits by applying transformation to s-domain.

SEMESTER	:	3RD ECE/DE/MEDICAL
CourseCode	:	23IM-PC209
CourseTitle	:	IntroductiontoVLSIfabrication
NumberofCredits	:	3 (L:3,T:0,P:0)
CourseCategory	:	Program Core Course

CourseObjectives:

Fabrication in VLSI (Very Large-Scale Integration) refers to the process of physically realizing the IC chip which was designed using software. This course serves as an introduction to basic processes used in fabricating semiconductor devices and integrated circuits. The objective is to understand the basic and advanced IC fabrication techniques in the field of VLSI.

CourseContent:

UNIT-I: Introduction [7Hrs.]

a. HistoryofIC's.
b. Operation&ModelsforDevicesofInterest:CMOSand MEMS(Microelectromechanical System)
c. Phase diagrams & solid solubility: Definition
d. Electronic Materials: Crystal Structures, Defects in Crystals, Si, Poly Si, Si Crystal Growth and Wafer preparation.
e. Clean room and WaferCleaning: Definition, Need ofClean Room, RCAcleaningof Si.
f. IC fabrication process

UNIT-II:Oxidation [7Hrs.]

Oxide Formation: Dry and Wet Oxidation, Kinetics of Oxidation, Oxidation Rate Constants, Dopant Redistribution, Oxide Charges, Device Isolation, LOCOS, Oxidation System

UNIT-III: Lithography [7Hrs.]

Lithographic Processes: Photoreactive material, Radiation Sources, Pattern generation and Mask-Making, Pattern transfer process. Mask defect, Pattern transfer defects.

Advanced Lithography: E-beam Lithography, X-ray Lithography, Ion Beam Lithography

UNIT - IV: Method used to Introduce Impurities into the Semiconductor Crystal [7 Hrs.]

Diffusion: Fick's First and Second Laws of Diffusion, Constant Source and Limited Source Diffusions, Diffusion System, Diffusion of Phosphorous and Boron in Silicon, Evaluation of Diffused Layers.

Ion Implantation: Problems in Thermal Diffusion, Advantages of Ion Implantation, Ion Stopping, Range Distributions, Ion ImplantationSystem, Different process considerations, Damage and annealing, Ion Channeling, High Energy Implantation.

UNIT-V: Deposited films: [7Hrs.]

Film Deposition Method: Basic operating Principles of Vacuum evaporation deposition, Sputter deposition, Chemical vapor Deposition. Advantages and disadvantages of Chemical Vapor deposition (CVD) techniques over PVD techniques, Different kinds of CVD techniques: APCVD, LPCVD, Metalorganic CVD (MOCVD), Plasma Enhanced CVD etc, Films for doping and interconnections.

UNIT-VI:Etching &Cleaning: **[2Hrs.]**

Wet Chemical etching: Anisotropic Effects,Selective etches; Dry Chemical etching, Reactive ion etching, Dry cleaning process.

UNIT VII: [2Hrs.]

Overview of Interconnects, Contacts, Metal gate/Poly Gate, Metallization, Problems in Aluminum Metal contacts, Al spike, Electromigration, Metal Silicide, Multi-Level Metallization, Planarization, Inter Metal Dielectric.

References:

1. Text Book: J. Plummer, M. Deal, and P. Griffin, Silicon VLSI Technology.
2. FUNDAMENTALS OF SEMICONDUCTOR FABRICATION, Gary May and S. M. Sze
3. S.K. Ghandhi, VLSI Fabrication Principles
4. VLSI Fabrication Principles: Silicon and Gallium Arsenide by Sorab K. Ghandhi; Publisher: ;Wiley
5. VLSI Fabrication Technologyby Balwinder Raj, BalwinderSingh, AshishDixit;Publisher: Laxmi Publications Private Limited

CourseOutcomes: After successful completion of the course students will able to understand the various process involved in fabrication of integrated circuits.

SEMESTER	:	3RD ECE/DE/MEDICAL
Course Code	:	**23IM-PC257**
Course Title	:	Semiconductor Fab Familiarization Lab
Number of Credits	:	1 (L:0 T: 0 P: 2)
Course Category	:	Program Core Courses

CourseObjective: Thiscourseenablesstudentstogainknowledgeonsemiconductor-basedprocesses, units,andcorrespondingequipment,suchasphotolithography,oxidation,thinfilmdeposition,etching, and packaging.

Course Content:

Demonstrations/MOOCofthefollowingprocesses

1. RCACleaning
2. PiranhaCleaning
3. Oxidationprocesssimulation
4. SpinCoating
5. Lithography
6. Thermal/E-beamEvaporation
7. Sputtering
8. Wetetching
9. Dryetching
10. PackagingTechnologies

SUGGESTEDLEARNINGRESOURCES:

Open Source:

- nano*HUB.ORG(SemiconductorDeviceEducationMaterial)*
- https://mrl.illinois.edu/

*The fabrication process involves hundreds of steps that take weeks or months to complete which makes the learning cycle too long. This is in addition to the exorbitant investment necessary to set up and maintain the state-of-the art machines and facilities required for the integrated circuit fabrication. An alternate approach which reduces the learning time and associated cost factor is the use of TCAD software which models and simulates semiconductor fabrication process. Process simulation, device simulation and circuit simulation together are termed as TCAD or Technology Computer Aided Design. Process simulation deals with structures such as atoms and their distribution, Device Simulation deals with currents and potentials in the devices and Circuit simulation is used to study larger circuit blocks. Circuit simulation is the most advanced and process simulation is the least developed of the three kinds of simulation. These simulators realistically reflect the time-dependent behavior of the processes and devices.TCAD tools proved that it is a powerful tool for understanding semiconductor fabrication processes and also for learning and training purposes.

S.No	TitleofBook	Author	Publication
1.	SiliconVLSITechnology	Plummer,Dealand Griffin	PearsonEducation
2.	Fundamentalof Semiconductor Fabrication	SzeandMay	WileyIndia
3.	SiliconProcess Technology	SKGandhi	WileyIndia
4.	Fundamentals Of Semiconductor Manufacturingand ProcessControl	GaryS.Mayand Costas J. Spanos,	AJOHNWILEY&SONS,INC., PUBLICATION

SEMESTER	:	**3RD ECE/DE/MEDICAL**
Course Code	:	**23IM-SI-259**
Course Title	:	Summer Internship I
NumberofCredits	:	2 (L:0, T:2, P: 0)
CourseCategory	:	Summer Internship

Rationale:

It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

Learning Outcome:

After studying this course, students will be able to:

- Demonstrate organizational setup, product range, manufacturing process, important machines and materials used in the training organization.
- Write daily & final report and its presentation later on.
- Demonstrate working culture of industry.
- Solve problem in industrial setup and to apply the knowledge and skills learnt in real life situations.

Detailed Contents

- Industrial training of a minimum of 4 weeks duration to be organized during the semester break starting after second Semester examinations.
- It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.
- Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An assessment has been provided in the study and evaluation scheme of III Semester. Evaluation of summer training report through viva-voce/presentation may comprise of weightage to performance in general behavior, quality of report, presentation during viva-voce examination and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.