SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)
Syllabus with effect from the Academic Year 2022-2023

PROGRAMME STRUCTURE
MSc (Electronics) Semester: IV

Programme Outcome (PO) - For MSc Electronics Programme	PO.1 The course begins with the foundation concepts of core electronics allied fields PO.2 The curriculum is designed to train the students in basic and advanced areas of Electronics by Keeping in mind the latest advances in the field. PO.3 The purpose of this course is to inculcate skills that are relevant for industry and cater to the requirements of the R & D Department and Industry. PO.4 This M.Sc. Program enables student to develop Speaking Presentation skills, they are encouraged to deliver seminars on a wide range of topics covering the different areas of Electronics.
Programme Specific Outcome (PSO) - For MSc Electronics Semester	PSO.1 M.SC. (Electronics) Program aims to develop specialized knowledge and skills both in the field of electronics for industrial automation and of the design of electronics systems. PSO.2 This course focuses on concepts relating to the Fabrication & Operation of semiconductor devices, measurement methodologies and the characteristics of sensors and instrumentation, embedded systems, VLSI Technology, Integrated Circuit manufacturing techniques, Optical Fiber communication systems, Computer Hardware etc. PSO.3 The main objective is to develop the ability and skills to understand, manage and promote technological innovation while adapting to the rapid changes typical of high technology sectors.

To Pass	At least 40% Marks in the University Examination in each paper and 40% Marks in the aggregate of University and Internal examination in each course of Theory, Practical & 40% Marks in Viva-voce.

CORE COURSE	**PS04CELE51**	**IC Fabrication Technology**	**T**	**4**	**3**	**30**	**70**	**100**
	PS04CELE52	**Optical Fiber Communication System**	**T**	**4**	**3**	**30**	**70**	**100**
	PS04CELE53	**Sensor Technology**	**T**	**4**	**3**	**30**	**70**	**100**
	PS04CELE54	**Practical**	**P**	**4**	**3**	**30**	**70**	**100**
	PS04CELE55	**Project Work**	**P**	**4**	**3**	**30**	**70**	**100**
	PS04CELE56	**Comprehensive Viva**	**=**	**1**	**=**	**=**	**50**	**50**

ELECTIVE COURSE (Any One)	**PS04EELE51**	**Design of VLSI Systems**	**T**	**4**	**3**	**30**	**70**	**100**
	PS04EELE52	**Computer Based Industrial Control**	**T**	**4**	**3**	**30**	**70**	**100**
	PS04EELE53	**Principles of Nano-Electronics**	**T**	**4**	**3**	**30**	**70**	**100**
	PS04EELE54	**Advanced Digital Systems Design with HDL**	**T**	**4**	**3**	**30**	**70**	**100**
	PS04EELE55	**CMOS Technology & VLSI Design**	**T**	**4**	**3**	**30**	**70**	**100**
Total Credits :				**25**	**Total Marks:**			**650**

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal Total	External Total	Total
Core Course	PS01CELE51	Semiconductor Science and Devices	T	4	3	30	70	100
	PS01CELE52	Applications of ICs And Fuzzy Electronics	T	4	3	30	70	100
	PS01CELE53	8 Bit Microcontroller and Applications	T	4	3	30	70	100
	PS01CELE54	Practical	P	4	3	30	70	100
	PS01CELE55	Project Work	P	4	3	30	70	100
	PS01CELE56	Comprehensive Viva	=	1	=	=	50	50
Elective Courses	PS01EELE51	Analytical and Bio Medical Instruments	T	4	3	30	70	100
	PS01EELE52	Network Analysis	T	4	3	30	70	100

Master of Science in Electronics
M.Sc.(Electronics) Semester IV

Course Code	PS04CELE51	Title of the Course	IC Fabrication Technology
Total Credits of the Course	4	Hours per Week	3+1 = 4 Hours

Course Objectives:	1.To learn each major IC fabrication process steps eg. Wafer Preparation, Epitaxy, oxidation, doping, depositions, lithography, etching, Annealing. 2.To know IC packaging.

Course Content		
Unit	Description	Weightage* (%)
1.	Semiconductor Materials, Crystal Structures, Energy Bands, Intrinsic Career Concentration, Donors and Acceptors, Electron Mobility, Resistivity and Conductivity, Crystal Growth, Electronic Grade Silicon, Czochralski Crystal Growth, Float-Zone Process, Characterization, Wafer Preparation, Fabrication of IC, Epitaxy, Chemical Vapor Deposition, Growth Model, Growth Chemistry, Doping and Autodoping, Reactors, Defects, Selective Epitaxial Growth, Low-Temperature Epitaxy (LTE) and Molecular Beam Epitaxy (MBE), Rapid Thermal Epitaxy (RTE).	25
2.	Oxidation, Theory of Oxide Growth, Experimental Fits- Orientation Dependence and Effects of Impurities, High Pressure Oxidation, Plasma Oxidation, and Rapid Thermal Oxidation, Oxide Properties, Dopant Redistribution at the Interface, Lithography, Clean Room, Optical Lithography, Masks, Photoresist, Pattern Transfer, Electron Lithography, X-Ray Lithography, Ion Lithography, Comparison of Lithographic Techniques	25
3.	Etching, Wet Chemical Etching, Dry Etching, Plasma Excitation and Plasma - Surface Interaction, Simple Plasma Etching Systems, Diffusion, Diffusion Theory, Diffusion Profiles, Constant-Surface-	25

	Concentration Diffusion, Constant-Total-Dopant Diffusion, Dual Diffusion Process, Extrinsic Diffusion, Diffusion in Silicon, Oxide Masking, Lateral Diffusion, Fast Diffusants, Diffusion in Polysilicon, Ion Implantation, Implant Uniformity, Contamination	
4.	Annealing, Furnace annealing, Rapid Thermal Annealing, Metallization, Metallization Choices, Metal Corrosion, Testing-Assembly and Packaging of IC, Die Bonding and Wire Bonding, Flip-Chip Technique, Hermetic and Plastic Packages, Through-Hole and Surface-Mount Packages, Tape Carrier Packages.	25

Teaching-Learning Methodology	Lectures, Seminars and tutorials, Independent study, Laboratory and practical learning, Field trips, Problem-based/enquiry-based learning, Projects, e-learning

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand integrated silicon based devices' process steps
2.	Understand all silicon fabrication processes, their metrologies and related theory.
3.	Develop an understanding of the complexities involved in a complete fabrication cycle of an integrated circuit.

Suggested References:	
Sr. No.	References
1.	VLSI Technology S. M. Sze, (Mc Graw-Hill International Edition, N.Y, U.S.A.)
2.	VLSI Technology Sujata Pandey & Manoj P Pandey (Dhanpat Rai & Co. New Delhi, INDIA)
3.	The Science and Engineering of Microelectronic Fabrication Stephen A Campbell, (Oxford University Press Inc. N.Y., U.S.A.)
4.	Semiconductor Devices - Physics and Technology S. M. Sze, (John Willey & Sons Inc., U.S.A.)
5.	Modern Semiconductor Fabrication Technology Peter Gise & Richard Blanchard (Reston Book - Prentice Hall, N.J., U.S.A.)
6.	Integrated Circuits K.R.Botkar (Khanna Publishers, New Delhi, INDIA)

On-line resources to be used if available as reference material
On-line Resources
1.https://nptel.ac.in/content/storage2/courses/113106062/Lec1.pdf to https://nptel.ac.in/content/storage2/courses/113106062/Lec31.pdf (please change Lec Number in given link address)
2.https://www.youtube.com/results?search_query=ic+fabrication+process+steps

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Master of Science (Electronics)
M.Sc. (Electronics) Semester IV

Course Code	PS04CELE52	Title of the Course	Optical Fiber Communication System
Total Credits of the Course		Hours per Week	3+1=4 Hours

Course Objectives:	1. To introduce to the learners the principle of transmission of guided light through optical fiber, the types of the Fiber cables, modes of propagation and possible losses and dispersion in the transmission. 2. To provide an understanding about the Light Sources for Optical Fibers, mainly various types of LED and Lasers and also Detectors. 3. To generate an understanding about the Fiber optic communication systems.

Course Content		
Unit	Description	Weightage* (%)
1.	Light propagation through Optical Fibers, Ray theory, meridional rays, skew rays, Types, Characteristics and data rates in optical fibers, Modes in fibers, Losses and Dispersion in Optical Fibers, Fiber materials, Fiber splicing, connectors, couplers and switches, connection losses.	25
2.	Optical processes in semiconductors - Optical absorption and emission, Spontaneous and stimulated emission Optical sources –LED-working process of simple PN Junction LED, Special Class LEDs- Double Hetero-junction LED, Edge Emitting LED, Surface Emitting LED, LASER- Distributed feedback Laser, Quantum–well Lasers, Drive Electronics-	25

	LED drivers, Laser diode drivers.	
3.	Optical detectors- Principle of operation– photo detectors, P-N, PIN, Avalanche photodiode, Phototransistor, Responsivity and Quantum Efficiency of Photo detectors, Delectability, Noise and bandwidth, Detector circuitry and receivers.	25
4.	Fiber optic communication system –Optical Time Division Multiplexing, Wave length Division Multiplexing-Demultiplexing, Optical Fiber measurement and field testing-Equipment used in field testing- Optical Power meter, Optical Time Domain Reflectometer (OTDR), Application of Fiber optics- Long –Haul communication, ISDN.	25

Teaching-Learning Methodology	Classroom Teaching (Offline/Online), learning from online resources

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to

1. 2. 3.	Know about the principle of working of optical fiber based systems. Get an idea about the various types of sources and detectors that can be used for optical fiber communication systems Have an understanding about the working of optical fiber based communication systems.

Suggested References:	
Sr. No.	References
1.	Optical Fiber Communication- Principle and practice John M. Senior (2010), Prentice Hall of India.
2.	Fiber optic communication and other applications Henry Zanger & Cynthia Zanger (1991), Maxwell Macmillan International Edition.
3.	An Introduction to Optical Fibers Allen H. Cherin (1983), Mcgrow Hill International Edition.
4.	Optical Fiber Communication Gerd Keiser (2017),Mcgrow Hill International Edition**.**

On-line resources to be used if available as reference material
On-line Resources
1.https://www.youtube.com/watch?v=WA0eHT3sfS0
2.https://nptel.ac.in/content/storage2/courses/117101054/downloads/lect9.pdf
3.https://nptel.ac.in/content/storage2/courses/113106062/Lec18.pdf
4.https://nptel.ac.in/content/storage2/courses/117101054/downloads/lect19.1.pdf

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Master of Science (Electronics)
M.Sc. (Electronics) Semester IV

Course Code	PS04CELE53	Title of the Course	Sensor Technology
Total Credits of the Course	4	Hours per Week	3+1=4 Hours

Course Objectives:	1. In depth study of science, technology and applications of Sensors. 2. To develop an understanding of the classification and the performance parameters of Sensors to facilitate the learner to compare various sensors and select the most suitable sensor for the need of the challenge. 3. To make the learners apply sensors applications in various fields such as modern home, agriculture, industries, automobile, transportation and defence.

Course Content		
Unit	Description	Weightage* (%)
1.	Importance of Sensors, Introduction, Classification of Sensors, Sensor Parameters- Static and Dynamic, Errors in Measurements, Standards of Measurement, Integrated Sensors, Bus-organized sensing system.	25
2.	Chemical Sensors: Characteristics, Specific Difficulties, Classification, Metal Oxide Semiconductor Gas Sensors, Chem FET, Electronic Nose, Electrochemical sensors, Lambda Probe, Pellistor , Fiber Optic Sensors (FOSs), Basic Concepts, Architecture of Fiber Optics Sensors (FOSs), Applications- Temperature, Liquid Level, Fluid Flow and Microbend Sensor, FOS in Medical and Military Applications.	25
3.	Resonating Quartz Sensors, Piezoelectricity, Resonance and Quartz properties, Applications, QCM, Surface Acoustic Wave Sensors (SAW), SAW Sensors Operation- Chemical and Physical Sensors,	25

	Magnetic Field Sensors, Mechanical Sensors, Optical and radiation (Infrared/thermal) sensors, Ultrasonic sensors.	
4.	Biosensors - Introduction and Definition, Receptor: Molecular Recognition Element Immobilization methods, Silicon Micromachining - Introduction, IC Technologies and Micromachining methods, Silicon Sensors, Micro Electro Mechanical Sensors (MEMs), Smart Sensors, Wireless sensors network.	25

Teaching-Learning Methodology	Classroom Teaching (Offline/Online), learning from online resources

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Get a complete idea about the modern generation of sensors for various applications
2.	Avail the basic understanding for the comparative analysis of various sensors and systems.
3.	Attain knowledge about the types of sensors which are very important today but the learner did not come across so far.

Suggested References:

Sr. No.	References
1.	Measurement and Instrumentation System W.Bolton (1998), Butterworth-Heinemann Publisher
2.	Sensors for Domestic Application Alnaldo D'Amico and Giorgio Sbeveglieri (1995), World Scientific Co. (USA)
3.	Sensors and Transducers (2nd ed.) D. Patranabis (2003), Prentice/Hall of India Private Limited, New Delhi (INDIA)
4.	Advance in Biosensor.(1sr. ed.) Bansi Malhotra Anthony Turne (Ed.) (2003) ,Jai Press Ltd., New Delhi (INDIA)
5.	Biosensors - An Introduction Brian Eggins (1996), Wiley Teuiner Publications
6.	Biosensors Principles & Applications Loic J. Blum and Pierre R. Coulet (Ed.) (1991), Marcel Dekker, Inc. (USA)
7.	Handbook of Modern Sensors Physics, Designs and Applications Fraden, Jacob (2016), Springer.
8	Sensor Technology Handbook Jon S. Wilson (2005), Elsevier /Newnes (London)

On-line resources to be used if available as reference material
On-line Resources
1. https://link.springer.com/boo/10.1007/978-1-4302-6014-1
2.https://www.figarosensor.com/technicalinfo/principle/catalytic-type.html

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Master of Science (Electronics)

M.Sc. (Electronics) Semester IV

Course Code	PS04EELE51	Title of the Course	Design of VLSI Systems
Total Credits of the Course	4	Hours per Week	3+1=4 Hours

Course Objective	1. To Study digital system and VLSI design methodology. 2. Design for testability and design verification. 3. Learn methods to improve digital VLSI systems performance: reliability, manufacturability, cost, power, security, etc. 4. Learn hardware design language (HDL). Implementing the HDL code on FPGA and CPLD

Course Content		
UNIT	Description	Weightage* (%)
1	An overview of VLSI, VLSI Design Methodology, Design Flow, VLSI Road Map, Logic Design with MOSFET, Elements of Physical Design. System level physical design: Large scale physical design, Interconnectivity, Delay model, Cross talk, Floor Planning & Routing, I/O Circuits, Power Distribution & Consumption, Clock Distribution	25
2	Reliability & testing of VLSI Circuits: Introduction to Testing of VLSI Circuits, Fault Models, Gate level testing, Boundary Scan testing, Ad-hoc Testing, Test Generation Methods, D-Algorithm, Introduction to ATPG.	25

3	System Specification using HDL, Introduction to HDL, VHDL modeling concept, Scalar data type & operations in VHDL, Sequential statements, Composite data type, Basic Modeling Constructs.	25
4	Subprogram in VHDL, Packages & USE Clauses, VHDL standard package-1164, Alias, Constants, Components and configurations, Files and Input/Output. Designing with Programmable Logic Devices, Digital Design with State Machine chart, Designing with FPGAs & CPLDs, VHDL model for memory buses.	25

Teaching-Learning Methodology	Traditional Classroom teaching with use of Multimedia facility in the classroom. Use of Computer Tool for live demonstration and problem / design based approach.

Evaluation Pattern		
Sr. No	Details of Evaluation	Weightage
1	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2	Internal Continuous Assessment in the form of Practical, Viva Voce, Quizzes, Seminars, Assignments, Attendance (as per CBCS R6.8.3)	15%
3	University Examination	70%

Course Outcome. Having completed this course, the learner will be able to	
1	Design complex digital systems using VLSI design methodology.
2	Design a digital system using given specifications and design constraints.
3	Plan and choose digital system testing strategy
4	Plan digital system verification strategy

Suggested References:	
Sr. No.	References
1	Introduction to VLSI Circuits & Systems John P. Uyemura, John Willey & sons (Asia) Pvt Ltd. NY,(USA)
2	The Designer guide to VHDL Peter J Ashenden, Harcourt India Pvt. Ltd., N.Delhi (INDIA)
3	Digital logic design principles Norman Balabanian & Bradely Carlson, John Willey & Sons Pvt. Ltd. . NY,(USA)
4	Modern VLSI Design : System on Silicon Wayne Wolf, Pearson education - Prentice Hall ,New Delhi (INDIA)
5	Principles of CMOS VLSI Design : A system perspective Neil H.E., Weste and Kamran Eshraghian Pearson Education -Prentice Hall New Delhi (INDIA)
6	Digital Integrated Circuits : A Design Perspective Jan M. Rabeay, Anantha Chandrakasan and Borivoje Nikolic Prentice Hall of India (EEE), New Delhi (INDIA)
7	Digital Systems Design using VHDL Charles H. Roth Jr., Thomson Brooks/ Cole (USA)

On-line resources to be used if available as reference material
On line resources.
1.Video lectures on VLSI Design by NPTEL

Master of Science (Electronics)

M.Sc. (Electronics) Semester IV

Course Code	PS04EELE52	Title of the Course	Computer Based Industrial Control
Total Credits of the Course	4	Hours per Week	3+1=4 Hours

Course Objective	1. To Focus on various Control schemes used in the Industrial Environment 2. Monitoring, controlling various parameters in the field via Computerized Network.

Course Content		
UNIT	Description	Weightage* (%)
1	Expectations from Automation, Current trends in Computer Control of Process Plants, Process Definition, Feedback Control, Basic Principles of Single controller loop, Two-position Control, Multi-position control, Proportional Integral Derivative Control, Multi-variable Control, Feed Forward Control, Introduction of Building Blocks of Automation System, Processing System, Multimicroprocessor Systems.	25

2	Local Area Networks, Analog and digital I/O Modules, Supervisory control and Data Acquisition Systems, Remote Terminal Unit, Direct Digital Control-Structure and Software. Distributed Digital Control, History, Functional Requirements of (Distributed) Process Control System, System Architecture, DCS, Final Control Element-Pneumatic, Hydraulic; Electric Actuation.	25
3	Introduction to Intelligent Controllers, Model Based Controllers, Predictive control, Artificial Intelligent Based Systems, Expert Controller, Fuzzy Logic System. Fuzzy Controller. Fuzzy Logic Tools, Conventional Control Systems, Fuzzy Logic Control Systems, Fuzzy Logic Control vs. PID Control.	25
4	Examples of Industrial Applications of FLC, Stability, Neural Controllers, VLSI Implementation of Neural Network. Fuzzy Neural Networks-Fuzzy Multilayer Perception, Fuzzy competitive Learning, Fuzzy Art, Fuzzy Min-Max Networks, Fuzzy Neurons, Fuzzy Neural Control Systems.	25

Teaching-Learning Methodology	Traditional Classroom teaching with use of Multimedia facility in the classroom, Use of Computer Tool for live demonstration and problem / design based approach.

Evaluation Pattern		
Sr. No	Details of Evaluation	Weightage
1	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2	Internal Continuous Assessment in the form of Practical, Viva Voce, Quizzes, Seminars, Assignments, Attendance (as per CBCS R6.8.3)	15%
3	University Examination	70%

Course Outcome. Having completed this course, the learner will be able to	
1.	Have knowledge of various aspects of Industrial Control schemes. Managed by PLC, DCS, SCADA etc.
2.	Get understanding of control applications used in Industry.
3.	Develop application models based on Fuzzy logic.

Suggested References:	
Sr. No.	References
1.	Computer based Industrial Control Krishna Kant, Prentice Hall of India, New Delhi (INDIA)
2.	Introduction to Applied Fuzzy Electronics Ahmad M. Ibrahim, Prentice Hall of India, New Delhi (INDIA)
3.	Industrial Automation : Hands On Frank Lamp, Kindle Edition

On-line resources to be used if available as reference material
On line resources.
1. On Line Video Lectures on Industrial Automation and control - NPTEL

Master of Science (Electronics)

M.Sc.(Electronics) Semester IV

Course Code	PS04EELE53	Title of the Course	Principles of Nano-Electronics
Total Credits of the Course	4	Hours per Week	3+1=4 Hours

Course Objective	1. To introduce the students about nanoelectronics and nanodevices, 2. To identify quantum mechanics behind nanoelectronics. 3. To describe the principle and the operation of nanoelectronic devices.

Course Content		
UNIT	Description	Weightage* (%)
1	Dimensionality and ideal semiconductor nanostructure, density of states, Quantum size effects and density of states for two dimensional systems, Superlattices, Electron states in quantum wells, wires and dots, Gate oxide tunneling in MOSFETs, Fowler-Nordheim tunneling.	25
2	Double barrier tunneling and resonant tunneling diode, Resonant tunneling transistor, Coulomb blockade in a nano capacitor, Tunnel junction and its excitation by current source, Coulomb blockade in a quantum dot circuit, Coulomb staircase.	25

3	Semiconductor quantum hetero and nano structures, Modulation doping, Energy band transitions in quantum wells, quantum wires and nano wires, Quantum dots and nano particles, Ballistic transport, Transport model, Quantum resistance and conductance.	25
4	Carbon nano tubes and carbon nano wires, Nano scale wire radius, Transport of spin and Spintronics, Single electron transistor, Carbon nano tube transistor, Nano tube hetero junction, Nano tube field effect transistor, Graphene in nano electronic systems.	25

Teaching-Learning Methodology	Traditional Classroom teaching with use of Multimedia facility in the classroom. Use of Computer Tool for live demonstration and problem / design based approach.

Evaluation Pattern		
Sr. No	Details of Evaluation	Weightage
1	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2	Internal Continuous Assessment in the form of Practical, Viva Voce, Quizzes, Seminars, Assignments, Attendance (as per CBCS R6.8.3)	15%
3	University Examination	70%

Course Outcome. Having completed this course, the learner will be able to

1	Learn the fundamental science and quantum mechanics behind nanoelectronics
2	Differentiate between microelectronics and nanoelectronics

Suggested References:	
Sr. No.	References
1	Fundamentals of Nanoelectronics George W. Hanson, Pearson Education, New Delhi, INDIA
2	Nanoelectronics A.S. Bhatia, NuTech Books, New Delhi, INDIA
3	Low Dimensional Semiconductors: Materials, Physics, Technology & Devices M.J.Kelly, Clarendon Press Oxford, N.Y., USA
4	Nanoelectronics: Principles and Devices Mircea Dragoman and Daniele, Artech House Publication, N.Y. USA
5	Semiconductor Heterojunctions and Nanostructures Omar Manasreh, McGraw Hill, N.Y., USA
6	Quantum Wells, Wires and Dots P.Harrison, Wiley, N.Y., USA
7	Silicon Nanoelectronics Shunri Oda and David Ferry, Taylor & Francis, N.Y., USA

On-line resources to be used if available as reference material
On line resources.
1. www.slideshare.net/tabirsir/nanoelectronics-pptfinal
2. ww.melbhattan.com/nanoelectronics
3. web.stanford.edu/~hspwong/EE 218 - Section 0...

Master of Science (Electronics)

M.Sc.(Electronics) Semester IV

Course Code	PS04EELE54	Title of the Course	Advanced Digital Systems Design with HDL
Total Credits of the Course	4	Hours per Week	3+1=4 Hours

Course Objective	1. To understand sequential and combinational logic design techniques 2. To introduce HDL 3. To learn various digital circuits using HDL 4. To learn PLD, CPLD, FPGA and their applications

Course Content		
UNIT	Description	Weightage* %
1	Introduction: Introduction to Computer-aided design tools for digital systems. Hardware description languages; introduction to VHDL, data objects, classes and data types, Operators, Overloading, logical operators. Types of delays Entity and Architecture declaration. Introduction to behavioral, dataflow and structural models.	25

2	VHDL Statements : Assignment statements, sequential statements and process, conditional statements, case statement Array and loops, resolution functions, Packages and Libraries, concurrent statements. Subprograms: Application of Functions and Procedures, Structural Modelling, component declaration, structural layout and generics.	25
3	Sequential and Combinational Circuit Design: VHDL Models and Simulation of combinational circuits such as Multiplexers, Demultiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions etc. Sequential Circuits Design : VHDL Models and Simulation of Sequential Circuits Shift Registers, Counters etc.	25
4	Prototyping and case studies: Design with CPLDs and FPGAs : Programmable logic devices : ROM, PLAs, PALs, GAL, PEEL, CPLDs and FPGA. Design implementation using CPLDs and FPGAs Design of Microcomputer: Basic components of a computer, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL Reference	25

Teaching-Learning Methodology	Traditional Classroom teaching with use of Multimedia facility in the classroom. Use of Computer Tool for live demonstration and problem / design based approach.

Evaluation Pattern		
Sr. No	Details of Evaluation	Weightage
1	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2	Internal Continuous Assessment in the form of Practical, Viva Voce, Quizzes, Seminars, Assignments, Attendance (as per CBCS R6.8.3)	15%
3	University Examination	70%

Course Outcome. Having completed this course, the learner will be able to	
1	Design combinational & sequential circuits using VHDL.
2	Integrate combinational & sequential circuits to design a micro architecture
3	Set environment, libraries, synthesis constraints for synthesis
4	Create test benches, run simulations and analyze/debug results to meet specifications

Suggested References:	
Sr. No.	References
1	Digital System Design using VHDL Charles. H.Roth ; PWS (1998).
2	VHDL-Analysis & Modelling of Digital Systems Navabi Z; McGraw Hill.
3	VHDL Douglas L. Perry, Mc Graw Hill Publications
4	VHDL: Analysis and Modeling of Digital Systems Zainalabedin Navabi, McGraw-Hill
5	Logic and Computer Design Fundamentals M. Morris Mano

On-line resources to be used if available as reference material
On line resources.
1 .web.itu.edu.tr/~ateserd/VHDL.pdf
2. www.ics.uci.edu/~jmoorkan/vhdlref/Synario VHDL..
3. atlas.physics.arizona.edu/.../downloads/vhdl/VHDL_Lang.pdf

Master of Science (Electronics)

M.Sc.(Electronics) Semester IV

Course Code	PS04EELE55	Title of the Course	CMOS Technology & VLSI Design
Total Credits of the Course	4	Hours per Week	3+1=4 Hours

Course Objective	1. To learn the basic CMOS Circuits. 2. To acquire knowledge of CMOS Process Technology. 3. To impart in-depth knowledge about analog and digital CMOS circuits.

Course Content		
UNIT	Description	Weightage* (%)
1	Introduction CMOS Logic: Gates Suing CMOS., Pass Transistors and Transmission Gates, Tristates, Multiplexers, Latches and Flip-Flops, CMOS Layout: Inverter Cross section, Layout Design rules, Gate Layout, MOS Transistor Theory: Ideal I-V, C-V Characteristics, Various MOS Capacitance Models, MOS Gate Capacitance Model, Channel Length Modulation, Body Effect, Sub threshold Conduction, Junction Leakage, Tunneling, Temp. and Geometry Dependence. DC Transfer characteristics: CMOS Ratioed Inverter Transfer Function.	25

2	CMOS Processing Technology CMOS Technologies: Background, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formation, Contacts and Metallization, Passivation, Metrology. Layout Design Rules: Design Rules Background, Scribe Line and Other Structures, MOSIS Scalable CMOS Design Rules, Micron Design Rules. CMOS Process Enhancements: Transistors, Interconnect, Circuit Elements, Beyond Conventional CMOS.	25
3	Circuit Characterization and Performance Estimation Delay Estimation: RC Delay Models, Linear Delay Model, Logical Effort, Parasitic Delay. Logical Effort and Transistor Sizing: Delay in a Logic Gate, Delay in Multistage Logic Networks, choosing the Best Number of Stages. Power Dissipation: Static Dissipation, Dynamic Dissipation, Low-Power Design. Interconnect: Resistance, Capacitance, Delay, and Crosstalk.	25
4	Design Margin: Supply Voltage, Temperature, Process Variation, Design Corners. Reliability, Scaling, Analog Circuits: MOS Small-signal Model, Common Source Amplifier, The CMOS Inverter as an Amplifier, Current Mirrors, Differential Pairs and its applications.	25

Teaching-Learning Methodology	Traditional Classroom teaching with use of Multimedia facility in the classroom. Use of Computer Tool for live demonstration and problem / design based approach.

Evaluation Pattern		
Sr. No	Details of Evoaluation	Weightage.*
1	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2	Internal Continuous Assessment in the form of Practical, Viva Voce, Quizzes, Seminars, Assignments, Attendance (as per CBCS R6.8.3)	15%
3	University Examination	70%

Course Outcome. Having completed this course, the learner will be able to	
1	Acquire the knowledge about various CMOS fabrication process and its modelling.
2	Design and implement various structures for low power applications.
3	Design various CMOS dynamic logic circuits.
4	Design techniques of low voltage and low power CMOS circuits for various applications.

Suggested References:	
Sr. No.	References
1	CMOS VLSI Design Neil H.E. Weste, David Harris, Ayan Banerjee: Third Edition, Pearson Education.
2	Principle of CMOS VLSI Design Neil H.E. Weste, Kamran Eshraghian, Pearson Education.
3	Chip Design for Submicron VLSI J. P. Uyemura, Cengage Learning.
4	CMOS Analog Circuit Design Philip E. Allen and Douglas R Holberg, Oxford.
5	Introduction to VLSI systems Carver Mead and Lynn Conway, BS Publication
6	Introduction to VLSI Circuits and Systems J. P. Uyemura,Wiley.

On-line resources to be used if available as reference material
On line resources.
1. webpages.eng.wayne.edu/cadence/ECE6570/doc/lect1_1.pdf
2. www.egr.msu.edu/classes/ece410/mason/files/Ch3-5.pdf
3. ON LINE Video lectures - NPTEL