GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39)
MICROELECTRONICS AND VLSI
SUBJECT CODE: 2163905
B.E. 6th SEMESTER

Type of course: Material Science and Electronics

Prerequisite: Fundament of Electronics and Physics

Rationale: The purpose of this course is to introduce the basics of the emerging field of microelectronics and Nanoelectronics as well as VLSI design

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs.	% Weig
1	SEMICONDUCTOR DEVICES AND SIMULATIONS - Junction diodes - Transistors: BJT, MOSFET - Photonic devices: LEDs, Photovoltaic cell - Device scaling - Device modelling and simulation methods - Moore's law.	10	20%
2	DIGITAL ELECTRONICS -Binary, Octal and Hexadecimal number systems and conversions-Boolean Algebra-Truth tables of logic gates (AND, OR, NOT) -NAND, NOR as universal gates-Difference between combinational circuits and sequential circuits. Flip-flops (S-R & J-K) – asynchronous counters – synchronous counters. (ROM) – semiconductor random access memory (RAM) .	10	20%
3	.MICROFABRICATION - Micro fabrication techniques - MEMS - Microfulidic devices	10	20%
4	VLSI TECHNOLOGY - Introduction - MOS transistor, NMOS, PMOS, CMOS - VLSI design issues - VLSI design techniques	10	20%
5	INTEGRATED CIRCUITS (ICs) - Introduction,	10	20%

- IC Fabrication		
- Overview of Analog IC and Digital IC		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
23	**20**	**20**	**7**	**00**	**00**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:
1. Semiconductor physics and devices: Basic principles, Donald A. Neamen, Mac Graw Hill, ISBN: 0-256-24214-3
2. Handbook of Nanotechnology by Bharat Bhushan, Springer, ISBN 3-540-01218-4
3. VLSI technology, SM Sze, McGraw Hill
4. Millman and Grabel, "Microelectronics", 2nd Ed. Tata McGraw-Hill, 1999.
5. N.H.Weste, "Principles of CMOS VLSI Design", Pearson Education, India,2002.
6. Tocci R J and Widmer N S, "Digital Systems – Principles and Applications", 8thEd., Pearson Education, India, New Delhi, 2001.
7. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory", 8th Ed, Pearson Education India, New Delhi, 2002.
8. Kang S.M. & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design",TMH, Ed. 2003.

Course Outcome:

1. To make the students familiar with the properties behavior and applications and implementations in microelectronic technology into integrated circuits.
2. To understand the basic concepts of VLSI circuit design.
3. To Understand the underlying physical processes governing the low-power VLSI and IC Technology

List of Experiments: (Any six + Opend Ended Experiment)

1. Design of electrical circuits and their simulation
2. Constructionofsimpledecoder&multiplexercircuitsusinglogicgates.
3. Bitparitygenerator&comparecircuits.
4. DesignofcombinationalcircuitsforBCDtodecimalconversiontodrive
5. Seven segmentdisplay usingmultiplexer.
6. Constructionofsimplearithmeticcircuits–adder,subtractorusinglogicgates.
7. Constructionofsimplearithmeticcircuits–adder,subtractorusingmultiplexer.
8. Constructionofsimplearithmeticcircuits–adder,subtractorusingdecoders.
9. RealizationofRS*JK&Dflipflopsusinguniversallogicgates.
10. Realizationofuniversalregisterusinglogicgates,JKflip*flops&multiplexer.
11. RealizationofAsynchronousUp/Downcounter.
12. RealizationofSynchronousUp/Downcounters.

13. Designofsequentialcounterwithirregularsequences.
14. Realizationofringcounter&Johnson'scounter.
15. Constructionofaddercircuitusingshiftregister&fulladder.
16. StudyofDAC&ADC.
17. Design&implementationofofmonostable&astable multivibratorusingNE555timer.
18. Design&implementationofbistablemultivibratorusingNE555timer.
19. Designofasimplefunctiongenerator(Sawtooth,sinewa ve,rampetc.)usingOpAMPs(IC741)toobservethewaveformonCRO.

Design based Problems (DP)/Open Ended Problem:

Open Ended /design based project: Apart from above experiments a group of students (Maximum Three) has to undertake one open ended problem/design problem. **(Students are free to select any area of science and technology may be based on their branch to define the project).**

Aims:

1. To provide experience in laboratory based experimentation, data recording and analysis and drawing of conclusions.
2. To develop report writing skills for scientific material.
3. To develop the ability to undertake investigations where, as part of the exercise, the goals and methods have to be defined by the investigator.
4. To develop skills in literature searches and reviews.

Evaluation of Open ended / design based small project

1. Open ended / design based small project will be evaluated by external examiner with appropriate marks allotment given by GTU time to time.
2. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
3. Evaluation should be done on **the approach of the student on his/her efforts** (not on completion) to study the design module of given task.

Examples

1. Build your own LED water conductivity meter - conductivity as a water quality measurement .
2. Build a Kinetic Energy Generator for Cell Phones .
3. Measure the power of the sun using photosensitive devices.
4. Simple Experiments With Transistors and Solid State Devices

Major Equipment:

1. Multimeter
2. Cathode-Ray Oscilloscope
3. PCBs
4. Electronics components
5. **I-V mearsuemnts system**
6. **Power Supply**
7. Digital Electronic Trainer

8. PCB Shear,Alligator Clips,Test Clips, Solder roll holder, Adjustable 50W soldering iron
9. LCR Meter

10. Function Generators
11. Signal Generators
12. Spectrum Analyzers
13. Signal Analyzers
14. LCD Color Digital Storage oscilloscope
15. Digital IC Tester

List of Open Source Software/learning website:

http://www.electronics-tutorials.ws/
http://www.learnabout-electronics.org/
http://www.circuitstoday.com/4-great-books-to-study-basic-electronics

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.