GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL & ELECTRONICS ENGINEERING (08) & ELECTRICAL ENGINEERING (09)

DIGITAL ELECTRONICS

SUBJECT CODE: 2140910

B.E. 4th SEMESTER

Type of Course: Engineering Science

Prerequisite:1) 2110016: Basic Electronics

Rationale: This subject focuses on the study of digital electronics and digital logic along with the basics of Digital Circuits. It also briefs the students about different types of memories. It details the students about use of digital electronics in Microprocessors and Microcontrollers and Its application in various electrical related fields Power system protection, instrumentation, power electronics, Electrical Drives and control of Electrical Euqipments.

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.	Topics	Teaching Hrs.	Module Weightage
1	**Number Systems:** Decimal, Binary, octal, and hexa-decimal number systems, binary arithmetic. Number base conversion, Complements **Codes**: Binary code, excess-3 code, gray code, error detection and correction codes.	07	20
2	**Logic families**: Positive logic and Negative Logic, AND, OR, NOT,NAND,NOR, X-OR GATE, INHIBIT CIRCUIT, Significance and type like TTL, CMOS, interface with different logic families, application relevant information, electrical characteristics,	04	08
3	**Boolean Algebra:** Introduction, Logic Operators, Postulates and theorems, properties –Product of Sums and Sum of Products– Karnaugh Map method – Two, three, four, five variable K-maps, Converting Boolean expressions to Logic and Vice versa, NAND and NOR implementation – Don't-Care conditions – The tabulation method	10	20
4	**Combinational Logic Circuit:** • Half and full Adder – Half and full Subtracter – Binary parallel adder – BCD Adder, Decimal adder – Magnitude comparator – Encoders & Decoders – Multiplexers–De-multiplexer	06	14
5	**Flip Flops and Sequential Logic and Circuits:** • Basic difference between Combinational logic and Sequential logic – Flip-Flops like S-R , J-K, D, Master Slave– Triggering of (level and Edge) flip-flops –Asynchronous and Synchronous Inputs –Excitation	07	15

	tables for flip-flops • Ripple and Synchronous counters – Registers – Shift registers –Pulse Generation.		
6	**Memory:** • Role of Memory in Computer Systems– Types and Terminology– Organization and operation, Reading & Writing, RAMs, ROMs, PROMs – Semiconductor RAM, Flash Memory	04	08
7	**D/A and A/D Converters:** Digital to Analog Converters D/A converter Specifications, Types of D/A converters, Mode of Operation, BCD-Input D/A converter, Integrated Circuit D/A Converters, D/A converter Applications, A/D converters, A/D Converter Specifications, A/D Converter Technology, Types of A/D converters, Integrated Circuit A/D Converters, A/D converter Applications	07	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
25-30%	25-30%	20-25%	10-15%	5-15%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Fundamentals of Digital Electronics by A. Anandkumar, PHI
2. Digital Electronics Principal and Integrated Circuits by Anil K. Maini, WILEY-INDIA
3. Digital Logic and Computer Design by M. Morris Mano, PHI
4. Digital Computer Electronics by Malvino & Brown, Tata McGraw Hill

Course Outcome:

After learning this course, the students should be able to:

1. Understand different number systems and its inter-conversions.
2. Understand the concept of Boolean algebra and its different theorems, properties etc.
3. Understand simplification of Boolean functions.
4. Understand the construction and working of different combinational circuits etc.
5. Understand different flip-flops and its applications.
6. Understand different sequential logic circuits and basic design of sequential circuits and counters.
7. Understand different types of memories and its applications.
8. Understand the fundamentals of D/A and A/D converters

List of Experiments (Laboratory Work):

Objectives: The laboratory work is aimed at putting the theory learnt in class in practice and to show that the results are matched with theory closely. In this context, following are the core objectives for laboratory work of this subject.

- Develop understanding of number systems and Boolean algebra.
- Understand the functioning of logic gates, their implementation and verification of truth tables.

- Develop the understanding of the working of different combinational logic circuits.
- Understand and verify the working of various sequential logic circuits.
- Understand simulation tools for digital logic circuits and simulation of digital logic circuits.
- Understand logic analyzer for testing the logic circuits.
- Understand and verify the working of Various Types of D/A and A/D converters

Directions for Laboratory work:

- ✓ The list of experiments is given as a sample.
- ✓ Minimum 10 experiments should be carried out.
- ✓ At least one experiment should be selected from each group.
- ✓ Similar laboratory work fulfilling the objectives can also be considered.
- ✓ Each experiment should be simulated before verifying practically.
- ✓ As far as possible, printed manual should be preferred so that students can concentrate in laboratory experiments and related study.

The sample list of experiments is given below.

List of Experiments and Design Based (DP)/Open Ended Problems:

There are four experiment groups: A, B, C and D. Total 10 experiments from Group A, B & C should be carried out (At least two experiments from each group). Over and above 10 performance experiments, self-study work may be given to students from group D. This includes study of logic families, datasheets of logic ICs, memory chips, etc.

Group A (Logic Gates):

1. Verification of truth table of Logic gates.
2. Implementation of various Logic gates using only NAND gates.
3. Implementation of various Logic gates using only NOR gate.

Group B (Combinational Circuits):

4. Verification of function of Half/Full adder circuits.
5. Verification of function of Half/full subtractor circuits.
6. Verification of function of Binary to Grey code conversion.
7. Verification of function of Grey to Binary code conversion.
8. Verification of function of 2 line to 4 line decoder.
9. Verification of function of 4 line to 2 line encoder.
10. Verification of function of 4 to 1 multiplexer.
11. Verification of function of 1 to 4 demultiplexer.
12. Study of Parity Generator.

Group C (Sequential Logic Circuits):

13. Verification of function of Latch and flip-flop.
14. Verification of shift left/ right register.
15. Verification of counter circuit like binary up/down counter, decimal counter, ring counter, Johnson counter etc.
16. Verification of Sequential circuits other than counter and shift registers.
17. Verification of Specification and Performance indices of D/A and A/D converters

Group D (Study Experiments):

18. To study standard graphics symbols for digital logic.
19. To study the construction, working and application of any one memory IC from datasheet.
20. To study the D/A and A/D converter IC with its specifications.

Major Equipments:

- Bread Board, Function Generator, Oscilloscope, Digital Logic Trainer Kits, Multimeter, Power Supply, Logic Analyzer,etc.
- Consumable Items: Various logic ICs for logic gates, flip-flops, latch, decoders, encoders, multiplexers, demultiplexer, etc., hook-up wires, Soldering iron, Desoldering pump, Electronics Toolkit, etc.

List of Open Source Software/learning website:

Open Source Software:

- TINA-TI for circuit simulation (http://www.ti.com/tool/tina-ti)
- OSCAD for CAD application (http://www.oscad.in/downloads)
- Fritzing for bread board/GP board wiring planning (http://fritzing.org/download)
- Multisim for circuit simulation (http://www.ni.com/multisim)
- Xilinx ISE/ Vivado (http://www.xilinx.com)
- http://sourceforge.net/projects/ktechlab/
- http://www.cburch.com/logisim/
- http://sourceforge.net/projects/digitalcircuitdesign/?source=directory

Web-based tools for design:

- https://www.circuitlab.com/editor/

Open source for Math Tools:

- http://maxima.sourceforge.net/
- http://www.sagemath.org/
- http://www.scilab.org/
- http://www.gnu.org/software/octave/

Learning website:

- http://www.datasheetcatalog.com/
- http://nptel.iitm.ac.in/courses.php
- http://ocw.mit.edu/
- http://www.electrical-engineering-portal.com

Active Learning Assignments (ALA) : Preparation of power-point slides: which may include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus can 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 faculty and the department.