GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS (20)
SUBJECT NAME: DESIGN CONCEPTS IN BASIC ELECTRONICS
SUBJECT CODE: 2132003
B.E 3rd Semester

Type of course: Engineering

Prerequisite: N.A.

Rationale: This subject can be considered to be a stepping stone to Computer Architecture. It involves Basics of electronics for hardware understanding.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE End Semester Examination; PA- Progressive Assessment.

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Number system and codes • Binary, Octal, Hexadecimal and Decimal Number systems and their inter conversion • BCD numbers (8421-2421), Gray Code, Excess–3 Code, Cyclic Code, Code Conversion, ASCII, EBCDIC codes. • Binary Addition and Subtraction, Signed and Unsigned binary numbers, 1's and 2's Complement Representation.	04	8.5%
2	Boolean Algebra: Basic logic circuits: • Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR and their truth tables), Universal Gates. • Laws of Boolean algebra, De-Morgan's theorem, Min term, Max term, POS, SOP. • Karnaugh Map, Simplification by Boolean theorems, don't care condition.	04	8.5%
3	Combinational Logic: • The Half Adder, the Full Adder, Subtractor circuit.		

	• Multiplexer De-multiplexer, Decoder, BCD to Seven segment decoder, encoders. • Flip flop and Timing circuit: Set-Reset laches, D-flip flop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T flip-flop.	07	15%
4	Registers & Counters: • Synchronous/Asynchronous counter operation, Up/down synchronous counter, application of counter. • Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register.	06	13%
5	Logic Families: • Introduction to digital logic family such as RTL, DTL, TTL, ECL, CMOS, IIR, HTL etc. their comparative study • Basic circuit, performance characteristics, Wired logic, open collector output etc.	04	8.5%
6	Diode Theory • Conductors and Semiconductors, Silicon Crystal, Intrinsic Semiconductors, Extrinsic Semiconductors, The Ideal diode, Reading a datasheet. • DC Resistance of diode, The Unbiased Diode- Forward Biased and Reverse Biased, Breakdown Energy levels, Barrier Potential and Temperature, Load lines, Surface-Mount diodes.	04	8.5%
7	Diode Circuits: • The Half-Wave rectifier, Full-Wave rectifier, Choke-input filter, Capacitor-input filter, Peak Inverse Voltage, Clippers and limiters, Clampers, Voltage Multipliers	05	10.5%
8	Bipolar Junction Transistor • The Unbiased Transistor, The Biased Transistor, transistor currents, CE connections, Base and Collector Curves. • Transistor Approximations, Reading Data Sheets, Surface-Mount Transistors • Variations in current gain, the load line, the Operating point, recognizing Saturation, the Transistor Switch	08	17%
9	Transistor Biasing Voltage – divider Bias, Accurate Analysis, Load Line and Q point, Fixed Bias, Self Bias, Emitter Bias.	05	10.5%

Reference Books:

1. Digital Fundamentals by Morris and Mano, PHI Publication
2. Fundamental of digital circuits by A.ANANDKUMAR,PHI Publication

3. Basic Electronics And Linear Circuits by N. N. Bhargava D. C. Kulshreshtha S. C. Gupta Tata McGraw - Hill Education publication.
4. Electronic Devices and Circuit Theory by Robert Boylested, Louis Nashelsky, PHI publication.

Course Outcome:
After completion of the course, the student will be able to –

- Identify different number systems and inter conversions;
- Design different real time application based combinational circuits.
- Identify different digital logic family and their specifications.
- Design counters, shift registers of desired sequences.
- Identify load line for different biasing techniques.
- Design simple diode based circuits.
- Design transistor based circuits for mini projects.

List of Experiments:
The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competency. Following is the list of experiments for guidance. A student should perform at least 10 experiments out of the 14.

Sr. No.	Practical/Exercise	Approx. Hours Reqd.
1	To study the operation of the logic gates: AND, OR, NOT, NAND, NOR and X-OR. To study NAND and NOR as universal gates.	02
2	Reduce the Boolean Expressions to its simplest possible form. Implement it using gates & K-maps.	02
3	Construct Half Adder, Full Adder, Half Subtractor & Full Subtractor. Verify the truth-table for each	02
4	Design 4-bit up and down counter using Master Slave JK Flip-flops.	02
5	Design 4-bit synchronous counter using Master Slave JK Flip-flops.	02
6	To study V-I characteristics of (a) PN Junction Diode (b) Zener Diode (c) LED	02
7	To study Half Wave Rectifier and Full Wave Rectifier.	02
8	To study L Filter and C Filter and calculation of related parameters.	02
9	To study Clipper circuits using PN Junction Diode.	02
10	To study Clamper circuits using PN Junction Diode.	02
11	To study transistor datasheets	02
12	To study Input and Output Characteristics of CB configuration of Transistor.	02
13	To study Input and Output Characteristics of CE configuration of Transistor.	02
14	To study self-bias circuit of CE configuration.	02

Major Equipment's:

(1) CRO (At least 20MHz)
(2) Function Generator (Frequency range up to 20 MHz) – need to have sine, square wave output.
(3) Dual Power Supply (0-12V/15V DC)/3A
(4) Multimeters for measurement of voltage and current with suitable ranges.
(5) Various Electronics Components including different types of diodes, transistors and digital ICs.

Open Ended Problem:
The faculty may allocate additional work to the student which involves preparation of a case study on a present day electronic system of choice.

Active learning Assignments (AL) : 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.