# GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

## COURSE CURRICULUM
## COURSE TITLE: DIGITAL ELECTRONICS AND DIGITAL INSTRUMENTS
### (Code: 3340904)

| Diploma Programmes in which this course is offered | Semester in which offered |
|---|---|
| Electrical Engineering | 4th semester |

## 1.   RATIONALE

Digital electronics has invaded all branches of engineering and electrical engineering in particular. Hence it is essential that the diploma electrical engineer have a sound understanding of the basic fundamentals of digital electronics. Similarly digital instruments are replacing the analog instruments. Therefore, this course has been designed so that basic skills to operate and maintain the basic digital circuits and digital instruments are developed in the students.

## 2.   COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Maintain digital electronic circuits and instruments.**

## 3.   COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.
   i.    Use digital integrated circuit logic family chips.
   ii.   Perform computational and measurement activities using digital techniques.
   iii.  Build sequential and combinational logic circuits.
   iv.   Analyse working of A/D and D/A converters.
   v.    Use display devices for digital circuits.
   vi.   Use digital meters for measurements.

## 4.   TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | |
| **L** | **T** | **P** | **C** | **ESE** | **PA** | **ESE** | **PA** | |
| 4 | 0 | 2 | 6 | 70 | 30 | 20 | 30 | 150 |

**Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

## 5.    COURSE DETAILS

| Unit | Major Learning Outcomes (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit – I Number Systems** | 1a. Convert numbers from one to another system<br>1b. Perform binary arithmetical operations.<br>1c. Explain various types of binary codes and its applications. | 1.1 Types of number system, inter conversion<br>1.2 Basic mathematical operations – 1's complement, 2's complement, 9s complement and 10's complement<br>1.3 Binary addition, subtraction, multiplication and division.<br>1.4 Introductions to codes –Binary, weighted ,non weighted codes, Excess code, Grey code, BCD code, Hamming code (only introduction) |
| **Unit– II Logic Gates And Wave Shaping Circuits** | 2a. Use of Diode as Wave shaping circuit with the output waveforms of the clipper circuit. | 2.1 Diode and transistor as a switch.<br>2.2 Diode as a clipper circuit |
| | 2b. Differentiate different logic levels<br>2c. Prepare the truth table of various logic gates.<br>2d. Develop basic gates using Universal gates | 2.3 Positive logic and negative logic levels<br>2.4 Different types of logic gates, symbol and truth table<br>2.5 Universal gates - NAND and NOR |
| | 2e. State the features of various logic families | 2.6  Logic family RTL, DTL<br>2.7  NMOS, PMOS and  CMOS |
| **Unit– III Boolean Algebra and Combinational Circuits** | 3a. Apply laws of Boolean algebra<br>3b. State the need for Demorgan's theorems. | 3.1 Laws of Boolean algebra.<br><br>3.2 Demorgan's theorems. |
| | 3c. Build logic circuit for a given Boolean expression<br>3d. Build various combinational circuits.<br>3e. Describe the working of 3 to 8 decoder and BCD to Seven segment decoder | 3.3 Boolean expression and logic diagram and vice versa<br>3.4 Simplification of given Boolean equation.<br>3.5 Combinational circuits:  Half and Full Adder,  half and full Subtractor, Multiplexer and Demultiplexer Encoder and Decoder |
| **Unit- IV Sequential Circuits** | 4a. Explain the working of various Flip Flops with the help of truth table. | 4.1 Flip-Flop (FF) circuits: R-S, D, J-K and master slave J-K. |
| | 4b. Describe the working of various types of  shift generator. | 4.2 Shift register: series, parallel left and right |
| | 4c. Draw the waveform of Asynchronous and Synchronous counter counters | 4.3 Asynchronous and Synchronous counter using 7493 and 7490 |
| | 4d. Select  various | 4.4 Introduction of Semiconductor memory |

| Unit | Major Learning Outcomes (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | semiconductor memories | RAM, ROM, PROM, EPROM and EEPROM |
| **Unit-V A to D And D to A Convertors and Display Devices** | 5a. Describe the working of various types of A to D convertors. 5b. Describe the working of various types of and D to A convertors. | 5.1 Digital to Analog conversion. • Weighted Resistor Network type • Binary Ladder Network type 5.2 Analog to Digital conversion • Parallel Comparator type • Successive approximation type • Counter OR Staircase type |
| | 5c. Explain working of various display devices used with digital circuits. | 5.3 Display devices • Mechanical Drum or Disc type • Light Emitting Diode type • Liquid Crystal Display |
| **Unit-VI Digital Instruments** | 6a. State the features of digital over analog instruments. | 6.1 Comparison of digital instrument with analog instrument. |
| | 6b. Draw the block diagram of digital instruments and explain each block. | 6.2 Basic building blocks of -digital instruments. |
| | 6c. Explain the working of various Digital instruments | 6.3 Digital volt-meter - Ramp and Staircase type 6.4 Digital frequency meter, multi meter, Digital watt meter, Digital energy meter |

## 6.    SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY)

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Number Systems | 8 | 2 | 4 | 4 | 10 |
| II | Logic Gates and Wave shaping Circuits | 11 | 4 | 4 | 6 | 14 |
| III | Boolean Algebra And Combinational Circuits | 12 | 3 | 4 | 8 | 15 |
| IV | Sequential Circuits | 11 | 4 | 6 | 4 | 14 |
| V | A to D and D to A Convertors and Display Devices | 8 | 4 | 4 | 2 | 10 |
| VI | Digital Instruments | 6 | 3 | 3 | 1 | 7 |
| | **Total** | **56** | **20** | **25** | **25** | **70** |

**Legends:** R = Remember; U = Understand; A = Apply 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.

## 7.    SUGGESTED LIST OF EXERCISES/PRACTICAL
The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

*Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

| S. No. | Unit No. | Practical Exercises (outcomes in psychomotor domain) | Approx Hrs. required |
|---|---|---|---|
| 1 | II | Verify the truth table of the different Logic Gates**.** | 2 |
| 2 | II | Build basic Gates using NAND Universal Gate. | 2 |
| 3 | II | Build basic Gates using NOR Universal Gate. | 2 |
| 4 | II | Build diode positive clipper circuits and observe the output waveform | 2 |
| 5 | II | Build diode negative clipper circuits and observe the output waveform. | 2 |
| 6 | III | Build and test the logic circuit to prove commutative laws, Associative laws and Distributive laws. | 2 |
| 7 | III | Verify Demorgan's theorems. | 2 |
| 8 | III | Build and test the logic circuit for a given Boolean Expression. | 2 |
| 9 | III | Build and test the logic circuit for simplification of a given Boolean Expression. | 2 |
| 10 | III | Build and test Half Adder Circuit. | 2 |
| 11 | III | Build and test Full Adder Circuit. | 2 |
| 12 | III | Build and test Half Subtractor Circuit. | 2 |
| 13 | III | Build and test Full Subtractor Circuit. | 2 |
| 14 | IV | Build and test the working of the R-S Flip-Flop for Active High inputs. | 2 |
| 15 | IV | Build and verify the truth table of R-S Flip-Flop for Active Low inputs. | 2 |
| 16 | IV | Build and verify the truth table of D Flip-Flop. | 2 |
| 17 | IV | Build and verify the truth table of JK Flip-Flop. | 2 |
| 18 | IV | Build and test the working of the Shift Register. | 2 |
| 19 | IV | Build and Test the working of the Decade counter. | 2 |
| 20 | IV | Display various alphanumeric characters on BCD and Seven segment LED Display. | 2 |
| 21 | IV | Build/Test the 4 bit Decoder circuit. | 2 |
| 22 | IV | Build/Test the 4 bit Encoder circuit. | 2 |
| 23 | V | Convert given analog signal to 4 bit Digital output using ADC | 2 |
| 24 | V | Convert the given digital signal to analog output using DAC. | 2 |
| 25 | VI | Build and Test various digital circuits with the help of simulation software. | 2 |
| **Total Hours** (Perform any practical worth 28 hours from above depending upon the availability of resources so that most units are covered) | | | **50** |

## 8.    SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:
i.    Student may validate the experimental results with that of results obtained using various simulation soft ware's.

ii.    Student may present seminar on a given topic of this subject
iii.   Students may develop counters for practical use

## 9.    SPECIAL INSTRUCTIONAL STRATEGIES (IF ANY)
- Visit to nearby electronic component manufacturing factories
- Display of animation/video films on functioning of digital instruments.

## 10.    SUGGESTED LEARNING RESOURCES
### A)    List of Books

| Sr. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1. | Digital Electronics | Sanjay Sharma | S.K.Kataria & sons. |
| 2. | Digital Electronics | Dr.B.R.Gupta & V.Singhal | S.K.Kataria & sons. |
| 3. | Digital Electronics (for Polytechnics) | Pratima Manhas Shaveta Thakral | S.K.Kataria & sons. |
| 4. | Trouble shooting & Maintenance of Electronic equipments | K. Sudeep singh | S.K.Kataria & sons. |
| 5. | Digital design : with an introduction to the verilog hdl | M. Morris Mano, Michael D. Ciletti | Pearson, 5$^{th}$ edition. |
| 6. | Morden Digital Electronics | R P Jain | TMH |
| 7. | Fundamentals of Digital circuits | A. Anand Kumar | PHI |
| 8. | Digital Electronics | K. Meena | PHI |
| 9. | Digital principles & applications | Malvino. A. P., Leach D. P., Saha Goutam | Tata Mcgraw Hill Education Private Limited (2010), 7$^{th}$ Edition |
| 10. | Pulse digital & switching wave forms | Millman & Taub | Mc. Graw Hill |
| 11. | Electronic devices & circuits | Allen Mottershed. | Prentice Hall of India |
| 12. | Principles of digital electronics | Malvino & Leach | Tata Mc. Graw Hill |
| 13. | Digital circuits & systems | Douglass V. Hall | Mc. Graw Hill |

### B)  List of Major Equipment/ Instrument with Broad Specifications
- Bread board with connecting wires & various logic input/output facilities
- Various Logic Gates, Flip-Flop, Registers, Counters, Encoder, Decoder,
- ADC, DAC, Seven Segment Code converter related ICs
- Digital Logic trainer board.
- A/D and D/A trainer modules.
- Universal counter module
- Demonstration kit for various display devices
- Digital IC tester
- Regulated Power Supply
- Digital Storage Oscilloscope
- Digital Multimeter

- Various kits of Digital Voltmeter, Frequency meter, Watt meter, Energy meter.
- Digital Function Generators
- The Virtual Instrumentation Educational Laboratory Suite specifically for teaching analog, digital, and power laboratories

### C) List of Software/Learning Websites

- Matlab 2011a
- Psim
- Electronics Work Bench
- www.nptel.iitm.ac.in
- www.ocw.mit.edu
- www.slideshare.net/
- www.alldatasheet.com
- www.nptl.iitm.ac.in
- www.ocw.mit.edu
- www.slideshare.net
- www.authorstream.com
- www.daenotes.com
- www.youtube.com/nptelhrd
- www.Howstuffworks.com
- Various Simulation soft ware's such as Electronics Workbench etc.

## 11. COURSE CURRICULUM DEVELOPMENT COMMITTEE
### Faculty Members from Polytechnics

- **Prof. S.V. Jagan**i Lecturer, Govt. Polytechnic Dahod.
- **Prof  J.C. Gadani**, Lecturer, C U Shah Govt. Polytechnic Surendranagar.
- **Prof  H.I. Joshi**, Lecturer, Govt. Polytechnic, Ahmedabad.

### Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. (Mrs.) C. S. Rajeshwari**, Head of Department of Electrical and Electronics Engineering.
- **Prof. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering.