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DIGITAL TECHNIQUES **Course Code : 313303**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Medical Electronics/ Computer Science/ Electronics & Computer Engg./**
Programme Code	**: AI/ AN/ AO/ CM/ CO/ CST/ CW/ DE/ DS/ EJ/ EK/ ET/ EX/ HA/ IC/ IE/ IS/ MU/ SE/ TE**
Semester	**: Third**
Course Title	**: DIGITAL TECHNIQUES**
Course Code	**: 313303**

I. RATIONALE

Digitization implies use of digital circuits in most of automation and industrial systems. The knowledge of logic gates, combinational and sequential circuits using discrete gates and digital ICs will enable students to interpret working of digital equipment and test their functionality.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:
Student will able to test the functionality of the digital circuits/system.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Apply number system and codes concept to interprete working of digital systems.
- CO2 - Apply Boolean laws to minimize complex Boolean function.
- CO3 - Develop combinational logic circuits for given applications.
- CO4 - Develop sequential logic circuits using Flip-flops.
- CO5 - Interpret the functions of data converters and memories in digital electronic systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313303	DIGITAL TECHNIQUES	DTE	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

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Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Convert the given number from one number system to another number system. TLO 1.2 Perform arithmetic operations on binary numbers. TLO 1.3 Subtract given binary numbers using 1's and 2's compliment method. TLO 1.4 Convert the given coded number into the other specified code. TLO 1.5 Write the application of the given code. TLO 1.6 Perform BCD addition and subtraction for the given Decimal numbers .	**Unit - I Number Systems** 1.1 Number Systems: Types of Number Systems (Binary, Octal, Decimal, Hexadecimal), conversion of number systems 1.2 Binary Arithemetic: Addition, Subtraction, Multiplication and Division 1.3 Subtraction using 1's and 2's complement method 1.4 Codes: BCD, Gray code, Excess-3 and ASCII code,Code conversions, Applications of codes. 1.5 BCD Arithemetic: BCD Addition, Subtraction using 9's and 10's complement	Lecture Using Chalk-Board

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Define the given characteristics parameters of the digital logic families. TLO 2.2 Draw symbol and truth table of given logic gates. TLO 2.3 Explain the concept of Buffer and Tristate logic . TLO 2.4 Implement basic gates and other gates with the help of universal gate. TLO 2.5 Simplify the given expression using Boolean laws and develop logic circuits .	**Unit - II Logic Gates and Boolean Algebra** 2.1 Logic Families: Characteristics Parameters of logic Families- Noise margin, Power dissipation, Figure of merit ,Fan in, Fan out, Speed of operation, maximum clock frequency supply voltage requirement ,power per gate , Comparison of TTL, CMOS and ECL logic family 2.2 Introduction to positive and negative logic systems, Logic Gates: Symbol ,Truth table of Basic logic gates(AND,OR,NOT),Universal gates(NAND,NOR) and Special purpose gates(EX-OR,EX-NOR) 2.3 Buffer: Tristate logic, Unidirectional and Bidirectional 2.4 Boolean algebra : Laws of Boolean algebra, Duality Theorem ,De-Morgan's theorem	Flipped Classroom Lecture Using Chalk-Board
3	TLO 3.1 Develop logic circuits for standard SOP/POS form of the given logic expression. TLO 3.2 Minimize the given logic expression using K-map (up to 4 variables). TLO 3.3 Design Adder and subtractor using K-map. TLO 3.4 Describe working of specified Encoder and Decoder with help of block diagram and truth table. TLO 3.5 Describe the working of Multiplexer and Demultiplexer.	**Unit - III Combinational Logic Circuits** 3.1 Standard Boolean expression: Sum of products [SOP] and Products of Sum [POS], Min-term and Max-term, SOP-POS form conversion, realisation using NAND/NOR gates 3.2 Boolean Expression reduction using K-map: Minimization of Boolean expressions (upto 4 variables) using SOP and POS form 3.3 Arithemetic circuits : design Half and Full Adder using K-maps, design Half and Full Subtractor using K-maps , n bit adder and n bit subtractor . 3.4 Encoder and Decoder: Functions of Encoder and Decoder, Block Diagram and Truth table, Priority Encoder (4:2, 8:3), BCD to 7 segment Decoder/Driver, Keyboard Encoder / decoder 3.5 Multiplexer and Demultiplexer: Working, Truth table and applications of MUX and DEMUX. MUX tree, DEMUX tree, DEMUX as Decoder	Flipped Classroom Presentations Lecture Using Chalk-Board

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Differentiate between Latch and Flip Flop. TLO 4.2 Explain basic memory cell and use relevant triggering technique for the given digital circuit. TLO 4.3 Describe the truth tables for the given Flip flops, applications of Flip flops. TLO 4.4 Use the given type of flip flop and its excitation table to design specific type of counter. TLO 4.5 Describe the working of specified shift register with the help of timing diagram. TLO 4.6 Design specified modulo-N counter using Flip flops . TLO 4.7 Design Ring /Twisted ring counter using given Flip-Flop.	**Unit - IV Sequential Logic Circuits** 4.1 Difference between Combinational and Sequential Logic circuits, Time independent (un-clocked)and Time dependent (Clocked) logic system , Flips- Flops and Latch, Basic memory cell ,RS-Latch using NAND and NOR, Triggering methods- Edge trigger and Level Trigger 4.2 Flip-Flops: S-R, J-K, T and D, Truth table and logic circuits of each flip-flop, Excitation table, applications 4.3 Race around condition in JK flip-flop, Master- Slave JK Flip Flop 4.4 Shift registers- Serial In Serial Out, Serial In Parallel Out, Parallel In Serial Out ,Parallel In Parallel Out,Bi-directional Shift register, 4-bit Universal Shift register 4.5 Counters- Synchronous and Asynchronous counters, Modulus of counter, Ripple counter, Ring Counter, Twisted Ring Counter, Up – down counter, Decade Counter, MOD-N counter, Timing Diagram	Video Demonstrations Lecture Using Chalk-Board Simulation
5	TLO 5.1 Describe the working of the given type of DAC. TLO 5.2 Calculate the output voltage for the given digital input for specified DAC. TLO 5.3 Describe the working of the given type of ADC. TLO 5.4 Compare working of ROM,EPROM, EEPROM and Flash Memory .	**Unit - V Data Converters and Memories** 5.1 Digital to Analog Data Converter (DAC)- circuit diagram and working of Weighted resistor DAC and R-2R Ladder DAC, DAC Specification/Selection factors 5.2 Analog to Digital Data Converter (ADC) : Block Diagram, Types and Working of Dual Slope ADC, Successive Approximation, Flash Type ADC, ADC selection factors/ specifications 5.3 Memories: Types- Primary memory , Secondary Memory, Organization, Dimension, Memory Bank, Features , Applications: RAM (SRAM, DRAM), Volatile and Non-Volatile, ROM (PROM, EPROM, EEPROM), Flash Memory, Comparison of RAM and ROM,EPROM and Flash Memory, SIMM: Features, SSD memory: Features,	Video Demonstrations Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Test the functionality of basic gates. LLO 1.2 Test the functionality of special purpose gates.	1	* Test the functionality of AND, OR, NOT, Ex-OR and EX-NOR logic Gates using equivalent 74 series or CMOS Devices [CD] series.	2	CO1 CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Test the functionality of NAND and NOR gate using breadboard.	2	* Test the functionality of the given Universal Gates using equivalent 74 series /CD series.	2	CO2
LLO 3.1 Test the functionality of the constructed Basic gates using universal gates.	3	* Construct Basic Gates using Universal Gates.	2	CO2
LLO 4.1 Construct Ex-OR, EX-NOR gates using universal gates.	4	Construct Exclusive Gates using Universal Gates.	2	CO2
LLO 5.1 Build the logic circuit on breadboard to verify the De - Morgan's theorems.	5	* Verify De-Morgan's Theorem (1 and 2).	2	CO2
LLO 6.1 Verify the truth table of Half and Full adder circuits for the given input.	6	* Implement 2 input, 3 input Adder Circuit.	2	CO3
LLO 7.1 Verify the truth table of Half and Full subtractor using Boolean expressions.	7	Implement 2 input, 3 input Subtractor Circuit.	2	CO3
LLO 8.1 Construct and test BCD to 7 segment decoder using Digital IC.	8	Test the output of BCD to 7 Segment Decoder using Digital IC for the given inputs.	2	CO3
LLO 9.1 Build/Test 2 or 4 bit Magnitude comparator using Digital IC.	9	Check the output of comparator circuit consisting of Digital IC.	2	CO3
LLO 10.1 Build / test function of MUX Digital IC.	10	* Build and test the functionality of 4:1/8:1 Multiplexer.	2	CO3
LLO 11.1 Build / test function of DEMUX Digital IC.	11	Build and test the functionality of 1:4/1:8 De-Multiplexer.	2	CO3
LLO 12.1 Test functionality of RS flip flop using NAND Gate .	12	Implement and verify the truth table of RS Flip flop.	2	CO4
LLO 13.1 Test functionality of Master Slave (MS) JK flip-flop using Digital IC.	13	Implement and test the functionality of master slave- JK Flip Flop using Digital IC.	2	CO4
LLO 14.1 Test functionality and truth table for D and T Flip flop.	14	Use Digital IC to construct and test the functionality of D and T flip flop.	2	CO4
LLO 15.1 Interpret timing diagram of 4 bit Universal Shift Register.	15	Build 4- bit Universal Shift register and observe the timing diagram.	2	CO4
LLO 16.1 Interpret timing diagram of 4-bit ripple counter using Digital IC.	16	Implement Ripple Counter using Digital IC.	2	CO4
LLO 17.1 Interpret timing diagram of Decade counter (Mod-10).	17	* Implement Decade Counter Using Digital IC.	2	CO4
LLO 18.1 Build R-2R resistive network on breadboard to convert given digital data into analog.	18	* Test the output of given R-2R type Digital to Analog Converter for the given input.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Implement 1:8 DEMUX using 1:4 /1:2 DE-MUX.
- Build a circuit to implement 4 Bit adder.
- Build a 4bit parity generator and parity tester.
- Implement 16:1 MUX using 8:1/4:1 MUX.
- Build a circuit to test 7 bit segment display.
- Build a LED display bar.
- Develop a project on Burglar alarm.
- Light Detector circuit using NAND gate.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Storage Oscilloscope 25MHz/60MHz/70MHz/100MHz Dual Channel, 4 Trace CRT / TFT based X10 magnification 20 nS max sweep rate, Alternate triggering Component tester and with optional features such as Digital Read out, USB interface. Any other Oscilloscope with additional features is also suitable with magnifying probe at least two probes, if possible isolated probe	15,16,17
2	Trainer kit for 4 bit Counter using Flip Flops 4 bit ripple counter synchronous counter IC 7476 based circuit, Input given by switches and output indicated on LED, Facility to select MOD 8 or MOD 16 mode, Built in DC power supply and manual pulser with indicator	16,17
3	Trainer kit IC DAC IC 0800 Trainer based on IC 0800, 8 bit digital input selected by switches and provision for measurement of analog output. Facility to study effect of change in reference voltage, Built in buffer amplifier, Built in DC power supply	18
4	Digital multimeter 3.5 digit with R , V, I measurements, diode and BJT testing	All
5	Digital IC Tester Tests a wide range of Analog and Digital ICs such as 74 series /CD series	All
6	Bread Board Development System Bread Board system with DC power output 5V,+/-12V and 0-5V variable , digital voltmeter ,ammeter , LED indicators 8 no , logic input switches 8 no, 7 segment display 2 no, clockgenerator	All
7	Trainer kits for digital ICs Trainer kit should consists of digital ICs for logic gates, flop flop, shift registers, counter alongwith toggle switches for inputs and bi-colourLED at outputs, built in power supply	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Number Systems	CO1	5	2	4	2	8
2	II	Logic Gates and Boolean Algebra	CO2	8	2	4	6	12
3	III	Combinational Logic Circuits	CO3	12	4	6	8	18
4	IV	Sequential Logic Circuits	CO4	12	4	6	8	18
5	V	Data Converters and Memories	CO5	8	4	6	4	14
Grand Total				**45**	**16**	**26**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- For formative assessment of laboratory learning 25 marks

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks.
- End semester summative assessment of 25 marks for laboratory learning

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	-	1	-	-	-	3			
CO2	2	-	2	-	-	-	2			
CO3	3	2	3	2	-	1	2			
CO4	3	2	3	2	-	1	2			
CO5	2	-	2	2	1	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jain R.P	Modern Digital Electronics	McGraw-Hill Publishing, New Delhi,2009 ISBN:9780070669116
2	Anand Kumar	Fundamentals of Digital Circuits	PHI learning Private limited, ISBN:978-81-203-5268-1
3	Salivahanan S, Arivazhagan S.	Digital Circuits and Design	Vikas Publishing House, New Delhi,2013 ISBN: 9789325960411
4	Puri.V.K	Digital Electronics	McGraw-Hill Publishing, New Delhi,2016 ISBN:97800746331751

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Sr.No	Author	Title	Publisher with ISBN Number
5	Malvino A.P Donald .P. Leach	Digital Principles	McGraw-Hill Education, New Delhi ISBN:9789339203405
6	Anil.K.Maini	Digital Electronics: Principles, Devices and Applications	Wiley India, Delhi, 2007, ISBN:9780470032145
7	Floyd, Thomas	Digital Fundamentals	Pearson Education India, Delhi 2014,ISBN:9780132737968
8	G.K.Kharate	Digital Electronics	Publisher: Oxford University Press, ISBN: 9780198061830

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://studytronics.weebly.com/digital-electronics.html	Basics of Digital Electronics
2	https://www.udemy.com/course/basics-of-digital-techniques/	Introduction To Digital Number System & Logic Gates
3	https://www.geeksforgeeks.org/synchronous-sequential-circuits-in-digital-logic/	Boolean Algebra and Logic Gates, Combinational and Sequential Logic Circuits
4	https://onlinecourses.nptel.ac.in/noc19_ee51/preview	Digital Circuits
5	https://de-iitr.vlabs.ac.in/	Virtual Labs for Digital Systems
6	https://www.tutorialspoint.com/digital_circuits/digital_circuits_sequential_circuits.htm	Sequential Circuits

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students