Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name	**: Diploma In Digital Electronics / Electronics & Tele-communication Engg. / Electronics & Communication Engg. / Electronics Engineering / Industrial Electronics**		
Programme Code	**: DE / EJ / ET / EX / IE**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Third** **NCrF Entry Level : 3.5**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme											Total Marks
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		
																	Practical						
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																							
1	DIGITAL TECHNIQUES	DTE	DSC	313303	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175
2	ANALOG ELECTRONICS	ATE	DSC	313324	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
3	CIRCUITS & NETWORKS	CKN	DSC	313325	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
4	PRINCIPLES OF ELECTRONIC COMMUNICATION	PEC	DSC	313326	1	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175
5	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	313002	-	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50
6	BASIC PYTHON PROGRAMMING	BPP	AEC	313011	-	2	-	2	-	4	2	-	-	-	-	-	25	10	25@	10	-	-	50
7	ELECTRONIC MEASUREMENTS & INSTRUMENTATION	EMI	AEC	313012	-	2	-	2	2	6	3	-	-	-	-	-	50	20	25@	10	25	10	100
Total					**1**	**17**	**0**	**16**	**7**		**20**		**120**	**280**	**400**		**175**		**150**		**175**		**900**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, 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.

Course Category : Discipline Specific Course Core (DSC) : 4, Discipline Specific Elective (DSE) : 0, Value Education Course (VEC) : 1, Intern./Apprenti./Project./Community (INP) : 0, AbilityEnhancement Course (AEC) : 2, Skill Enhancement Course (SEC) : 0, GenericElective (GE) : 0

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Medical Electronics/ Electronics & Computer Engg.**
Programme Code	**: AI/ AN/ AO/ CM/ CO/ CW/ DE/ DS/ EJ/ ET/ EX/ HA/ IC/ IE/ IS/ MU/ 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

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
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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

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

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

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
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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

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.
- 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

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
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)

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
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

Sr.No	Link / Portal	Description
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

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Medical Electronics/ Electronics & Computer Engg.**
Programme Code	**: DE/ EJ/ ET/ EX/ IC/ IE/ IS/ MU/ TE**
Semester	**: Third**
Course Title	**: ANALOG ELECTRONICS**
Course Code	**: 313324**

I. RATIONALE

Analog electronic circuits are the basic building blocks of many complex electronic system. Therefore it is necessary for students to understand the working principle and testing of basic analog circuits consist of discrete components and integrated circuits. After learning this course students will be able to apply the concept of working of basic electronic circuit and Op-Amp circuits to maintain the electronic system.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain the following industry/ employer expected outcome through various teaching learning experiences:
Maintain analog electronic circuits.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use transistor as a Power Amplifier.
- CO2 - Construct various configurations of Op-Amp for different applications.
- CO3 - Maintain different waveform generator circuits.
- CO4 - Analyze active filters used in various electronic circuits.
- CO5 - Use specific analog IC to develop various applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313324	ANALOG ELECTRONICS	ATE	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

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
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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 Describe the performance of the given power amplifier parameters. TLO 1.2 Explain with sketches the working of given type of power amplifier. TLO 1.3 Compare the given type of power amplifiers on the basis of performance parameter. TLO 1.4 Select relevant type of power amplifier for the given applications.	**Unit - I Power Amplifiers** 1.1 Power Amplifier: Concept, Performance parameters like: Gain, Bandwidth, frequency band, efficiency and distortion 1.2 Classification: Class A, Class B, Class AB and Class C power amplifier and their applications 1.3 Circuit diagram, working, input output waveforms and efficiency of single stage Class A, Class B, Class AB and Class C power amplifier, Push Pull amplifier, Complementary symmetry push–pull amplifier. Transformer less push-pull amplifier. Distortions in Power amplifier 1.4 Generalised features of audio power amplifier IC's, Heat Sink	Lecture Using Chalk-Board Video Demonstrations Assignments

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 Describe with sketches the function of the given block(s) of Op-Amp. TLO 2.2 List ideal characteristics of Op-Amp. TLO 2.3 Define the given parameters of Op-Amp. TLO 2.4 Interpret the output waveform of given mode of operation of Op-Amp. TLO 2.5 Calculate the output voltage of given arithmetic circuit consist of Op-Amp. TLO 2.6 Describe the working of the given application circuit consist of Op-Amp.	**Unit - II Op-Amp and its applications** 2.1 Op-Amp: block diagram, symbol, characteristics, open loop and closed loop amplifier, virtual ground concept, IC-741 and it's pin configuration 2.2 Op-Amp parameters: input offset voltage, output offset voltage, input offset current, input bias current, Common Mode Rejection Ratio, Power supply rejection ratio ,slew rate, input and output Impedance, bandwidth and gain bandwidth product, Drift parameters 2.3 Closed loop configurations: inverting and non-inverting 2.4 Basic mathematical applications such as adder, subtractor, integrator and differentiator 2.5 Sample and Hold circuit, I-V converter, V-I converter 2.6 Comparator: Zero Crossing Detector (Inverting and Non Inverting type), Schmitt Trigger, Window Detector and Peak Detector	Lecture Using Chalk-Board Video Demonstrations Assignments
3	TLO 3.1 Explain the principle of positive and negative feedback for amplifier circuit. TLO 3.2 State Barkhausen's criteria for oscillation. TLO 3.3 Describe the working principle of given type of oscillator. TLO 3.4 Calculate the frequency of oscillation for given oscillator. TLO 3.5 Select the circuit components of the given type of oscillator for given operating frequency.	**Unit - III Waveform Generators** 3.1 Principle of feedback amplifier. Types of feedback: Negative and Positive feedback, advantages and disadvantages of negative feedback, Types of feedback connections (Block Diagrams and features only) 3.2 Oscillator: need of oscillator, compare oscillator and amplifier 3.3 Condition for oscillations: Barkhausen's criteria, classification of oscillator 3.4 Oscillators Circuits : Phase shift oscillator using IC 741 , Hartley oscillator using IC 741 and crystal oscillator using BJT & FET	Lecture Using Chalk-Board Video Demonstrations Assignments Blended Classroom
4	TLO 4.1 Describe with circuit diagram working of the given type of filter. TLO 4.2 Identify the type of filter based on given frequency response. TLO 4.3 Calculate the cut off frequency of given type of filter. TLO 4.4 Develop given type and order of active filter for the given cut off frequency.	**Unit - IV Active Filters** 4.1 Definition, type of filters and difference between active and passive filter 4.2 Merits and demerits of active filter over passive filter 4.3 Terms related to filters: Order of filter, cut off frequency, Pass band, Stop band, Center frequency, Roll off rate, Bandwidth and Q factor 4.4 Order and frequency response: First and second order of low pass and high pass filter	Lecture Using Chalk-Board Assignments Video Demonstrations Blended Learning Tools

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.
5	TLO 5.1 Develop a circuit for the given application using IC-555. TLO 5.2 Calculate the duty cycle of the given type of multivibrator. TLO 5.3 Describe the working of given block of PLL. TLO 5.4 Develop a circuit for the given application using IC-565.	**Unit - V Specialized IC Applications** 5.1 Timer IC: IC 555 block diagram, pin diagram and functions, Astable and Monostable multivibrators, Voltage Controlled Oscillator 5.2 Phase Lock Loop (PLL) : IC 565 pin diagram, block diagram and it's working, Lock range and Capture range 5.3 Applications of PLL: PLL as a frequency multiplier, FM Demodulator	Lecture Using Chalk-Board Assignments Video Demonstrations Blended Learning Tools

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 Interpret the operation of single stage Class A power amplifier.	1	* Test the performance of single stage Class A power amplifier.	2	CO1
LLO 2.1 Interpret the operation of Class B push pull power amplifier.	2	* Test the performance of Class B push pull power amplifier.	2	CO1
LLO 3.1 Interpret the operation of Class AB power amplifier.	3	Test the performance of Class AB power amplifier.	2	CO1
LLO 4.1 Measure output voltage swing of Op-Amp (IC 741).	4	* Determine the range of output voltage swing of Op-Amp (IC 741).	2	CO2
LLO 5.1 Measure input offset voltage and output offset voltage of IC 741.	5	* Build the circuit to measure input offset voltage and output offset voltage of IC 741.	2	CO2
LLO 6.1 Connect IC 741 in inverting and non-inverting mode. LLO 6.2 Measure the voltage gain of inverting and non-inverting amplifier circuit using IC 741.	6	* Determine the gain of inverting and non-inverting amplifier using IC 741.	2	CO2
LLO 7.1 Select the proper range of multimeter to measure the voltage. LLO 7.2 Measure output voltage of adder circuit consist of IC 741.	7	* Build /Test adder circuit consist of IC 741.	2	CO2
LLO 8.1 Select the proper range of multimeter to measure the voltage. LLO 8.2 Measure output voltage of subtractor circuit consist of IC 741.	8	Build /Test subtractor circuit consist of IC 741.	2	CO2
LLO 9.1 Use function generator. LLO 9.2 Interpret input and output waveforms of Integrator circuit consist of IC 741.	9	* Build /Test Integrator circuit consist of IC 741.	2	CO2
LLO 10.1 Use function generator. LLO 10.2 Interpret input and output waveforms of Differentiator circuit consist of IC 741.	10	* Build /Test Differentiator circuit consist of IC 741.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Measure output current of V to I converter circuit using IC 741.	11	* Build/ Test V to I converter circuit using IC 741.	2	CO2
LLO 12.1 Interpret output voltage waveform of zero crossing detector.	12	* Build the circuit of zero crossing detector and test the output.	2	CO2
LLO 13.1 Check the performance of feedback on the output voltage of amplifier.	13	Use transistor to build/test voltage series feedback amplifier with feedback.	2	CO3
LLO 14.1 Check the performance of feedback on the output voltage of amplifier.	14	Use transistor to build/test voltage shunt feedback amplifier with feedback.	2	CO3
LLO 15.1 Check the performance of amplifier for positive and negative feedback.	15	* Test the effect of positive and negative feedback on the output voltage of given amplifier.	2	CO3
LLO 16.1 Measure the output frequency of RC phase shift oscillator based on IC 741.	16	* Test the circuit to measure the frequency of oscillation of the given RC phase shift oscillator consist of IC 741.	2	CO3
LLO 17.1 Measure the output frequency of Crystal Oscillator	17	Test the circuit of transistorised Crystal Oscillator	2	CO3
LLO 18.1 Measure the output frequency of Hartley Oscillator consist of IC 741.	18	Test the Hartley Oscillator based on IC 741.	2	CO3
LLO 19.1 Observe the output waveform of Hartley Oscillator.	19	Simulate the working of Hartley Oscillator using multisim or relevant software.	2	CO3
LLO 20.1 Measure bandwidth and cut off frequency of low pass filter. LLO 20.2 Plot the frequency response of low pass filter.	20	* Build and test the circuit of first order low pass filter.	2	CO4
LLO 21.1 Measure bandwidth and cut off frequency of high pass filter. LLO 21.2 Plot the frequency response of high pass filter.	21	* Build and test the circuit of first order high pass filter.	2	CO4
LLO 22.1 Observe the output waveform of high pass filter.	22	Simulate the working of high pass filter consist of IC 741 using multisim or relevant software.	2	CO4
LLO 23.1 Select the proper value of R and C for generating waveform of specific duty cycle.	23	* Build / test astable multivibrator using IC 555 for the specific duty cycle.	2	CO5
LLO 24.1 Measure the time period of monostable multivibrator using IC 555.	24	Build / test monostable multivibrator using IC 555 for the specific duty cycle.	2	CO5
LLO 25.1 Observe the output waveform of monostable multivibrator.	25	Simulate the working of monostable multivibrator using IC 555 using multisim or relevant software.	2	CO5
LLO 26.1 Check the performance of Voltage Controlled Oscillator using IC 555.	26	* Build/ Test Voltage Controlled Oscillator using IC 555.	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 27.1 Measure the output frequency of multiplier circuit consist of IC565.	27	Build/ test the circuit of frequency multiplier using PLL IC 565.	2	CO5
LLO 28.1 Interpret input and output waveform of FM demodulator circuit contains PLL (IC 565).	28	Check the performance of PLL as FM demodulator (IC 565).	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

- 1) Construct audio amplifier using IC LM386N or equivalent IC.
- 2) Develop clap switch using IC 741.
- 3) Build automatic light operated switch using LDR and IC 741.
- 4) Build automatic evening lamp using IC 555 or equivalent IC.
- 5) Construct square wave generator using IC 741 or equivalent.
- 6) Develop low pass filter/high pass filter with cut off frequency of 2KHz using universal IC UAF42 or equivalent IC.

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.
- 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	Cathode Ray Oscilloscope Dual Trace 20Mhz/30Mhz, 1Mega ohm Input Impedance.	1,2,3,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26
2	Digital Storage Oscilloscope 20MHz and above, 1Mega ohm Input Impedance.	1,2,3,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26
3	Function Generator 0-2 MHz with sine, square and triangular output with variable amplitude and frequency.	1,2,3,9,10,12,13,14,15,19,20,21,22,23,24,25,26
4	Simulation software like: TINA-TI/Multisim etc. or any other open-source simulation software can be used.	19,22,25

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	Dual Tracking Power Supply 0-30V,2 A, short circuit and over voltage protection.	3,4,5,6,7,8,9,10,11,16,17,18,19,20,21
6	Analog IC tester with tests Op-amp,555, IC testing 741 , 555 ,556 ,565 it has Auto search facility of IC's Test by: Truth table/sequence table comparison ZIF: 40 pin DIP ZIF sockets.	4,5,6,7,8,9,10,11,12,16,17,18,19,20,21,22,23,24,25,26
7	Variable DC power supply 0-30V, 2A with short circuit and over voltage protection.	All
8	Digital Multimeter: Minimum 3 ½ digit 4 ½ digit display,9999 counts digital multimeter measures Vac, Vdc(1000V max) , Adc, Aac (10 amp max), Resistance(0-100 M ohm), diode and transistor testing mode.	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Power Amplifiers	CO1	8	4	4	4	12
2	II	Op-Amp and its applications	CO2	11	4	6	8	18
3	III	Waveform Generators	CO3	8	4	4	6	14
4	IV	Active Filters	CO4	8	4	4	6	14
5	V	Specialized IC Applications	CO5	10	4	4	4	12
Grand Total				**45**	**20**	**22**	**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.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks.
- End semester summative assessment is 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	3	1	2	2	1	--	2			
CO2	3	2	2	2	1	--	2			
CO3	2	2	2	2	1	1	2			
CO4	2	3	2	1	1	1	1			
CO5	2	3	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	Sedha R.S.	Applied Electronics	S.Chand, New Delhi,2015 ISBN:9788121927833
2	Gayakwad Ramakant A.	Op-Amps and Linear Integrated Circuits	PHI Learning, New Delhi 2011, ISBN:9788120320581
3	Salivahanan S., Bhaaskaran Kanchana V. S.	Linear Integrated Circuits	Tata McGraw-Hill Education,New Delhi, 2018, ISBN: 9789353160487
4	Chaudhary D. Roy	Linear Integrated Circuits	New Age International Publishers ISBN: 9788122420906
5	S. Salivahanan, N. Suresh Kumar	Electronic Devices and Circuits	McGraw Hill Education, Edition-Fourth, ISBN-9789339219505

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=mgoCeOCjiBI	Basic of Op-Amp.
2	https://youtu.be/dKTbrZMscpM?si=6lQ3xdhGvLDZL-VL	Class A Power Amplifier
3	https://www.youtube.com/watch?v=BfjdB09V1NQ&list=PLuv3GM6-gs E3npYPJJDnEF3pdiHZT6Kj3&index=22	Op-Amp as Integrator
4	https://www.youtube.com/watch?v=M3yI0byaqKc&list=PLuv3GM6-gs E3npYPJJDnEF3pdiHZT6Kj3&index=27	Introduction to Oscillator.
5	https://www.youtube.com/watch?v=aeQoEnH74C8&list=PLuv3GM6-gs E3npYPJJDnEF3pdiHZT6Kj3&index=31	Working of Crystal Oscillator.
6	https://www.elprocus.com/op-amp-applications-in-electronics/	Applications of Op-Amp.
7	https://testbook.com/electrical-engineering/power-amplifier-definition-types-and-uses	Power Amplifiers

Sr.No	Link / Portal	Description
8	http://vlabs.iitkgp.ac.in/be/exp17/inverting_opamp.html	Virtual Lab for Inverting Amplifier
9	https://ae-iitr.vlabs.ac.in/exp/astable-monostable-multivibrator/simulation/astable/exp.html?	Virtual Lab for Multivibrators using Op-Amp.

Note :

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

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics**
Programme Code	**: DE/ EJ/ ET/ EX/ IE**
Semester	**: Third**
Course Title	**: CIRCUITS & NETWORKS**
Course Code	**: 313325**

I. RATIONALE

Diploma engineers must deal with the electronic circuit while maintaining various electronic equipment/systems in the industry. This course will help the students to use principles of circuit and analyse to maintain the electric circuit/network.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry/ employer expected outcome through various teaching learning experiences

Measure and interpret Electric circuits/networks parameters.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Calculate voltage and current of the given circuit using nodal and mesh analysis.
- CO2 - Use various network theorems to calculate circuit parameters.
- CO3 - Determine the circuit parameters of two port network.
- CO4 - Calculate the electrical parameters of single phase A.C. circuit.
- CO5 - Find the resonance condition of electric/electronic circuits.

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	
313325	CIRCUITS & NETWORKS	CKN	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

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 Define various terms related to circuit and network. TLO 1.2 Use KCL and KVL to calculate voltage and current in the given resistive circuit. TLO 1.3 Apply nodal analysis to find voltage and current of the given network. TLO 1.4 Apply mesh analysis to determine voltage and current of the given network. TLO 1.5 Convert the given star connection to delta connection and vice versa. TLO 1.6 Use source conversion techniques to simplify the given circuit. TLO 1.7 Analyze the transient response of RL, RC and RLC series circuit.	**Unit - I DC Network Analysis** 1.1 Terms related to circuit and network: Node, Branch, Loop, Mesh 1.2 Kirchhoff‘s Current Law (KCL) and Kirchhoff’s Voltage Law (KVL) 1.3 Nodal Analysis 1.4 Mesh Analysis 1.5 Star-delta and delta- star conversion 1.6 Conversion of voltage to current source and current to voltage source 1.7 Transient Response : RL series circuit, RC series circuit , RLC Series circuit	Lecture Using Chalk-Board Video Demonstrations Assignments

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 Use superposition theorem to calculate voltage and current in the given multisource circuit. TLO 2.2 Use Thevenin's theorem to simplify the complex circuit. TLO 2.3 Use Norton's theorem to simplify the complex circuit. TLO 2.4 Calculate load impedance using maximum power transfer theorem for the given circuit. TLO 2.5 Use reciprocity theorem to analyse the given circuit.	**Unit - II Network Theorems** 2.1 Superposition theorem for both AC voltage and DC source 2.2 Thevenin' s theorem 2.3 Norton's theorem 2.4 Maximum power transfer theorem 2.5 Reciprocity theorem	Lecture Using Chalk-Board Video Demonstrations Blended learning Assignments
3	TLO 3.1 Differentiate the given types of networks. TLO 3.2 Calculate Z, Y parameters of the given circuit. TLO 3.3 Find the ABCD parameters of the given circuit. TLO 3.4 Connect two port networks in series, parallel and cascade configuration and analyze the output. TLO 3.5 List the types and applications of attenuator. TLO 3.6 List the types and applications of passive filters.	**Unit - III Analysis of two port network** 3.1 Network Types: Active and Passive, Bilateral and Unilateral, Linear and Nonlinear, Symmetrical and Asymmetrical, Single port and Two port network 3.2 Open circuit(Z) and short circuit(Y) parameters 3.3 Transmission (ABCD) parameters 3.4 Interconnection of two port network- series, parallel and cascade configuration 3.5 Attenuators: Definition, types-T and Pi, features, frequency response, applications, comparison 3.6 Passive Filters: Definition, types- Low pass filter (LPF),high pass filter (HPF), band pass filter(BPF) and band stop filter (BSF), features, frequency response, applications, comparison	Lecture Using Chalk-Board Video Demonstrations Assignments
4	TLO 4.1 Analyze the phasor diagram of series A.C. circuit. TLO 4.2 Calculate active, reactive, apparent power and power factor for the specified circuit. TLO 4.3 Analyze the phasor diagram of parallel A.C. circuit. TLO 4.4 Determine admittance, conductance and susceptance for the given circuit. TLO 4.5 Interpret the output of the given R, L and C component at initial and final condition.	**Unit - IV Single Phase A.C. Circuit** 4.1 AC circuit with series element: R-L, R-C and R-L-C circuits, voltage and current waveform, impedance, reactance, phasor diagram, impedance triangle 4.2 Different types of Power: power factor, active (real) power, apparent power, reactive power, power triangle, power triangle of series AC circuit 4.3 AC circuit with parallel element: Resistance in parallel with pure inductance and capacitance and for series combination of resistance and inductance in parallel with capacitance, voltage and current waveform, impedance, reactance, phasor diagram, impedance triangle, power triangle for above circuit 4.4 Definition of admittance, conductance and susceptance 4.5 Initial and final conditions in switching circuits, meaning of t=0-, t=0+, t= infinity, R, L and C at initial and final conditions	Lecture Using Chalk-Board Video Demonstrations Assignment

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.
5	TLO 5.1 Find the resonance condition for the specified series RLC circuit and calculate current, voltage, bandwidth, quality factor at resonant condition. TLO 5.2 Interpret the behaviour of series circuit with change in frequency. TLO 5.3 Find the resonance condition for the specified parallel RLC circuit and calculate current, voltage, bandwidth, quality factor at resonant condition. TLO 5.4 Interpret the behaviour of parallel RLC circuit with change input frequency. TLO 5.5 Describe the procedure to tune the given electrical circuit to achieve the resonance in the circuit.	**Unit - V Resonance in Series and Parallel circuits** 5.1 Resonance in series circuit: Impedance, phase angle, voltage, current, bandwidth, Quality factor (Q), magnification factor for series resonance circuit 5.2 Behaviour of RLC series circuit with change in input frequency 5.3 Resonance in Parallel Circuit: Impedance, phase angle, voltage, current, bandwidth, Quality factor (Q), magnification factor for parallel resonance circuit 5.4 Behaviour of RLC parallel circuit with change in input frequency	Lecture Using Chalk-Board Blended learning tools Assignments

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 Identify the loops in the given circuit. LLO 1.2 Verify KVL to find out the voltage across the element.	1	* Measure the voltage across resistive circuit and verify it, using Kirchhoff's Voltage law (KVL).	2	CO1
LLO 2.1 Identify the nodes in the given circuit. LLO 2.2 Verify KCL at given node.	2	Measure current in various branches of the given circuit and verify it, using Kirchhoff's current law (KCL).	2	CO1
LLO 3.1 Identify the meshes in given circuit. LLO 3.2 Use mesh analysis to calculate current through given branch.	3	* Measure current through and voltage across given branch of electric network and verify it by mesh analysis.	2	CO1
LLO 4.1 Identify the nodes in the given circuit. LLO 4.2 Use nodal analysis to calculate node voltage.	4	* Measure voltage at particular node and current through branch of network and verify it by nodal analysis.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Measure the current of the RL series circuit. LLO 5.2 Plot and interpret the transient response of given circuit on graph paper.	5	Observe transient response of RL series circuit with DC excitation.	2	CO1
LLO 6.1 Measure the voltage across capacitor in RC series circuit. LLO 6.2 Plot and interpret transient response of given circuit on graph paper.	6	* Observe transient response of RC series circuit with DC excitation.	2	CO1
LLO 7.1 Measure voltage and current of the given circuit. LLO 7.2 Verify Superposition theorem.	7	* Measure current through given branch of network and voltage across given element of the circuit and verify it applying Superposition theorem.	2	CO2
LLO 8.1 Measure load current of the given circuit. LLO 8.2 Verify Norton’s theorem.	8	Measure short circuit current and Norton's resistance of the given circuit and verify it using Norton’s theorem.	2	CO2
LLO 9.1 Measure load current of the given circuit. LLO 9.2 Verify Thevenin’s theorem.	9	* Measure open circuit voltage and thevenin's resistance of the given circuit and verify it using Thevenin’s theorem.	2	CO2
LLO 10.1 Verify Maximum power transfer theorem and calculate current ,voltage and power.	10	* Vary load resistance to transfer Maximum power in the given circuit using maximum power transfer theorem.	2	CO2
LLO 11.1 Verify the concept of interchangeability of sources and detectors in the given circuit.	11	Measure voltage to current ratio before and after interchanging the position of voltage source and current in the given circuit to verify reciprocity theorem.	2	CO2
LLO 12.1 Calculate input and output impedances of given network. LLO 12.2 Interpret the Z-parameters matrix.	12	* Measure input and output voltages and currents of the given two port network and calculate open circuit(Z) parameters for the given circuit.	2	CO3
LLO 13.1 Calculate Y parameters of given network. LLO 13.2 Interpret the Y parameters matrix.	13	Measure input and output voltages and currents of the given two port network and calculate short circuit(Y) parameters for given circuit.	2	CO3
LLO 14.1 Calculate ABCD parameters of given network. LLO 14.2 Interpret the ABCD parameters matrix.	14	Measure input and output voltages and currents of the given two port network calculate transmission(ABCD) parameters for given circuit.	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Construct low pass filter using R and C and interpret the frequency response of RC Low Pass Filter.	15	Develop RC low pass filter on breadboard and plot its frequency response.	2	CO3
LLO 16.1 Construct high pass using R and C and interpret the frequency response of RC high pass filter.	16	* Develop RC high pass filter on breadboard and plot its frequency response.	2	CO3
LLO 17.1 Construct band pass filter using R and C and interpret the frequency response of RC band pass filter.	17	Develop RC band pass filter on breadboard and plot it's frequency response.	2	CO3
LLO 18.1 Construct symmetrical T attenuator. LLO 18.2 Interpret I/O of symmetrical T type attenuator.	18	* Test the performance of Symmetrical T attenuator.	2	CO3
LLO 19.1 Construct symmetrical Pi attenuator. LLO 19.2 Interpret I/O of PI type attenuator.	19	Test the performance of Symmetrical Pi attenuator.	2	CO3
LLO 20.1 Connect the R and L in series with A.C. supply and measure current and voltage across the circuit element. LLO 20.2 Interpret the phasor diagram of given RL series circuit for various input A.C. supply.	20	* Measure voltage and current in the given R-L series circuit and calculate active, reactive and apparent power consumed in the circuit.	2	CO4
LLO 21.1 Connect the R and C in series with A. C. supply. LLO 21.2 Interpret the phasor diagram of given RC series circuit for various input A.C. supply.	21	Measure voltage and current in the given R-C series circuit and calculate active, reactive and apparent power consumed in the circuit.	2	CO4
LLO 22.1 Connect the R, L and C in series with supply. LLO 22.2 Interpret the phasor diagram of given RLC circuit for various input A.C. supply	22	* Measure voltage and current in the given R-L-C series circuit and calculate active, reactive and apparent power consumed in the circuit.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 23.1 Connect the R and C in parallel with supply. LLO 23.2 Interpret the phasor diagram of given RC parallel circuit for various input A.C. supply.	23	*Measure voltage and current in the given R-C parallel circuit and calculate power factor, active, reactive and apparent power consumed in the circuit.	2	CO4
LLO 24.1 Connect the R, L and C in parallel with supply. LLO 24.2 Interpret the phasor diagram of given R-L-C parallel circuit for various input A.C. supply.	24	Measure voltage and current in the given R-L-C parallel circuit and calculate power factor, active, reactive and apparent power consumed in the circuit.	2	CO4
LLO 25.1 Connect series connection of resistor and inductor in parallel with capacitor. LLO 25.2 Interpret the phasor diagram of given RL series circuit in parallel with C, for various input A.C. supply.	25	* Measure voltage and current in the given R-L-C parallel circuit consists of series connection of resistor and inductor in parallel with capacitor and calculate power factor, active, reactive and apparent power consumed in the circuit.	2	CO4
LLO 26.1 Measure and interpret initial and final condition of the capacitor in the given DC circuit.	26	Measure initial and final voltage across the capacitor before and after swicthing input supply.	2	CO4
LLO 27.1 Measure and interpret initial and final condition of the Inductor in the given DC circuit.	27	Measure initial and final current flowing through the inductive coil before and after switching the supply.	2	CO4
LLO 28.1 Tune the supply frequency to create resonance in given RLC series circuit.	28	* Measure voltage and current in the given RLC series circuit and calculate resonance frequency and impedance at resonance using variable supply frequency.	2	CO5
LLO 29.1 Tune the circuit parameters (L or C) and measure the resonance frequency of RLC series circuit .	29	Measure voltage and current in the given RLC series circuit and calculate resonance frequency and impedance at resonance by varying L or C.	2	CO5
LLO 30.1 Tune the supply frequency to create resonance in given RLC parallel circuit.	30	* Measure current of given RLC parallel circuit and calculate resonance frequency and impedance at resonance by varying supply frequency.	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
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

- Prepare a report on real life applications of resonance (e.g. musical instruments)
- Prepare power point presentation on source transformation, star- delta transformation, mesh and nodal analysis and give presentation in the class.
- Build a circuit on breadboard with multiple resistors connected in series and measure voltage across each resistor. Verify using KVL.
- Prepare a chart for comparison of single phase series RLC and parallel RLC circuit and draw input and output waveforms also.
- Build a circuit to change brightness of lamp/change the speed of fan/ change the temperature of heater using basic components.
- Build a circuit on breadboard with multiple resistors connected in parallel and measure current across each resistor. Verify using KCL.

Assignment

- Calculate the Z, Y and ABCD parameters for the given two port network.
- Find circuit parameters of Single Phase AC series(R-L, R-C,R-L-C) and parallel (R-L, R-C,R-L-C) circuit, also draw its phasor diagram.
- Find the resonance condition for the specified series and RLC circuit and calculate current, voltage, bandwidth, quality factor .Observe the behaviour of R, L and C with change in frequency for series circuit.
- Identify the number of loops and nodes in the given circuit and solve the circuit using Nodal analysis and Mesh analysis.
- Simplify complex circuit using Thevenin’s theorem, Norton’s theorem and draw equivalent circuit for given circuit.

Activities For Specific Learning / Skills Development

- Verification of various network analysis and theorems in Virtual Laboratory (https://asnm-iitkgp.vlabs.ac.in/).
- Verification of various network analysis and theorems using Simulation Software (MATLAB, PSPICE).
- Perform R-L-C circuit analysis in Virtual Laboratory (https://asnm-iitkgp.vlabs.ac.in/exp/rlc-circuit-analysis/).
- Experimental verification of frequency response of R-L-C series Circuit (https://asnm-iitkgp.vlabs.ac.in/exp/rlc-series-circuit/).
- Test the resonance in Series RLC circuit using Simulation Software (MATLAB, PSPICE).

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.
- 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	Voltmeter PMMC Type: DC, 0-150/300 V, 0-250/500 V, 0-75/150 V	11,12,13,14,16
2	Ammeter PMMC Type: DC, 0-1.5/3 Amp, 0-2.5/5 Amp, 0-5/10 Amp	12
3	Single phase Autotransformer 0-270 V,50Hz,10 A	20,21,22,23,24,25
4	Digital Storage Oscilloscope: 2 and 4 analog channel models 100 and 70 MHz bandwidth models Up to 1 GS/s sampling rate.	26,27,28
5	Signal Generator, Frequency : 0.1Hz ~ 5MHz ; Output waveforms : Sine, triangle, square, positive and negative pulse	26,27,28
6	Decade capacitor Box with Decades of 1nF, 10nF, 100nF, 1μF, 10μF	28,29,30
7	Decade Resistance Box with range 1 ohm to 1000 M ohm	28,29,30
8	Decade Inductor Box with Decades of 10μH, 100μH, 1mH, 10mH, 100mH	28,29,30
9	Ammeters MI type: AC/DC, 0-1 Amp, 0-1.5 Amp, 0-2.5 Amp, 0-5 Amp	All
10	Voltmeter MI Type: AC/DC, 0-150/300 V, 0-250/500 V, 0-75/150 V	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	DC Network Analysis	CO1	8	4	4	6	14
2	II	Network Theorems	CO2	12	2	6	10	18
3	III	Analysis of two port network	CO3	8	2	4	6	12
4	IV	Single Phase A.C. Circuit	CO4	11	4	4	6	14
5	V	Resonance in Series and Parallel circuits	CO5	6	2	4	6	12
Grand Total				**45**	**14**	**22**	**34**	**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 summative assessment is of 25 marks for laboratory learning.
- End semester assessment is of 70 marks.

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	3	2	1	1	1	1			
CO2	3	3	2	1	1	1	1			
CO3	2	2	3	1	1	1	1			
CO4	2	2	3	1	-	1	-			
CO5	2	1	2	1	-	1	-			

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	Mittal V.N., Mittal Arvind	Basic Electrical Engineering	McGraw Hill Education, Noida,2005,ISBN: 978007093572
2	Paranjothi S.R.	Electric Circuit Analysis	New Age Publisher, New Delhi , 2011, ISBN:978-81-224-3154-4
3	Theraja B.L.,Theraja A.K.	A Text book of Electrical Technology Vol-I	S. Chand and Co. New Delhi, 2006 ISBN:978-81-219-2440-5
4	Boylested R.L.	Introductory Circuit Analysis	Wheeler New Delhi, 2013,ISBN: 978-0023131615
5	P. Ramesh Babu	Electric Circuit Analysis	Scitech Publication (India) Pvt. Ltd ISBN : 978 81 8371 078 7
6	Ravish R Sihngh	Network Analysis and Synthesis	Mc Graw Hill Education (India) Pvt. Ltd. ISBN: 978-1-25-906295-7
7	Richard C. Doorf, James A. Svaboda	Introduction to electric Circuit	Wiley India Pvt. Ltd. ISBN: 978-81-265-5344-0
8	Sudhakar, A., Palli Shyammohan, S	Circuit and network	McGraw Hill, New Delhi, 2006 ISBN: 978-0-07-340458-5

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	www.scilab.org/scilab	Open source simulator for simulation of theorems
2	www.ni.com/multisim	Open source simulator for simulation of theorems and circuit analysis

Sr.No	Link / Portal	Description
3	https://www.nptelvideos.com/course.php?id=462	NPTEL Circuit Theory Video Lectures
4	https://asnm-iitkgp.vlabs.ac.in/	Virtual laboratory link for theorems, R-L-C circuit analysis and its frequency response
5	https://www.udemy.com/course/electrical-circuit-for-electric al-electronics-engineering/	Basics, circuit element, circuit solving, network theorems, transient analysis
6	https://everycircuit.com/app	Online and mobile app to design and simulate electronic 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

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics**
Programme Code	**: DE/ EJ/ ET/ EX/ IE**
Semester	**: Third**
Course Title	**: PRINCIPLES OF ELECTRONIC COMMUNICATION**
Course Code	**: 313326**

I. RATIONALE

In the fastest growing telecommunication era, diploma engineers deal with electronic communication systems. The use of basic principles of electronic communication will help the students in handling communication systems in the industry and consumer market .This course is developed to empower the students to apply their knowledge and skill to maintain the communication systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attend the following industry/employer expected outcome through various teaching learning experiences .
Maintain basic electronic communication system.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Select relevant frequency range/band for different communication mode.
- CO2 - Maintain AM based communication system.
- CO3 - Maintain FM based communication system.
- CO4 - Identify propagation mode for specified radio frequency band.
- CO5 - Identify relevant type of antenna for given frequency range/application.

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	
313326	PRINCIPLES OF ELECTRONIC COMMUNICATION	PEC	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : 1 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 Identify the relevant frequency band of electromagnetic spectrum for the specified signal. TLO 1.2 Differentiate analog and digital signal. TLO 1.3 Compare features of the given types of transmission modes. TLO 1.4 Distinguish between external and internal noise sources.	**Unit - I Basics of Electronic Communication** 1.1 Electromagnetic (EM) wave spectrum, frequency bands and their applications 1.2 Signals and its representation: analog and digital signal (In time and frequency domain) 1.3 Block diagram of Analog communication system and operation of each block 1.4 Transmission modes: Simplex , half duplex and full duplex, quadraplex ,Synchronous, Asynchronous and iso-synchoronus 1.5 Noise, Sources of Noise, signal to noise ratio(S/N) and noise figure unit for noise (only concept) 1.6 Ancient communication method in India :-In the history of communication humans relied on non-verbal forms of communication such as drum sounds, pigeons, messengers , symbols and smoke signals. (IKS-1 hour, No question in theory paper)	Chalk-Board Presentations Video Demonstrations

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 modulation and give its need. TLO 2.2 Describe with sketches the given parameters of AM signal. TLO 2.3 Calculate modulation index and modulated signal power of the given AM signal. TLO 2.4 Describe working of the given type of AM detection method . TLO 2.5 Describe working of each block of super heterodyne receiver.	**Unit - II Amplitude Modulation (AM) Communication** 2.1 Modulation ,Need for modulation 2.2 Types of modulation techniques ,Amplitude Modulation: Modulating signal , Carrier signal , modulation Index , mathematical representation of AM Signal (no derivation, only numericals) ,representation in time and frequency domain , Frequency Spectrum ,Types of AM band spectrum (DSB, SSB and VSB)and their applications , Power relations in AM wave (no derivation, only numerical) 2.3 Generation of AM: Block Diagram and working Low level and High Level AM transmitter 2.4 Demodulation of AM signal: Diode detector and practical diode detector, Automatic gain control and Delayed AGC 2.5 Block diagram and working of each block of super heterodyne receiver with waveforms Characteristics Selectivity , Sensitivity and Fidelity	Chalk and Board Videos demostration Visit to Telecommunication Industry
3	TLO 3.1 Differentiate between AM and FM. TLO 3.2 Generate FM signal using given type of method. TLO 3.3 Explain working of the each block of FM receiver . TLO 3.4 Explainworking of the given FM detector circuit. TLO 3.5 Differentiate between FM and PM waveforms.	**Unit - III Frequency Modulation (FM) Communication** 3.1 Frequency modulation: Mathematical representation of FM signal Use of Bessel's function (no derivation),representation of FM signal in time domain and frequency domain, frequency deviation ratio, modulation index (numerical), types of frequency modulation (Narrow Band and Wide Band FM), Concept of Pre-emphasis and De-emphasis and working 3.2 Generation of FM using direct method (varactor diode and reactance modulator) and indirect method (Armstrong method) 3.3 FM detector circuits: Ratio detector and PLL as FM demodulator 3.4 FM Receiver : Block diagram and working with waveforms 3.5 Phase Modulation : definition, waveforms and applications	Chalk and Board Video Demonstrations, Visit to Telecommunication Industry

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 Describe with sketches propagation mode of the given type of radio wave /band. TLO 4.2 Describe properties of the given type of wave propagation. TLO 4.3 Define critical frequency, skip distance, skip zone, fading, multiple hop with respect to sky wave propagation. TLO 4.4 Describe the concept of Duct propagation and troposphere scatter propagation of waves.	**Unit - IV Wave Propagation** 4.1 Concept of propagation of radio waves 4.2 Ground Wave propagation 4.3 Sky wave: Ionospheric layers, concept of actual height and virtual height, critical frequency, skip distance, skip zone. concept of fading, maximum usable frequency, multiple hop sky wave propagation 4.4 Space Wave propagation : line of sight, multipath space wave propagation , radio horizon, shadow zone 4.5 Duct propagation (microwave space-wave propagation) Troposphere scatter propagation	Chalk-Board Collaborative learning
5	TLO 5.1 Describe with sketches the working principle of the given type of antenna. TLO 5.2 Sketch the radiation pattern of resonant and non-resonant antenna. TLO 5.3 Compare given type of antenna on the basis of parameters. TLO 5.4 Select type of antenna for transmission and reception of given frequency band.	**Unit - V Antenna** 5.1 Antenna fundamentals :Resonant antenna and Non-resonant antennas, ideal antenna, principle of transmitting and receiving antenna Concept of Electromagnetism interference (EMI) and Electromagnetic Compatibility (EMC) 5.2 Antenna parameters : Radiation pattern , polarization, bandwidth, beam width, antenna resistance, directivity and power gain, antenna gain 5.3 Dipole antenna: Half dipole antenna (Resonant Antenna) and its radiation pattern, folded dipole antenna and its radiation pattern, radiation pattern of Dipole antenna for different length Major lobe , minor lobe , Radiation Pattern for Unidirectional , bidirectional and Omni directional antenna 5.4 Antenna (working principle, constuction, radiation pattern and applications) : Loop antenna, Telescopic antenna, Yagi-Uda antenna, Micro wave antenna - Dish antenna, Horn antenna and Micro-strip patch antenna , Printed antenna, Smart antenna flexible antenna	Chalk-Board Site/Industry Visit Demonstration

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 output of simplex and duplex mode of communication . LLO 1.2 Determine the number of channels for simplex, half duplex and full duplex Communication .	1	* Demonstrate the simplex ,half duplex and full duplex communication link using switches, wires and LEDs.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Test analog and digital signals on CRO and spectrum analyzer. LLO 2.2 Observe the difference between time domain and frequency domain representation of a signal .	2	Observe the different analog and digital signals on CRO and spectrum analyzer in time domain and frequency domain.	2	CO1
LLO 3.1 Interpret the effect of change in modulating frequency on AM signal.	3	Observe the AM modulated waveforms generated for different modulating frequencies.	2	CO2
LLO 4.1 Calculate modulation index 'm' from the observed AM waveform . LLO 4.2 Interprete the effect of 'm' on AM signal.	4	*Generate AM wave and measure its modulation index for different values of modulating signal amplitude.	2	CO2
LLO 5.1 Observe the AM demodulated signal on DSO/CRO. LLO 5.2 Observe the output waveform of AM demodulator and measure its frequency.	5	Build and test the AM demodulator circuit .	2	CO2
LLO 6.1 Observe the AM signal using simulation software. LLO 6.2 Interpret the demodulated AM signal using simulator software.	6	* Display the AM modulator and demodulator signal using MATLAB Simulink/SCILAB /relevant software for different modulating frequencies.	2	CO2
LLO 7.1 Observe the waveforms and measure the voltages at various test points of AM receiver. LLO 7.2 Troubleshoot various faults of AM receiver such as low volume, hum sound.	7	Test the output of various stages/blocks of the AM receiver.	2	CO2
LLO 8.1 Calculate modulation index 'm' from the observed FM wave . LLO 8.2 Interpret the frequency deviation and modulation index of the FM signal.	8	* Build and test FM signal using voltage controlled oscillator / IC 566 to measure frequency deviation and modulation index.	2	CO3
LLO 9.1 Interpret the FM signal using simulation software. LLO 9.2 Calculate the modulation index and frequency deviation of FM signal.	9	Display FM signal using suitable simulation software such as MATLAB/SCILAB/ relevant software.	2	CO3
LLO 10.1 Build a FM detector circuit using IC 564/565. LLO 10.2 Observe the FM demodulated signal and draw the input and output waveforms.	10	* Demodulate the given FM signal using IC 564/565 and test the output from the given input waveforms.	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Observe the waveforms and measure the voltages at various test points of FM receiver. LLO 11.2 Troubleshoot various faults in AM receiver such as popping, hissing etc.	11	Test the output of various stages/blocks of the FM receiver.	2	CO3
LLO 12.1 Interpret the MUF for the given critical frequency.	12	Use simulation software to measure MUF for the given critical frequency and incident angle.	2	CO4
LLO 13.1 Use RF source and field meter to measure the field strength of given antenna. LLO 13.2 Plot the radiation pattern of given antenna .	13	*Test the performance of given dipole antenna ,measure the field strength and plot the radiation pattern for different length of antenna.	2	CO5
LLO 14.1 Use RF source and field meter to measure the field strength of given yagi-uda antenna. LLO 14.2 Plot the radiation pattern of Yagi- Uda antenna and interpret the beamwidth .	14	Test the performance of given Yagi-Uda antenna .	2	CO5
LLO 15.1 Interpret the directivity and beamwidth from the radiation pattern of the given antenna.	15	* Use suitable simulation software to plot the radiation pattern of given antenna.	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)

Visit

- BSNL/Radio station and prepare report on technique used for modulation demodulation.

Micro project

- 1.Develop a intercom circuit.

2.Build a Walkie Talkie Circuit.
3.Build a circuit of AM receiver.
4.Build a circuit of FM receiver.

Assignment

- 1.Prepare report on AM FM transmission of nearby your city.

2.Draw neat sketches of AM and FM receivers.
3.Draw neat sketches of different AM and FM generation circuits.
4.Prepare Internet based report on the role of electronic communication used for Defense/ISRO.

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.
- 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 multimeter : 3 1/2 digit display ,9999 counts digital multimeter measures :Vac,Vdc (1000 V max) ,Adc,Aac (10 A max) , Resistance (0 to 100 Mohm).	1,7,11
2	Antenna trainer kit : for dipole and Yagi- Uda antenna, mobile antenna, omnidirectional antenna, horn antenna, other common types of antenna.	13,14
3	Function generator : Frequency range 0.1 Hz to 30 Mhz.	2,3,4,5,8,10
4	AM Trainer kit for Modulation and Demodulation.	3,4,5,7
5	RF signal generator with wide frequency range 100 Khz to 150 Mhz fine frequency adjustment by calibrated dial built in audio frequency generator.	3,4,5,7,8,10,11
6	DSO with Bandwidth : 50-100 MHz TFT colour LCD Dual channel real time sampling 1GSa/s equivalent sampling 25 GSa/s Memory 1Mbpts 10 waveforms and 10 Set ups can be stored.	3,4,5,8,10
7	Simulation software suitable for communication experiments : MATLAB,SCILAB,TINA PRO or any other relevant open source software.	6,9,12,15
8	FM Trainer kit for Modulation (using voltage controlled Oscillator / IC 566) and Demodulation (using IC 564/565) .	8,10,11
9	Cathode ray oscilloscope Dual Trace 20/30/100 Mhz,1 Mega ohm input impedance .	All
10	Regulated power supply : DC supply voltages Dual DC 0-30V ; 0-2A Automatic overload(current protection) constant voltage and constant current operation.	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Electronic Communication	CO1	6	4	4	4	12
2	II	Amplitude Modulation (AM) Communication	CO2	13	4	6	8	18
3	III	Frequency Modulation (FM) Communication	CO3	10	2	6	6	14
4	IV	Wave Propagation	CO4	7	2	4	6	12
5	V	Antenna	CO5	9	4	4	6	14
Grand Total				**45**	**16**	**24**	**30**	**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.

For formative assessment of laboratory learning 25 marks.
Each practical will be assessed consider 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment 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	1	2	1	1			
CO2	2	3	3	2	2	1	2			
CO3	2	3	3	2	2	1	2			
CO4	2	-	1	2	2	-	1			
CO5	2	-	1	2	2	1	1			

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	Dennis Roddy John Coolen	Electronic Communication	Pearson Education India, New Delhi , ISBN: 978-817758-558-2
2	GEORGE KENNEDY BERNARD DEVIS	ELECTRONICS COMMUNICATION SYSTEM	TATA Mc- Graw Hill, New Delhi, ISBN: 9780071077828
3	Ravi Kumar Jatoth , T. Kishore Kumar , V .V. Mani	Electronics and Communications Engineering	Apple Academic Press ISBN: ISBN-13 978-1774633892
4	Tomasi W.	ELECTRONIC COMMUNICATION SYSTEM	Pearson Education India, New Delhi, ISBN: 9780130221254
5	Constantine A. Balanis	Antenna Theory: Analysis and Design	Wiley-Student edition India, New Delhi, ISBN: 9788126524228
6	Frenzel George:Dravid Bernard:Prasanna SRM	Electronic Communication Systems	Mc-Graw Hill , New Delhi ,ISBN: 9780071077828
7	R. L. Yadava	Antenna and Wave Propagation	EEE, PHI,ISBN : 9788120342910

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description

Sr.No	Link / Portal	Description
1	https://www.electronicsforu.com/electronics-projects/fm-radio-receiver-using-ic-ta-7640ap	FM radio receiver
2	https://www.etti.unibw.de/labalive/index/amplitude-modulation/	Amlitude Modulation
3	https://www.etti.unibw.de/labalive/experiment/amtransmitterrecordaudiodemo/	AM transmitter 1 - record audio transmit signal via file
4	https://www.etti.unibw.de/labalive/experiment/amtransmitrecordedsignal/	AM transmitter 2 - transmit recorded signal via USRP
5	https://www.etti.unibw.de/labalive/experiment/fmtransmitterrecordaudiodemo/	FM transmitter
6	https://www.etti.unibw.de/labalive/experiment/fmdemod/	FM receiver
7	https://www.tutorsglobe.com/homework-help/electrical-engineering/fault-in-fm-radio-receiver-71490.aspx	Fault finding in FM radio receiver.
8	https://www.radioandtvhelp.co.uk/help-guides/radio/troubleshooting-interference-to-am-radio#:~:text=Problems%20on%20AM%20radio%20can,and%20could%20indicate%20reception%20problems.	Fault finding in AM radio receiver.
9	https://ijarsct.co.in/Paper10949.pdf	Simulation software to measure MUF for the given critical frequency and incident angle.
10	https://www.ahsystems.com/articles/Understanding-antenna-gain-beamwidth-directivity.php	Antenna parameters .
11	https://kcgcollege.ac.in/Virtual-Lab/Electronics-and-Communication-Engineering/Exp-2/	Frequency Modulation and Demodulation
12	https://vlab.amrita.edu/?sub=3&brch=163&sim=260&cnt=2644	Amplitude Modulation (Simulation experiment)

Note :

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

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Hotel Management & Catering Technology/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SC/ TC/ TE/ TR/ TX**
Semester	**: Third**
Course Title	**: ESSENCE OF INDIAN CONSTITUTION**
Course Code	**: 313002**

I. RATIONALE

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry /employer expected outcome – Abide by the Constitution in their personal and professional life.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - List salient features and characteristics of the constitution of India.
- CO2 - Follow fundamental rights and duties as responsible citizen of the country.
- CO3 - Analyze major constitutional amendments in the constitution.
- CO4 - Follow procedure to cast vote using voter-id.

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	
313002	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50

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 Explain the meaning of preamble of the constitution. TLO 1.2 Explain the doctrine of basic structure of the constitution. TLO 1.3 List the salient features of constitution. TLO 1.4 List the characteristics of constitution.	**Unit - I Constitution and Preamble** 1.1 Meaning of the constitution of India. 1.2 Historical perspectives of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble of the Constitution of India.	Presentations Blogs Hand-outs Modules Flipped classrooms Case studies

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 Enlist the fundamental rights. TLO 2.2 . Identify fundamental duties in general and in particular with engineering field. TLO 2.3 Identify situations where directive principles prevail over fundamental rights.	**Unit - II Fundamental Rights and Directive Principles** 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance under part-IV-A. 2.3 Relevance of Directive Principles of State Policy under part-IV A.	Presentations Blogs Hand-outs Modules Case Study Flipped Classroom
3	TLO 3.1 Enlist the constitutional amendments. TLO 3.2 Elaborate the elements of Centre-State Relationship TLO 3.3 Analyze the purposes of various amendments.	**Unit - III Governance and Amendments** 3.1 3.1 Amendment procedure of the Constitution and their types - simple and special procedures. 3.2 The Principle of Federalism and its contemporary significance along with special committees that were setup. 3.3 Major Constitutional Amendment procedure - 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd	Cases of Federal disputes with relevant Supreme court powers and Judgements Presentations Blogs Hand-outs Problem based learning
4	TLO 4.1 Explain the importance of electoral rights. TLO 4.2 Write the step by step procedure for process of registration TLO 4.3 Explain the significance of Ethical electoral participation TLO 4.4 Explain the steps to motivation and facilitation for electoral participation TLO 4.5 Enlist the features of the voter's guide TLO 4.6 Explain the role of empowered voter TLO 4.7 Write the steps of voting procedure TLO 4.8 Write steps to create voter awareness TLO 4.9 Fill the online voter registration form TLO TLO 4.10 Follow procedure to cast vote using voter-id.	**Unit - IV Electoral Literacy and Voter's Education** 4.1 Electoral rights , Electoral process of registration 4.2 Ethical electoral participation 4.3 Motivation and facilitation for electoral participation 4.4 Voter's guide 4.5 Prospective empowered voter 4.6 Voting procedure 4.7 Voter awareness 4.8 Voter online registration https:/ /www.ceodelhi.gov.in/ELCdetails.aspx	Presentations Hand-outs Modules Blogs Problem based Learning

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

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

Assignment

- Outline the procedure to submit application for Voter-id
- Assignments are to be provided by the course teacher in line with the targeted COs.

A1. Prepare an essay on Constitution of India .
A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA

- Assignments are to be provided by the course teacher in line with the targeted COs. A1. Prepare an essay on Constitution of India . A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA A3. Self-learning topics: Parts of the constitution and a brief discussion of each part Right to education and girl enrollment in schools. GER of Girls and Boys. Right to equality. Social Democracy. Women Representation in Parliament and State Assemblies. LGBTQIA+

Micro project

- 1. Organize a workshop-cum discussions for spreading awareness regarding Fundamental Rights of the citizen of the country

2. Prepare elaborations where directive principle of State policy has prevailed over Fundamental rights with relevant Supreme Court Judgements.
3. Organize a debate on 42nd, 97th and 103rd Constitutional Amendment Acts of Constitution of India.

Seminar

- 1 Differences in the ideals of Social democracy and Political democracy.

2 Democracy and Women's Political Participation in India.
3 Khap Panchayat - an unconstitutional institution infringing upon Constitutional ethos.
4 Situations where directive principles prevail over fundamental rights.

Group discussions on current print articles.

-

- Art 356 and its working in Post-Independent India.
- Women's Resrvation in Panchayat leading to Pati Panchayats - Problems and Solutions.
- Adoption of Article 365 in India.
- Need of Amendments in the constitution.
- Is India moving towards a Unitary State Model ?

Activity

- Arrange Mock Parliament debates.

Prepare collage/posters on current constitutional issues.
i. National (Art 352) & State Emergencies (Art 356) declared in India.
ii. Seven fundamental rights.
iii. Land Reforms and its effectiveness - Case study of West-Bengal and Kerala.

Cases: Suggestive cases for usage in teaching:

- A.K. Gopalan Case (1950) :SC contented that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.

Shankari Prasad Case (1951) : This case dealt with the amendability of Fundamental Rights (the First Amendment's

validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.

Minerva Mills case (1980) :This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.

Maneka Gandhi case (1978) :A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable."

Other cases:

1. Kesavananda Bharati Case (1973) : In this case the Hon. SC laid down a new doctrine of the 'basic structure' (or 'basic features') of the Constitution. It ruled that the constituent power of Parliament under Article 368 does not enable it to alter the 'basic structure' of the Constitution. This means that the Parliament cannot abridge or take away a Fundamental Right that forms a part of the 'basic structure' of the Constitution.
2. Mathura Rape Case(1979) : A tribal woman Mathura (aged 14 to 16 years) was raped in Police Custody. The case raised the questions on the idea of 'Modesty of Woman' and here it was was a tribal woman who succumbs to multiple pattiarchies. Custodial rape was made an offence and was culpable with the detainment of 7 years or more under Section 376 of Indian Penal Code. The weight of proofing the allegations moved from the victim to the offender, once sexual intercourse is established. The publication of the victim's identity was banned and it was also held that rape trials should be conducted under the cameras.
3. Puttswamy vs Union of India (2017) : In this landmark case which was finally pronounced by a 9-judge bench of the Supreme Court on 24th August 2017, upholding the fundamental right to privacy emanating from Article 21. The court stated that Right to Privacy is an inherent and integral part of Part III of the Constitution that guarantees fundamental rights. The conflict in this area mainly arises between an individual's right to privacy and the legitimate aim of the government to implement its policies and a balance needs to be maintained while doing the same.
4. Navtej Singh Johar & Ors. v. Union of India (2018) : Hon. SC Decriminalised all consensual sex among adults, including homosexual sex by scrapping down section 377 of the Indian penal code (IPC). The court ruled that LGBTQ community are equal citizens and underlined that there cannot be discrimination in law based on sexual orientation and gender.
5. Anuradha Bhasin Judgement (2020) : The Supreme Court of India ruled that an indefinite suspension of internet services would be illegal under Indian law and that orders for internet shutdown must satisfy the tests of necessity and proportionality. The Court reiterated that freedom of expression online enjoyed Constitutional protection, but could be restricted in the name of national security. The Court held that though the Government was empowered to impose a complete internet shutdown, any order(s) imposing such restrictions had to be made public and was subject to judicial review.

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.
- 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 : NOT APPLICABLE

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

Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Constitution and Preamble	CO1	4	0	0	0	0
2	II	Fundamental Rights and Directive Principles	CO2	4	0	0	0	0
3	III	Governance and Amendments	CO3	4	0	0	0	0
4	IV	Electoral Literacy and Voter's Education	CO4	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Assignment, Self-learning and Terms work Seminar/Presentation

Summative Assessment (Assessment of 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	1	-	-	-	2	-	-			
CO2	1	-	-	-	2	-	-			
CO3	1	2	-	-	2	-	1			
CO4	-	-	-	1	-	-	-			

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	P.M.Bakshi	The Constitution of India	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105 (Check the new edition)
2	D.D.Basu	Introduction to Indian Constitution	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3	B. K. Sharma	Introduction to Constitution of India	PHI, New Delhi, 6thedition, 2011, ISBN:8120344197

Sr.No	Author	Title	Publisher with ISBN Number
4	MORE READS :	Oxford Short Introductions - The Indian Constitution by Madhav Khosla. The Indian Constitution: Cornerstone of a Nation by Granville Austin. Working a Democratic Constitution: A History by Garnville Austin Founding Mothers of the Indian Republic: Gender Politics of the Framing of the Constitution by Achyut Chetan. Our Parliament by Subhash C. Kashyap. Our Political System by Subhash C. Kashyap. Our Constitution by Subhash C. Kashyap. Indian Constitutional Law by Rumi Pal.	Extra Read
5	B.L. Fadia	The Constitution of India	Sahitya Bhawan,Agra, 2017, ISBN:8193413768

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.legislative.gov.in/constitution-of-india	Constitution overview
2	https://en.wikipedia.org/wiki/Constitution_of_India	Parts of constitution
3	https://www.india.gov.in/my-government/constitution-india	Constitution overview
4	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/	Fundamental rights and duties
5	https://main.sci.gov.in/constitution	Directive principles
6	https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf	Parts of constitution
7	https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm	Parts of constitution
8	https://constitutionnet.org/vl/item/basic-structure-indian-constitution	Parts of constitution

Note :

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

Programme Name/s	**: Automation and Robotics/ Digital Electronics/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Medical Laboratory Technology/ Medical Electronics/**
Programme Code	**: AO/ DE/ EE/ EJ/ EP/ ET/ EX/ IC/ IE/ IS/ ML/ MU**
Semester	**: Third**
Course Title	**: BASIC PYTHON PROGRAMMING**
Course Code	**: 313011**

I. RATIONALE

Electronics based industries needs to deal with creating circuits design, simulation, signal processing and control systems which can be developed using Python. This course deals with the basics of python to enhance the programming skills of diploma students. The course will enable students to write python programs as well as use different python libraries to solve given problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain the following industry/employer expected outcome through various teaching learning experiences:
Develop programs using python to solve wide-reaching electronics engineering related problems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Develop script to demonstrate use of basic building blocks of python.
- CO2 - Implement conditional and looping statements for given problem statement.
- CO3 - Perform operations on sequence structures in python.
- CO4 - Implement basics of object oriented programming concepts.
- CO5 - Create modules and packages for given purpose.

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	
313011	BASIC PYTHON PROGRAMMING	BPP	AEC	2	-	2	-	4	2	-	-	-	-	-	25	10	25@	10	-	-	50

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 Describe the given Keywords and Constants in Python. TLO 1.2 Use indentation, comments in the given program. TLO 1.3 Use different types of operators for writing expressions. TLO 1.4 Write python program using input output statements.	**Unit - I Basic Python's Constructs** 1.1 Introduction to Python- Python as scripting Language, Programming language Vs Scripting Language (C vs Python), Python's Technical Strength, Application in different domains 1.2 Python's building blocks- Identifiers, Keywords, Variables, Constants, Indentation, Comments in python 1.3 Python's Data Types – Numbers, Strings, List, Tuples, Dictionaries, Sets 1.4 Input and Output statements in python 1.5 Operators in Python- Operators as Arithmetic, Assignment, Unary Minus, Relational, Logical, Boolean, Bitwise, Membership, Identity, Operator precedence and Associativity	Presentations Lecture Using Chalk-Board Hands-on
2	TLO 2.1 Develop programs using Conditional Statements. TLO 2.2 Develop programs using Loop statements. TLO 2.3 Use statements to control the loops.	**Unit - II Control Statements in Python** 2.1 Types of Control Statements – Decision making statements, Looping statements 2.2 Decision Making Statements: - if, if….else, else-if ladder ,nested if and switch statement 2.3 Looping statement: - while loop, for loop, nested loop 2.4 Manipulating Loops- use of break, continue and pass statements	Lecture Using Chalk-Board Demonstration Hands-on Flipped Classroom

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.
3	TLO 3.1 Develop program to manipulate List for given purpose. TLO 3.2 Develop program to manipulate Tuples for given purpose. TLO 3.3 Develop program to manipulate Sets for given purpose. TLO 3.4 Develop program to manipulate Dictionaries for given purpose.	**Unit - III Data Structures in Python** 3.1 List- Defining List, Creating list, Accessing values from list, Updating the elements of a list, Concatenation of two lists, Repeating of Lists, Membership in list, Aliasing and cloning Lists, Methods to process Lists, Nested Lists 3.2 Tuples- Defining Tuple, Creating Tuples, Accessing the Tuple elements, Inserting elements in a Tuple, modifying elements of a Tuple, Deleting elements from a Tuple, Basic operations in Tuples, Functions to process Tuples, Nested Tuples 3.3 Sets- Defining Set, Creating a Set, Accessing elements from set, Add and update Set, Remove an elements from a Set, Built in functions with Set, Set methods to perform mathematical operations, other relevant set methods 3.4 Dictionaries- Defining Dictionary, Creating Dictionary, Accessing elements from Dictionary, Add and update Dictionary, Delete an element from a Dictionary, Built in functions of Dictionary, Methods to perform Dictionary	Demonstration Lecture Using Chalk-Board Hands-on
4	TLO 4.1 Use python built-in functions to perform tasks. TLO 4.2 Develop relevant user defined function for the given purpose. TLO 4.3 Define classes to create and access objects with its methods and attributes.	**Unit - IV Functions with Basic OOP concepts** 4.1 Python Functions- Use of python built in functions (e.g. type/data conversion functions, math and string functions), User defined function- Function definition, function calling, function arguments and parameter passing, Return statement, scope of variables (Global and Local Variables) 4.2 Basic OOP concepts- Introduction to object-oriented programming, Creating classes and objects, Constructors and Destructors in python, Data abstraction and Encapsulation	Demonstration Lecture Using Chalk-Board Hands-on
5	TLO 5.1 Develop a python module in python for given purpose. TLO 5.2 Develop a python package for given purpose. TLO 5.3 Use NumPy for performing mathematical operations on arrays. TLO 5.4 Use matplotlib to create data visualization in python.	**Unit - V Modules and Packages in Python** 5.1 Modules- Writing modules, importing module, python built in modules (Numeric and mathematical module, Functional Programming Module) 5.2 Python packages- Introduction, Writing python packages, using standard packages (NumPy, matplotlib) and user defined package statements	Demonstration Lecture Using Chalk-Board Hands-on

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 Install Python Integrated Development Environment.	1	a) Install and configure Python IDE. b) Write Python program to display message on screen.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Use operators in Python.	2	*a) Write simple Python program to calculate equivalent registers connected in series and parallel. Accept values of R1, R2 and R3 from the user. *b) Write simple Python program to calculate value of voltage by applying Ohm's law. Accept value of Current(I) and Resistance(R) from the user.	2	CO1
LLO 3.1 Implement two-way branching statement.	3	Write program to check whether entered frequency is radio frequency or audio frequency.	2	CO2
LLO 4.1 Implement multi-way branching statement.	4	*a)Write program to display various radio frequency bands using if..elseif ladder. *b)Write program to display resistor color code using switch statement.	2	CO2
LLO 5.1 Implement control loops for solving iterative problems.	5	*a. Write a simple Python program to demonstrate use of control loops: i) while ii) do while *b. Create a simple program, to demonstrate use of: for loop in Python (e.g.: various pattern building, printing multiplication table, checking palindrome number etc.)	2	CO2
LLO 6.1 Perform basic operations on the Lists.	6	*Write Python program to perform following operations on List: a) Create b) Access c) Update d) Delete elements from list.	2	CO3
LLO 7.1 Execute various tuple operations.	7	Develop Python program to perform following operations on Tuples: a) Create b) Access c) Update d) Delete Tuple elements	2	CO3
LLO 8.1 Implement various set operations.	8	Write Python program to perform following operations on Set: a) Create b) Access c) Update d) Delete Access Set elements	2	CO3
LLO 9.1 Execute various operations on Dictionaries.	9	*Create a program to perform following operations on Dictionaries in Python: a) Create b) Access c) Update d) Delete e) Looping through Dictionary	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Use built-in mathematical functions and string functions in python.	10	a) *Create python program to demonstrate use of math built-in function. b) *Create python program to demonstrate use of string built-in function.	2	CO4
LLO 11.1 Create user defined functions in Python.	11	Write python programs to define function with arguments. a) Calculate factorial of a number b) Swapping of two variables	2	CO4
LLO 12.1 Implement function with default arguments.	12	Write programs to define function with default arguments.	2	CO4
LLO 13.1 Use built-in python mathematical modules.	13	*Create a program to demonstrate use of: Built-in module (e.g. numeric, mathematical functional and programming module) in Python.	2	CO5
LLO 14.1 Write user-defined module in python.	14	Write program to create a user-defined module (e.g.: building calculator) in python.	2	CO5
LLO 15.1 Use python built-in packages.	15	*Develop Python program to demonstrate use of NumPy package for creating, accessing and performing different array operations.	2	CO5
LLO 16.1 Implement user-defined packages in python.	16	Write program to demonstrate the use of user defined packages in Python.	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

- Not Applicable

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.
- 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

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	a) Computer System with all necessary peripherals and internet connectivity. b)Any relevant python IDE like IDLE/PyCharm/VSCode/Jupiter Notebook/Online Python Compiler.	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basic Python's Constructs	CO1	4	0	0	0	0
2	II	Control Statements in Python	CO2	4	0	0	0	0
3	III	Data Structures in Python	CO3	10	0	0	0	0
4	IV	Functions with Basic OOP concepts	CO4	6	0	0	0	0
5	V	Modules and Packages in Python	CO5	6	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each practical will be assessed considering – 60% weightage to process and – 40% weightage to product.

Summative Assessment (Assessment of Learning)

- 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			
CO2	2			1			2			
CO3	1	1	1	2			2			
CO4	1	2	2	2			2			
CO5	1	1	1	2			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	Giancarlo Zaccone	Natural Computing with Python	BPB, ISBN:9789388511612
2	Martin C. Brown	Python: The Complete Reference	Tata McGraw Hill ISBN: 9789387572942
3	Yashwant Kanetkar	Let Us Python	BPB, ISBN: 978-9391392253
4	Kumar Naveen, Taneja Sheetal.	Python Programming: A modular approach	Pearson, ISBN: 978-9352861293
5	Mark Lutz and David Ascher	Learning Python	O'Reilly, ISBN: 978-1449355739
6	Paul Barry	Head First Python	O'Reilly, ISBN: 978-1449382674
7	John Guttag	Introduction to Computation and Programming Using Python	MIT Press, ISBN: 978-0262529624
8	David Beazley	Python Essential Reference	Addison-Wesley Professional, ISBN: 978-0672329784
9	Dr. R. Nageswara Rao	Core Python Programming	DREAMTECH PRESS, ISBN: 978-9386052308

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.programiz.com/python-programming	Python Programming
2	https://python-iitk.vlabs.ac.in/Introduction.html	Virtual Lab for Python Programming-Basic Constructs in Python
3	https://www.geeksforgeeks.org/python-programming-language/	Python Programming
4	https://intellipaat.com/academy/course/introduction-to-python-programming-free-course/	Online Course-Python Programming
5	https://www.w3schools.com/python/	Python Programming
6	https://www.tutorialspoint.com/python/index.htm	Python Programming
7	https://www.python.org/	Python Programming
8	https://spoken-tutorial.org/tutorial-search/?search_foss=Python+3.4.3&search_language=English	Spoken Tutorial on Python Programming

Note :

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

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Medical Electronics**
Programme Code	**: DE/ EJ/ ET/ EX/ IE/ MU**
Semester	**: Third**
Course Title	**: ELECTRONIC MEASUREMENTS & INSTRUMENTATION**
Course Code	**: 313012**

I. RATIONALE

This course is designed to enable the students to handle different test and measuring instrument for testing various electronics and automation systems. Handling test and measuring instrument is the essential activity in any electronic industry. This course will develop skills to select various types of sensors and transducers and to maintain automation system.

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:
Maintain automation systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Interpret the characteristics of measuring instrument.
- CO2 - Use various test and measuring instrument.
- CO3 - Interpret working of various types of sensors and transducers.
- CO4 - Measure physical quantities using various types of transducers and sensors.
- CO5 - Maintain signal conditioning and data acquisition 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	
313012	ELECTRONIC MEASUREMENTS & INSTRUMENTATION	EMI	AEC	2	-	2	2	6	3	-	-	-	-	-	50	20	25@	10	25	10	100

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 Select instrument on basis of nature of operation. TLO 1.2 List static and dynamic characteristics of the given measuring instrument. TLO 1.3 Identify standard used of given instrument.	**Unit - I Fundamentals of electronic measurements** 1.1 Fundamentals of measuring instruments 1.2 Static and dynamic characteristics of instrument 1.3 Calibration and standards of Instrument: International, primary, secondary, working	Teacher input Demonstration Hands on practice
2	TLO 2.1 Measure output voltage at each test point of CRO. TLO 2.2 Calculate unknown frequency and phase of given input signal by observing Lissajous pattern. TLO 2.3 Describe the procedure to measure frequency, time period, voltage using DSO. TLO 2.4 Measure output of Function generator for sine, square, triangular waveform. TLO 2.5 List front panel controls of Spectrum Analyzer. Measure fundamental and side band frequency, power of given signal.	**Unit - II Testing and measuring Instrument** 2.1 Cathode Ray Oscilloscope (CRO): Introduction, CRO block diagram, function of each block, uses of CRO:Time and frequency measurement, Voltage measurement, Lissagous patterns for phase and unknown frequency measurement 2.2 Digital Storage Oscilloscope (DSO): Introduction, block diagram, operation and uses of digital storage oscilloscope(DSO):Time and frequency measurement, voltage measurement, store and recall mode 2.3 Function generator: Introduction, block diagram, operation and uses of function generator: Sine, square, Triangular waveforms 2.4 Spectrum Analyzer: Introduction, block diagram, operation and uses of spectrum Analyzer: Power performance of signals	Teacher input Hands-on

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.
3	TLO 3.1 Observe output at each block of Instrumentation system. TLO 3.2 Differentiate sensors and transducers. TLO 3.3 Suggest transducer for particular application. TLO 3.4 Describe working of thermal, optical, magnetic and electric sensors. TLO 3.5 Select thermal, optical, magnetic and electric sensors for given application.	**Unit - III Sensors and Transducers** 3.1 Instrumentation System: Block diagram of Instrumentation system, function of each block 3.2 Sensors and Transducer: definition, difference between sensors and transducers ,classification of sensors 3.3 Thermal, optical, magnetic and electric sensors: working principle and applications 3.4 Transducer: Need for Transducer, selection criteria of transducer, types: primary and secondary, active and passive, analog and digital, resistive, capacitive, inductive (Linear variable differential transformer (LVDT), Rotary variable differential transformer (RVDT), Piezo electric transducer	Demonstration Presentations Flipped Classroom
4	TLO 4.1 Measure temperature by selecting transducer. TLO 4.2 Describe procedure to measure pressure using Bourdon Tube, Bellows, Diaphragm. TLO 4.3 Suggest the flow meter to measure flow of the fluid. TLO 4.4 Measure humidity using hygrometer and pH value by pH meter.	**Unit - IV Application of Sensors and Tranducers** 4.1 Temperature measurement types: Resistance Temperature Detector (RTD)– (PT-100) , Thermistors, Thermocouple – Seeback & Peltier effect , Type J, K, R, S, T etc. (Based on material, temperature ranges) , Pyrometer – Optical type 4.2 Pressure measurement types: Bourdon Tube, Bellows, Diaphragm 4.3 Flow measurement types: variable head flow meter, venturimeter, orifice plate. Variable area flow meter: Rotameter, electromagnetic flow meter 4.4 Special transducers and measurement: Humidity measurement using hygrometer, pH measurement	Flipped Classroom Demonstration Hands on practice
5	TLO 5.1 Identify signal conditioning block in any instrumentation system. TLO 5.2 Describe the Data acquisition system.	**Unit - V Data Acquisition System** 5.1 Signal conditioning: Introduction, types, block diagram and working of AC and DC signal conditioning circuits 5.2 Data Acquisition Systems (DAS): Introduction, block diagram, working and applications of DAS	Teacher input Demonstration Site/Industry Visit

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 Determine accuracy, resolution, hysteresis of analog multimeter.	1	* Test performance of analog multimeter.	2	CO1
LLO 2.1 Use CRO to measure amplitude and frequency of the given input signal.	2	Measurement of amplitute and frequency of given signal using CRO.	2	CO2
LLO 3.1 Display Lissajous pattern on CRO and interpret it to measure frequency of the given input signal.	3	* Lissajous pattern to measure unknown frequency.	2	CO2
LLO 4.1 Display Lissajous pattern on CRO and interpret it to measure phase of the given input signal.	4	Lissajous pattern for phase measurement.	2	CO2
LLO 5.1 Measure amplitude and frequency of the given input signal using DSO.	5	* Measurement of amplitude and frequency using DSO.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Use spectrum analyzer to measure frequency band of the given input signal.	6	* Frequency band measurement using Spectrum analyzer.	2	CO2
LLO 7.1 Test the performance of the given potentiometer.	7	Test potentiometer characteristics.	2	CO3
LLO 8.1 Measure Linear displacement using LVDT.	8	* Linear displacement measurement using LVDT.	2	CO3
LLO 9.1 Measure pressure using strain gauge.	9	Pressure measurement using strain gauge.	2	CO4
LLO 10.1 Measure temperature of the given liquid using RTD (PT-100) .	10	Temperature measurement of of the given liquid using RTD.	2	CO4
LLO 11.1 Measure temperature using thermocouple (J or K type).	11	* Temperature measurement using thermocouple.	2	CO4
LLO 12.1 Measure flow of fluid using venturi meter .	12	* Flow measurement using venturi tube.	2	CO4
LLO 13.1 Measurement of flow using orifice plate .	13	Flow measurement using orifice plate.	2	CO4
LLO 14.1 Use rotameter to measure flow of liquid.	14	Flow measurement using Rotameter.	2	CO4
LLO 15.1 Use pH meter to measure pH value of given solution.	15	* pH measurement using pH meter.	2	CO4
LLO 16.1 Interpret the performance of Portable Data Acquisition System.	16	Test the performance of each block of Data Acquisition System.	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

- Measure temperature of hot plate using semiconductor temperature sensor (LM35).
- Use a fire sensor to make a small electronic alarm circuit.
- Make temperature control circuit using thermistor.
- Make a small circuit using LDR as a sensing device.
- Design D.C. signal conditioning circuit using Wheatstone bridge circuit and implement on PCB.

Assignment

- Prepare a power point presentation on Spectrum analyzer.
- Prepare a chart for use of DSO in various industries.
- Prepare a chart to show the uses of DSO.
- Make a report on use of Spectrum analyzer in Telecommunication field.

Field visit

- Visit to nearby Industry to observe working of various instruments and prepare a detail report.

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.
- 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	Analog multi-meter: 0-10A, 0-600V, 0-10 Mohms	1
2	RTD: Pt 100	10
3	Thermocouple:Type: J or K type	11
4	Venturi tube: 12" X 4.35" or equivalent, wide range of diameter ratios, tube operates with minimum head loss,accuracy:0.25%	12
5	Orifice Plate: 30mm diameter	13
6	Rotameter: Accuracy +/-2% of Full scale	14
7	pH meter: Portable pH meter range om 0 to as solution 0.1/0.01 pH	15
8	Data Acquisition System for any physical parameter monitoring and PC standard interface or any equivalent	16
9	Dual trace CRO with probe: Bandwidth AC 10Hz~20MHz (-3dB). DC 20MHz (-3dB), X10 Probe	2,3,4
10	Function generator: Frequency Ranges: 0.1 Hz to 1 MHz, output waveforms: sine, triangle, square, ramp, pulse	2,3,4,5,6
11	Digital storage oscilloscope: Bandwidth 60MHz,dual channel, sampling rate 1 GS/sec	5
12	Spectrum analyzer: 9 kHz - 6.2 GHz, Max acquisition BW:40MHz	6
13	Digital multi-meter: 0-10A, 0-600V, 0-10 Mohms with 3 -1/2 digital LCD display	7
14	DC power supply (0-30V), 1Amp.	7
15	LVDT: Stroke range ±0.1 plus/minus 2.54 or available range	8
16	Strain gauge: Universal general - purpose strain gauge	9

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of electronic measurements	CO1	4	0	0	0	0
2	II	Testing and measuring Instrument	CO2	8	0	0	0	0
3	III	Sensors and Transducers	CO3	6	0	0	0	0
4	IV	Application of Sensors and Tranducers	CO4	8	0	0	0	0
5	V	Data Acquisition System	CO5	4	0	0	0	0

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
Grand Total				30	0	0	0	0

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Formative assessment of laboratory learning 50 marks.
- Each practical will be assessed considering 60% weigtage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester summative Assessment each 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	_	_	2	1	1	1			
CO2	2	_	1	2	1	2	2			
CO3	2	_	1	2	1	1	1			
CO4	2	_	1	2	2	2	2			
CO5	2	2	2	2	2	2	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	Sawhney, A.K.	Electrical & Electronic Measurements & Instrumentations	Dhanpat Rai & sons, New Delhi, 2017 or latest edition 2021.
2	Kalsi,H.S.	Electronic Instrumentation	McGraw Hill, New Delhi,2010 ISBN:13-9780070702066 or latest edition
3	David,A.Bell	Electronic Instrumentation and Measuremens	Oxford University Press, New Delhi edition- 2013 ISBN : 10:0-19-569614-X or latest edition
4	Helfrick, A.D. Cooper, W.D.	Modern Electronic Instrumentation and measurement Techniques	Pearson Education India,1st Edition, New Delhi,2015,ISBN-13:978 or latest edition
5	Ghosh, A.K	Introduction to Measurement & Instrumentation	Prentice Hall India Learning Private Limited 2013, 4th or latest Edition, ISBN-13-978-8120346253.
6	Murty, D.V.S.	Transducers and Instrumentaion	Prentice Hall India Learning Private Limited, 2nd Edition, ISBN-13-978-8120335691

Sr.No	Author	Title	Publisher with ISBN Number
7	Patranabis D.	Sensors and Transducers	PHI Learning Private Limited, 2nd Edition, ISBN-978-81-203-2198-4

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://en.wikipedia.org/wiki/Electronic_test_equipment	Testing using CRO, multimeter, function generator and spectrum analyser.
2	https://en.wikipedia.org/wiki/List_of_electrical_and_electronic_measuring_equipment	Measuring instruments used in electrical and electronic work.
3	https://en.wikipedia.org/wiki/Instrumentation	Sensors to measure physical and electrical quantities
4	https://en.wikipedia.org/wiki/Flow_measurement	Flowmeters
5	https://en.wikipedia.org/wiki/Data_acquisition	Data acquisition system

Note :

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