

GOVERNMENT POLYTECHNIC, PUNE
'120- NEP'SCHEME

PROGRAMME	DIPLOMA IN ET
PROGRAMME CODE	03
COURSE TITLE	BASIC POWER ELECTRONICS
COURSE CODE	ET31205
PREREQUISITECOURSECODE&TITLE	NA
CLASS DECLARATION COURSE	NO

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme						Credits	Assessment Scheme										Total Marks				
			Actual Contact Hrs./Week			SLH	NLH	Paper Duration		Theory				Based on LL & TSL				Based on SL						
			CL	TL	LL					Total	Practical													
											FA-TH	SA-TH	Max	Min	FA-PR	SA-PR	SLA							
																		Max	Min		Max	Min	Max	Min
ET31205	BASIC POWER ELECTRONICS	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175				

Total IKS Hrs for Term: 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, *#-Online Examination, @\$-Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

- If the candidate does not secure minimum passing marks in **FA-PR** (Formative Assessment -Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
- If the candidate does not a secure minimum passing of marks in the **SLA** (Self Learning Assessment) of any course, then the candidate shall be declared as a '**fail**' and will have to repeat and resubmit SLA work.
- Notional learning hours** for the semester are **(CL+LL+TL+SL) hrs.*15 Weeks**
- 1 credit** is equivalent to **30 Notional hours**.
- *Self-learning hours shall not be reflected in the Timetable.
- *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Electronic control circuits are pivotal in modern industries. In today's era of automation and advanced manufacturing, mechanical control systems are increasingly being replaced by power electronics devices. This course is designed to familiarize participants with the fundamental principles and applications of basic power electronics devices, enabling them to effectively maintain control circuits used in various industrial settings. The course has been structured to achieve this objective.

III. COURSE-LEVEL LEARNING OUTCOMES(CO'S)

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

CO1: Analyse the basic operation of various power semiconductor devices.

CO2: Maintain triggering and commutation circuits.

CO3: Use phase-controlled rectifiers in different applications.

CO4: Use choppers and inverters in different applications.

CO5:Maintain controlled circuits consisting of power electronic devices.

CO6:Use BJT as a waveform generator.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I POWER ELECTRONICS.(CLHrs-04,Marks-08)				
1.	TLO1.1: Define power electronics TLO1.2: Able to draw V-I characteristics of Power MOSFET. TLO1.3: Describe the working principle of IGBT & MOSFET.	1.1 Introduction to Power Electronics 1.2 Power MOSFET-Construction, Operating Principle, V-I characteristics and Uses of Depletion and Enhancement type Power MOSFET. 1.3 IGBT- Construction, Operating Principle, V-I Characteristics and Uses of IGBT.	Classroom Learning, Reference books, NPTEL	CO1
UNIT-II THYRISTOR FAMILY DEVICES.(CLHrs-08,Marks-18)				
2	TLO 2.1: Describe the operating principle of SCR. TLO 2.2: Define different currents related to SCR. TLO 2.3: Able to classify thyristor family. TLO 2.4: Able to differentiate between devices.	2.1 Introduction, Classification of amplifiers, BJT as an amplifier. Single-stage CE amplifier, frequency response, voltage gain, and bandwidth. 2.2 Thyristor family devices SCR, LASCR, SCS, GTO, and TRIAC: Construction, Operating Principle, V-I characteristics and Applications. 2.3 FET amplifier: Common Source amplifier, the working principle and applications.	Classroom Learning, Reference books, NPTEL	CO2
UNIT-III TURN ON AND TURN OFF METHODS OF SCR.(CLHrs-09,Marks-10)				
	TLO 3.1: Describe Turn ON & turn OFF methods. TLO 3.2: Classify turn OFF methods. TLO 3.3: Explain with sketches the methods of triggering for the given SCR. TLO 3.4: Explain with sketches the effect of the given firing angle on load voltage. TLO 3.5: Explain with sketches the turn-OFF methods of the given SCR. TLO 3.5: Explain the Pulse transformer used in the triggering circuit.	3.1 Concept of Turn-On mechanism of SCR: High Voltage triggering, thermal triggering, Illumination triggering, dv/dt triggering Gate triggering of SCR. 3.2 Gate trigger circuits - Resistance triggering circuit, Resistance Capacitance triggering circuit (Operation, applications, and limitations) 3.3 SCR triggering using UJT, PUT-Relaxation Oscillator circuit and Synchronized UJT triggering circuit: (Operation and applications). 3.4 Pulse transformer used in triggering circuit (Operation and Applications).	Classroom Learning, Reference books, NPTEL	CO3

		3.5 Concept of Turn-Off mechanism and methods of Commutation - Class A Series resonant commutation circuit, Class B-Shunt resonant commutation circuit, Class C-Complimentary symmetry commutation circuit.		
UNIT-IV PHASE CONTROLLED RECTIFIERS.(CLHrs-08,Marks-16)				
4	TLO4.1: Define firing angle. TLO4.2: Write equations for controlled rectifiers. TLO4.3: Compare controlled rectifiers. TLO4.4: Describe the effect of freewheeling diode with waveform. TLO4.5: State needs for poly-phase rectifier	4.1 Concept of phase control. (Firing Angle α and conduction angle ϕ) 4.2 Circuit diagram, working, equations for and Waveforms of VDC of following rectifiers. 4.3 Single phase half wave controlled rectifier with R, RL load. Effect of freewheeling diode. 4.4 Single phase centre tapped full wave controlled rectifier with R, RL load. Effect of freewheeling diode. 4.5 Single phase Bridge type full wave controlled rectifier with R, RL load. Effect of freewheeling diode. 4.6 Basic three-phase half-wave uncontrolled and controlled Rectifier. 4.7 Need and Uses of Poly-phase Rectifier	Classroom Learning, Reference books, NPTEL	CO4
UNIT-V CONVERTERS.(CLHrs-10,Marks-12)				
5	TLO5.1: Define Choppers & inverters. TLO5.2: Classify Choppers & inverters. TLO5.3: State need for inverters. TLO5.4: Define performance parameters of Inverters. TLO5.5: Describe the working principle of Choppers & inverters.	5.1 Concept of Choppers 5.2 Chopper: basic circuit and its operation. 5.3 Step Up and Step down Chopper, Jones chopper. 5.4 Inverters- Need of an inverter, Classification of inverters, Basic series & parallel inverter, Important applications of inverter. 5.5 Working principle of single phase half bridge inverter 5.6 Definitions of performance parameters of inverter.	Classroom Learning, Reference books, NPTEL	CO5

UNIT-VI INDUSTRIAL CONTROL CIRCUITS. (CLHrs-06,Marks-12)

6	TLO 6.1: Describe the working principle of solid-state batteries. TLO6.2: Describe the application of SCR as a battery charger. TLO6.3: Describe the application of DIAC-TRIAC as a Light dimmer circuit. TLO6.4: State applications of SMPS & UPS	6.1 Solid state batteries: Principle of working, application advantages and disadvantages 6.2 Battery charger using SCR. 6.3 Light dimmer circuit using DIAC-TRIAC 6.4 Block diagram and Concept of UPS and application 6.5. Block diagram and Concept of SMPS and application	Classroom Learning, Reference books, NPTEL	CO6
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V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1*	Plot transfer and output characteristics of Insulated - Gate Bipolar Transistor (IGBT). test the performance of IGBT	Plot transfer and output characteristics of Insulated - Gate Bipolar Transistor (IGBT).	02	CO1
2	Measure the holding current and latching current of the given SCR from its VI characteristics curve	Plot the VI characteristics curve of the given SCR, & find its holding current and latching current	02	CO2
3*	Determine break over voltage of given DIAC from its curve	Plot the VI characteristics curve of the given DIAC & find its break-over voltage	02	CO2
4*	Determine the breakover voltage of the given TRIAC in the first and third quadrants.	Plot the VI characteristics curve of the given TRIAC & find its breakover voltage.	02	CO2
5	Observe the effects of variation of R, in R triggering circuit & R, C in RC triggering circuits on the firing angle of SCR.	Observe the effects of variation of R, in R triggering circuit & R, C in RC triggering circuits on the firing angle of SCR.	02	CO3
6*	Observe the effect of variation of R on firing angle in synchronized UJT triggering circuit.	Observe the effect of variation of R on firing angle in synchronized UJT triggering circuit.	02	CO3
7*	Test the performance of half wave controlled rectifier with R, RL load and measure load voltage	Test the performance of half wave controlled rectifier with R, RL load and measure load voltage	02	CO4
8	Test the performance of a full wave-controlled rectifier with R, RL load, and measure load voltage.	Test the performance of a full wave-controlled rectifier with R, RL load, and measure load voltage.	02	CO4
9*	Measure output voltages of Step up chopper for different values of duty cycles	Measure output voltages of the Step-up chopper for different values of duty cycles.	02	CO5
10*	Measure output voltages of Step down chopper for different values of duty cycles	Measure output voltages of the Step-down chopper for different values of duty cycles.	02	CO5
11*	Test parallel inverter to measure frequency and output voltages.	Test parallel inverter to measure frequency and output voltages.	02	CO5

12*	Build a Light Dimmer circuit for a 60 or 100-watt lamp.	Build a Light Dimmer circuit for a 60 or 100-watt lamp.	02	CO6
13	Complete a micro-project based on guidelines provided in sr.no. 11.	Complete a micro-project based on guidelines provided in sr.no. 11.	02	----

Note: A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of a minimum of 12 or more practicals needs to be performed. Out of which, the Practicals marked * as compulsory.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Microproject

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs, and ADOs (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions to the project work and give a seminar presentation of it before submission. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- Controlled Rectifier: Build a circuit of the Battery charger for charging a battery of 6V, 4AH.
- Controlled Rectifier: Build fan speed regulator circuit using DIAC, and TRIAC on zero PCB.
- Phase-controlled Rectifiers: Build the circuit for Speed control of the 12V DC shunt motor using IGBT on zero PCB.
- Phase-controlled Rectifiers: Build AC power flasher using two SCRs on zero PCB.
- Industrial Applications of Power Devices: Build DC time delay relay using PUT on zero PCB.
- Turn ON and Turn OFF methods of SCR: Build Ramp and pedestal synchronized triggering circuit using
- UJT and pulse transformer on zero PCB.
- Industrial Applications of power devices: Build Emergency light system. For 6V battery on zero PCB.
- Choppers and Inverters: Build a step-down chopper using MOSFET/IGBT on zero PCB.
- Industrial Applications of power devices: Simulate control of intensity of light using phase control

Assignments

- Prepare journals based on practicals performed in the laboratory.
- Library survey of different data sheets and manuals.
- Prepare charts of symbols of power electronic devices.
- To collect the literature related to the specification of available power devices used in the market.
- Refer to technical magazines to collect information on the current devices used in the power electronic industry
- Prepare a PowerPoint presentation for controlled rectifiers.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	EquipmentNamewithBroadSpecifications	RelevantLLO Number
1	VariableDCpowersupply0-100 V,5Amp, SCprotection, display for voltage and current	1,2,4,5,6,7,8,9,10,11,12,13
2	CathodeRayOscilloscopeDualtrace20MHz,1M Ω ,Input Impedance	5,6,7,8,9,10,11,12,13
3	FunctionGenerator0-2MHzwithSine, square, and triangular output	1,2,3,4,5,6,7,8,9,10,11
4	DigitalMultimeter:3/1/2-digitdisplay,9999countsdigital	9,15
	LRC Q Meter	5,6,7,8,12,13

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

Sr.No	Unit	UnitTitle	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	TotalMarks
1	I	POWER ELECTRONICS	CO1	4	2	4	2	8
2	II	THYRISTORS FAMILY DEVICES	CO1	8	2	6	4	12
3	III	TURN ON AND TURN OFF METHODS OF SCR	CO2	9	6	6	4	16
4	IV	PHASE CONTROLLED RECTIFIER	CO3	8	2	10	2	14
5	V	CONVERTERS	CO5	10	2	6	2	10
6	VI	INDUSTRIAL CONTROL CIRCUITS	CO6	6	2	6	2	10
GrandTotal				45	16	38	16	70

IX. ASSESSMENT METHODOLOGIES /TOOLS

Formative assessment (Assessment for learning)		Summative Assessment (Assessment of Learning)
1. Tests	4. Self-Learning	1. EndTermExam
2. Assignment	5. Term Work	2. Micro-project
3. MidtermExam	6. Seminar/Presentation	

X. 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	2	3	3	--	2	2	2	2	3
CO2	3	3	3	3	--	2	2	3	2	3
CO3	3	2	2	3	--	2	2	3	2	3
CO4	3	2	3	3	--	2	2	3	2	3
CO5	3	3	3	3	--	2	2	3	2	3
CO6	3	2	3	3	--	2	2	3	2	3

Legends:-High:03,Medium:02,Low:01,NoMapping:-

*PSOs are to be formulated at the institute level



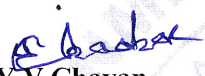

XI. SUGGESTED LEARNING MATERIALS/BOOKS

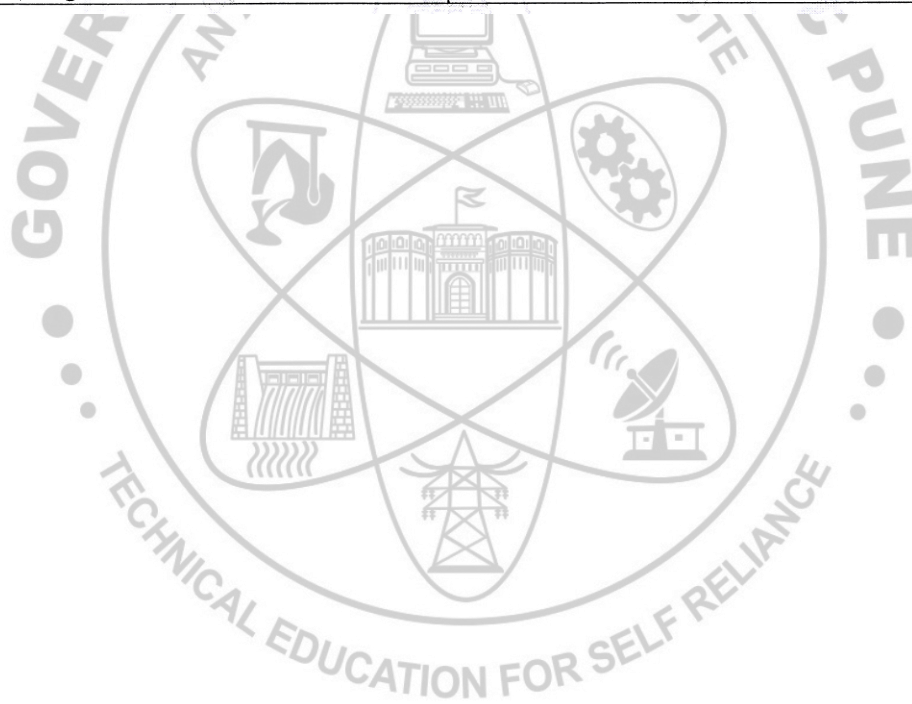
Sr.No	Author	Title	Publisher
1	Moorthi, V.R.	Power Electronics	Oxford University Press, New Delhi 110001, 2013 ISBN 0-19-567092-2
2	Bhattacharya	Fundamentals of Power Electronics	S.K., ISTE Learning Materials Centre, 2006, ISBN 9788125918530
3	Umanand, L,	Power Electronics Essentials and Applications	Wiley India Pvt.Ltd, New Delhi, 2011 ISBN:9788126519453
4	Singh, Khanchandani	Power Electronics	ISBN:9781259082429
5	Rashid, Muhammad H	Power Electronics Circuit Devices And Application	Pearson Education India, New Delhi, 2012 ISBN:9780137967636

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://www.electronicshub.org	SCR, controlled rectifiers, SMPS, UPS
2.	https://www.electrical4u.com/electrical-engineering-articles/power-electronics/	thyristor family characteristics & application. IGBT, Converters, chopper
3.	https://en.wikipedia.org/wiki/Power_MOSFET	Power MOSFET
4.	https://instrumentationtools.com	Thyristor Commutation Techniques - Types, Working Principles
5.	https://electricalbaba.com/scr-turn-on-methods-explained-in-detail/	Turn on and turn off the Mechanism of SCR

Sr.No	Link/Portal	Description
6.	https://www.electronicsmind.com/what-is-series-inverter-circuit-working/	Series and Parallel inverter
7.	https://www.circuitstoday.com	Battery charger circuit using SCR

Name&Signature:  Smt. C. D. Pophale Lecturer in E&TC (Course Experts)		 Smt. B. J. Nimbalkar Lecturer in E&TC (Course Experts)	
Name& Signature:  Dr. Y. V. Chavan (Programme Head)		Name & Signature:  Shri. S. B. Kulkarni (CDCIn-charge)	



GOVERNMENT POLYTECHNIC, PUNE

‘120 – NEP’ SCHEME

PROGRAMME	DIPLOMA IN E&TC
PROGRAMME CODE	03
COURSE TITLE	DIGITAL COMMUNICATION
COURSE CODE	ET41202
PREREQUISITE COURSE CODE & TITLE	PRINCIPLE OF ELECTRONIC COMMUNICATION
CLASS DECLARATION COURSE	YES

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme						Credits	Assessment Scheme										Total Marks
			Actual Contact Hrs./Week			SLH	NLH	Paper Duration		Theory				Based on LL & TSL				Based on SL		
			CL	TL	LL					Practical										
										FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
												Max	Max	Max	Min	Max	Min	Max	Min	
ET41202	DIGITAL COMMUNICATION	DSC	3	1	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Term: 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, *# - Online Examination, @\$ - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

- If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
- If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
- Notional learning hours** for the semester are (CL + LL + TL + SL) hrs. * 15 Weeks
- 1 credit** is equivalent to **30 Notional hours**.
- * Self-learning hours shall not be reflected in the Timetable.
- * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Electronic digital communication serves as the cornerstone of modern communication systems, influencing how individuals, organizations, and societies exchange information, collaborate, and interact. This course is designed to provide learners with a comprehensive understanding of the principles, theories, and technologies that underpin electronic digital communication, empowering them to navigate and harness the capabilities of digital technologies effectively.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following COs on completion of course-based learning
CO1: Interpret the fundamental principles and technologies underlying electronic digital communication systems.

CO2: Use pulse code modulation system for various applications.

CO3: Analyze the performance of different digital modulation techniques.

CO4: Analyze the performance of coding schemes in terms of error detection, error correction capability and efficiency.

CO5: Evaluate the trade-offs between different multiplexing techniques and select appropriate schemes based on application requirements.

CO6: Compare frequency spread spectrum and direct spread spectrum.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT I. INTRODUCTION OF DIGITAL COMMUNICATION SYSTEM (CL Hrs-07, Marks-10)				
1.	<p>TLO 1.1: Describe the digital communication block diagram.</p> <p>TLO 1.2: Explain the given communication channel characteristics</p> <p>TLO 1.3: Define channel capacity and write its equation.</p> <p>TLO 1.4: List the advantages and disadvantages of digital communication.</p>	<p>1.1 Elements of basic digital communication system with its block diagram: source encoder and decoder, channel encoder and decoder, modulator and demodulator, advantages and disadvantages of digital communication</p> <p>1.2 Communication channel characteristics: bit rate, baud rate, bandwidth, repeater distance. Concept of Entropy and information rate.</p> <p>1.3 Channel capacity definition and equation, Channel noise and its effect, Hartley's law. Shannon-Hartley theorem.</p> <p>1.4 Advantages and disadvantages of digital communication.</p>	Chalk-Board Presentations Video Demonstrations	CO1
UNIT II PULSE CODE MODULATION TECHNIQUES (CL Hrs-08, Marks-12)				
2	<p>TLO 2.1: Compare natural and flat top sampling.</p> <p>TLO 2.2: Illustrate the need for sampling and quantization process.</p> <p>TLO 2.3: Explain the term aliasing effect, quantization process, quantization error, companding, and inter-symbol interference.</p> <p>TLO 2.4: Compare the performance of the given type of pulse modulation technique.</p> <p>TLO 2.5: Describe the working of PCM and DPCM transmitter and receiver.</p> <p>TLO 2.6: Describe the working of DM and ADM transmitter and receiver.</p>	<p>2.1 Sampling & quantization process: Nyquist sampling theorem, types of sampling (natural & flat top sampling), aliasing effect, quantization process, quantization error, companding</p> <p>2.2 PAM, PWM, PPM definition, generation, block diagram, waveform analysis, and their comparison.</p> <p>2.3 Pulse code modulation (PCM), Differential Pulse Code Modulation (DPCM): Transmitter & Receiver block diagram and its working, Advantages and disadvantages.</p> <p>2.4 Delta modulation (DM): Block diagram of Transmitter & Receiver, slope overload, granular noise. Advantages and disadvantages.</p> <p>2.5 Adaptive Delta modulation (ADM): Transmitter & Receiver block diagram and its working, Advantages and disadvantages.</p>	Classroom Learning, Reference books, NPTEL	CO2

UNIT III DIGITAL MODULATION TECHNIQUES (CL Hrs-08, Marks-13)				
3	<p>TLO 3.1 Compare coherent and non-coherent detection techniques.</p> <p>TLO 3.2 Describe the generation of a given type of shift keying signal.</p> <p>TLO 3.3 State the need for M-ary encoding</p> <p>TLO 3.4 Draw the constellation diagram for given keying signals.</p> <p>TLO 3.5 Compare the salient features of the given types of digital modulation techniques.</p>	<p>3.1 Types of digital modulation techniques and their advantages, the concept of coherent and non-coherent detection</p> <p>3.2 Shift keying techniques: Amplitude Shift Keying(ASK), Frequency Shift keying (FSK), Phase Shift keying(PSK), Differential Phase Shift keying (DPSK), Quadrature Phase Shift Keying (QPSK), constellation diagram, transmitter and receiver block diagram and their working with waveforms</p> <p>3.3 M-ary encoding: Need, M-ary FSK and M-ary PSK</p> <p>3.4 Quadrature amplitude modulation (QAM): Need, transmitter and receiver block diagram and their working with waveforms, constellation diagram</p>	Classroom Learning, Reference books, NPTEL	CO3
SECTION II				
UNIT IV CODING METHODS AND ERROR CONTROL (CL Hrs-08, Marks-12)				
4	<p>TLO 4.1 Construct the Huffman code for the given 'n' bit data.</p> <p>TLO 4.2 Compare the given line code based on average DC value, bit period, and Bandwidth.</p> <p>TLO 4.3 Apply the error detection and correction technique for the given length of the data bit to generate the coded data.</p>	<p>4.1 Source Coding: Huffman coding</p> <p>4.2 Channel coding: Error, Causes of error and its effects, error detection & correction using parity, checksum, Vertical redundancy check (VRC), Longitudinal redundancy check (LRC), Cyclic redundancy check (CRC), Linear block code, Hamming code.</p> <p>4.3 Line coding formats: Classification of Line codes, Unipolar- RZ, NRZ, Polar – NRZ, RZ, Bipolar NRZ/AMI, Manchester split phase and Differential Manchester and their Waveforms.</p>	Classroom Learning, Reference books, NPTEL	CO4
UNIT V MULTIPLEXING AND MULTIPLE ACCESS TECHNIQUE (CL Hrs-07, Marks-12)				
5	<p>TLO 5.1 Classify the given multiplexing techniques based on the domain of working.</p> <p>TLO 5.2 Explain the working principle of a given type of multiplexing technique.</p> <p>TLO 5.3 Choose the suitable multiplexing techniques for multiplexing the given number of signals.</p> <p>TLO 5.4 Classify the given multiple access techniques based on the domain of working.</p>	<p>5.1 Multiplexing: Need, Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Code Division Multiplexing(CDM): transmitter, receiver block diagram and its working</p> <p>5.2 Multiple Access techniques: Need, Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access(CDMA), Space Division Multiple Access (SDMA), Advantages of TDMA over FDMA</p>	Classroom Learning, Reference books, NPTEL	CO5

UNIT VI SPREAD SPECTRUM MODULATION (CL Hrs-07, Marks-11)

6	<p>TLO 6.1 Interpret the aspect of spread spectrum (SS) modulation for the given application.</p> <p>TLO 6.2 Generate the PN sequence for the given length of data bits.</p> <p>TLO 6.3 Define jamming margin, processing gain and Eb/No ratio.</p> <p>TLO 6.4 Compare the performance of the fast and slow frequency hopping based on a given parameter.</p>	<p>6.1 Introduction to spread spectrum modulation: Advantages over fixed frequency, application of spread spectrum modulation, model of spread spectrum modulation system</p> <p>6.2 Pseudo-noise (PN) sequences: Definition, generation and maximum length sequence.</p> <p>6.3 Types of SS modulation: Direct sequence spread spectrum (DSSS), jamming margin, processing gain, Eb/No ratio, Frequency hopped spread spectrum, slow and fast frequency hopping.</p>	Classroom Learning, Reference books, NPTEL	CO6
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V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1*	LLO 1.1 Illustrate the difference observed in waveforms of natural and flat-top sampled signals.	*Performance of natural and flat-top sampling circuit	02	CO 2
2	LLO 2.1 Generate modulated and demodulated signals on DSO.	*Performance of pulse width modulation and demodulation circuit	02	CO 2
3*	LLO 3.1 Determine the position of pulses as per change in the input signal.	*Performance of pulse width modulation and demodulation circuit	02	CO2
4*	LLO 4.1 Plot output waveform of binary data as per input data.	Performance of Pulse code modulation and demodulation circuit	02	CO2
5	LLO 5.1 Generate and verify the DPCM signal using simulation software.	*Implement differential pulse code modulation and demodulation by using suitable simulation tool	02	CO2
6*	LLO 6.1 Observe modulated and demodulated signal.	*Performance of delta modulation and demodulation circuit	02	CO2
7*	LLO 7.1 Observe how quantization error is removed in ADM.	*Performance of adaptive delta modulation and demodulation circuit	02	CO2
8	LLO 8.1 Measure the amplitude level of the output signal according to binary data.	*Transmit and receive digital signal using Amplitude shift keying	02	CO3
9*	LLO 9.1 Observe demodulated signal as per transmitted binary data.	*Transmit and receive digital signal using Frequency Shift Keying	02	CO3
10*	LLO 10.1 Measure the phase shift according to binary data.	*Transmit and receive digital signal using Phase Shift Keying	02	CO3
11*	LLO 11.1 Measure the phase shifts corresponding to the binary data.	*Performance of QPSK modulation and demodulation	02	CO3

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
12*	LLO 12.1 Measure the amplitude and phase shifts according to the binary data.	Performance of QAM modulation and demodulation	02	CO3
13	LLO 13.1 Observe line code for given data.	*Generate- a)Unipolar-NRZ, RZ b) Bipolar-NRZ (AMI), Manchester Code for given data	02	CO4
14*	LLO 14.1 Calculate the 7-bit hamming code for given 4-bit data.	*Generation of hamming code for 4-bit data	02	CO4
15*	LLO 15.1 Determine the position of error in given data.	Error correction using hamming code	02	CO4
16*	LLO 16.1 Determine PN sequence.	*Generation of PN sequence using suitable simulation tool	02	CO5
17	LLO 17.1 Observe the CDMA signal with the spreading sequences for each channel.	*Generation of two-channel CDMA-DSSS signal using suitable simulation tool	02	CO6

Note: A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of a minimum of 12 or more practical needs to be performed. Out of which, the practicals marked as ‘*’ are compulsory.

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

Micro project

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions to the project work and give a seminar presentation of it before submission. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- Build a sampling circuit.
- Built flat top sampling circuit.
- Build a circuit to generate an FSK signal.
- Build a circuit to generate an ASK signal.
- Build a circuit to generate hamming code.
- Build a circuit to generate a PPM signal.
- Build a circuit to generate a PWM signal.
- Build a circuit to generate a PN sequence.

Industrial Visit

Visit the nearby communication industry and prepare a report on techniques used for modulation/demodulation.

Assignment/Activities

- List the importance of digital communication in the modern era.
- Explain how IoT relies on digital communication.
- Prepare a chart to add key details for each digital communication technique, such as advantages, disadvantages, and real-world applications.

VII. LABORATORY EQUIPMENT/ INSTRUMENTS/ TOOLS/ SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Variable DC power supply 0-30V, 2 Amp, SC protection, display for voltage and current	1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17
2	Cathode Ray Oscilloscope Dual trace 20 MHz, 1M Ω , Input Impedance	1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17
3	Function Generator 0-2MHz with Sine, square, and triangular output	1,2,3,4,5,6,7,8,9,10,11
4	Digital Multimeter: 3 1/2-digit display, 9999 counts digital	9,15

VIII. SUGGESTED FOR 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
SECTION I								
1	I	INTRODUCTION OF DIGITAL COMMUNICATION SYSTEM	CO1	7	2	4	4	10
2	II	PULSE CODE MODULATION TECHNIQUES	CO2	8	2	4	6	12
3	III	DIGITAL MODULATION TECHNIQUES	CO3	8	4	4	5	13
								35
SECTION II								
4	IV	CODING METHODS AND ERROR CONTROL	CO4	8	2	4	6	12
5	V	MULTIPLEXING AND MULTIPLE ACCESS TECHNIQUE	CO5	7	2	4	6	12
6	VI	SPREAD SPECTRUM MODULATION	CO6	7	-	5	6	11
								35
Grand Total				45	12	25	33	70

IX. ASSESSMENT METHODOLOGIES / TOOLS

Formative assessment (Assessment for Learning)		Summative Assessment (Assessment of Learning)
1. Tests	4. Self-Learning	1. End Term Exam
2. Assignment	5. Term Work	2. Micro-project
3. Midterm Exam	6. Seminar/Presentation	

X. 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	2	2	2	1	2			
CO2	1	2	1	--	-	--	2			
CO3	--	2	2	--	1	--	2			
CO4	--	2	2	1	1	--	1			
CO5	--	--	2	--	2	--	2			
CO6	--	--	2	--	2	--	2			
Legends:- High:03, Medium:02, Low:01, No Mapping: -- *PSOs are to be formulated at the institute level										

XI. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher
1	Simon Haykin	Digital Communications	John Wiley and Sons, ISBN-978-8126508242
2	K.Sam Shanmugam	Digital and Analog Communication Systems	Wiley India Pvt Ltd, ISBN-978-8126509140
3	Rao. Ramkrishna P.	Digital Communication	McGraw Hill Education (1 July 2017), ISBN-978-0070707764
4	B. P. Lathi	Modern Digital and Communication Systems	Oxford University Press, ISBN-978-0198073802
5	Bernard Sklar	Digital Communications: Fundamentals and Applications	Pearson 2021, ISBN-13:978-0-13-458856-8
6	Amitabha Bhattacharya	Digital Communication	McGraw Hill Education, ISBN-10 9780070591172

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://nptel.ac.in/courses/117101051	Introduction to Digital Communication by NPTEL
2.	https://www.etti.unibw.de/labalive/experiment/qpsksignalgeneration/	virtual communication lab for practicals
3.	https://nptel.ac.in/courses/106105082	Data Communication
4.	http://www.digimat.in/nptel/courses/video/117105136/L13.html	Spread spectrum techniques

Name & Signature:  Smt. P.G. Gabhakar Lecturer in E&TC (Course Experts)	
Name & Signature:  Dr. Y.V. Chavan (Programme Head)	Name & Signature:  Shri. S.B. Kulkarni (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMA IN ET
PROGRAMME CODE	03
COURSE TITLE	ELECTRONIC EQUIPMENT MAINTENANCE AND SIMULATION
COURSE CODE	ET41201
PREREQUISITE COURSE CODE & TITLE	NA
CLASS DECLARATION COURSE	YES

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TSL				Based on SLA		Total Marks	
													Practical							
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR				
														Max	Min	Max	Min	Max		Min
ET41201	ELECTRONIC EQUIPMENT MAINTENANCE AND SIMULATION	SEC	--	--	4	--	4	2	--	--	--	--	50	20	50#	20	--	--	100	

Total IKS Hrs for Term: 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,*# - Online Examination,@\$ - Internal Online Examination

Note:

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

II. RATIONALE:

Introducing a course on the Indian Constitution can provide students with a comprehensive understanding of the country's legal framework and democratic principles. Such a course could cover the historical context of its creation, the structure and functions of the government it establishes, and the fundamental rights and duties of citizens. It could also explore the significant amendments and judicial interpretations that have shaped its evolution over time. This foundational knowledge is not only for fostering informed and engaged citizens who can contribute to the nation's democratic processes but also enriches the educational experience by fostering a sense of national identity and ethical responsibility among future engineers. Furthermore, embedding Electoral Literacy and Voter Education in diploma engineering programs strategically empowers these future professionals with an awareness of their electoral privileges and the workings of democracy.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's):

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Choose a maintenance policy for specified Equipment/Appliances/Gadgets.

CO2: Select troubleshooting tools for the given electronic equipment.

CO3: Comprehend the distribution of legislative, executive, and financial powers between the Union and the State Maintain electronic appliances and laboratory equipment.

CO4: Test the performance of electronic circuits using simulation tools.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Pedagogies	Learning	Relevant COs
UNIT-I ELECTRONIC EQUIPMENT MAINTENANCE MANAGEMENT (CL HRS-NIL, MARKS -NIL)					
1	<p>TLO 1.1 Describe different types of electronic maintenance.</p> <p>TLO 1.2 Explain the maintenance policy for the given equipment.</p> <p>TLO 1.3 Choose the service option for the maintenance of the given equipment with justification.</p> <p>TLO 1.4 Illustrate the procedure to install application software.</p> <p>TLO 1.5 Differentiate maintenance and troubleshooting process of equipment.</p>	<p>1.1 Objective of maintenance management service, types of maintenance: preventive, predictive, & corrective maintenance</p> <p>1.2 Maintenance policy: Concept of warranty and guarantee, equipment service options</p> <p>1.3 Interpretation of the service and operation manuals, software installation procedure and policies</p> <p>1.4 Maintenance versus troubleshooting versus calibration.</p> <p>1.5 Fault finding tools and instruments</p> <p>1.6 troubleshooting technique and measures</p> <p>1.7 S/W installation procedure and policies.</p>	Classroom Learning, Reference books, NPTEL		CO1
UNIT-II FUNDAMENTALS OF TROUBLESHOOTING (CL HRS-NIL, MARKS -NIL)					
2	<p>TLO 2.1 Describe the circuit and wiring diagram of the given equipment.</p> <p>TLO 2.2 Illustrate general troubleshooting procedure.</p> <p>TLO 2.3 Identify with proper justification the use of relevant tools for troubleshooting of given equipment.</p> <p>TLO 2.4 Choose the relevant measure to troubleshoot the given equipment with justification.</p>	<p>2.1 Block, circuit, wiring/line diagram of available equipment</p> <p>2.2 General troubleshooting procedure</p> <p>2.3 General troubleshooting techniques</p> <p>2.4 Fault-finding tools, test and measuring instruments, temperature-sensitive intermittent problems and corrective actions, situations where repairs should not be attempted</p> <p>2.5 General troubleshooting measure</p>	Classroom Learning, Reference books, NPTEL		CO2

UNIT-III MAINTENANCE OF ELECTRONIC EQUIPMENT (CL HRS-NIL, MARKS -NIL)				
3	<p>TLO 3.1 Illustrate common steps of maintenance of given home appliances.</p> <p>TLO 3.2 Describe common steps of installation of UPS and DTH.</p> <p>TLO 3.3 Explain the working procedure of the given laboratory equipment using It's a block diagram.</p> <p>TLO 3.4 State the principle of power generation of solar PV cells.</p> <p>TLO 3.5 Write the installation procedure of the CCTV Surveillance system.</p> <p>TLO 3.6 Explain the block diagram of the central processing unit.</p>	<p>3.1 Electronic appliances: Maintenance of home appliances, battery charger, water level controller, emergency light system, SMPS, Public address (PA) system.</p> <p>3.2 Installation, operation, and fault finding of offline/online. uninterruptible power supply (UPS).</p> <p>3.3 Laboratory equipment: Operation and testing of meter, electrometer, and voltmeter.</p> <p>3.4 Installation and testing of solar power system</p> <p>3.5 Installation and testing of surveillance system.</p> <p>3.6 Assembling of computer system.</p>	Classroom Learning, Reference books, NPTEL	CO3
UNIT-IV SIMULATION SOFTWARE (CL HRS-NIL, MARKS -NIL)				
4	<p>TLO 4.1 State need for EDA tools.</p> <p>TLO 4.2 Describe the procedure to create a new file in the given EDA tool software.</p> <p>TLO 4.3 Design given analog circuits using EDAtool.</p> <p>TLO 4.4 Sketch given Digital and Op-Amp-based circuits using the EDA tool.</p> <p>TLO 4.5 Design real-life applications using any simulation software</p>	<p>4.1 Introduction to Electronic Design Automation (EDA) tools, need of simulation software.</p> <p>4.2 MATLAB or others.</p> <p>4.3 Main features of EDA tool: Open file, create a new file, run, simulation, virtual instrument, edit windows, functions, controls, file formats and report generation</p> <p>4.4 Circuit analysis: Analog circuits (RL, RC, RLC), OpAmp-based circuits (inverting/non-inverting amplifiers), digital circuits (adder, multiplexer and flip flops)</p> <p>4.5 Simulation of various real-life applications like water level controller, and temperature controller.</p>	Classroom Learning, Reference books, NPTEL	CO4

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

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles/Tutorial Titles	Number of hrs.	Relevant COs
1*	Prepare the work order for the maintenance of electronic equipment	Preparation of work order for the maintenance of electronic Equipment.	02	CO1
2	Prepare Bin cards for the maintenance of given electronic equipment.	Preparation of Bin cards for the maintenance of given electronic equipment.	02	CO1
3*	Test electronic components such as loudspeakers, microphones, relays, solenoids, switches, etc. in equipment.	Performance of electronic components	02	CO2
4*	Test the performance of the given stepper motor	The performance of the given stepper motor.	02	CO2
5*	Rectify the fault of the regulated power supply.	Troubleshooting the regulated power Supply.	02	CO3
6*	Rectify the fault of a tachometer.	Troubleshooting of speed measuring device	02	CO3
7	Troubleshoot the photovoltaic solar panel power system.	Troubleshooting the photovoltaic solar panel power system.	02	CO3
8*	Install DTH unit	Installation of DTH System.	02	CO3
9*	Troubleshoot the data projector	Troubleshooting of the data projector	02	CO3
10*	Assemble various parts of the computer system and install the operating system, applications software and antivirus.	Assembling various parts of the computer system and installing an operating system, applications software and antivirus.	02	CO3
11*	Install offline/online UPS.	Installation of online/offline UPS.	02	CO3
12	Test the performance of online/offline UPS.	Installation of offline/online UPS.	02	CO3
13*	Install a CCTV network on the institute premises.	Installation of CCTV.	02	CO3
14*	Install and Test solar power system.	Installation and testing of solar power System.	02	CO3
15*	Rectify the fault of the function generator.	Troubleshooting of function generator.	02	CO3
16	Rectify the fault of SMPS.	Troubleshooting of SMPS	02	CO3
17	Rectify the fault of DSO.	Troubleshooting of DSO.	02	CO3
18*	Install the available EDA tool software.	Installation of EDA tool.	02	CO4
19*	Measured AC voltage and current in RL, RC, and RLC circuits using EDA tools.	Measurement of AC voltage and current in RL, RC, and RLC circuits using EDA tools	02	CO4
20*	Test the output of regulated power supply circuit at different points using the EDA tool.	Simulation of the regulated power supply using the EDA tool.	02	CO4
21	Test the output of the half-wave rectifier circuit using the EDA tool.	Simulation of Half-Wave rectifier circuit using EDA tool.	02	CO4

Sr. No	Practical/Tutorial/Laboratory Outcome (LLO)	Learning	Laboratory Experiment / Practical Titles/Tutorial Titles	Number of hrs.	Relevant COs
22*	Test the output of full wave bridge rectifier circuit using the EDA tool.		Simulation of full-wave bridge rectifier circuit using the EDA tool	02	CO4
23*	Simulate inverting amplifier using IC741.		Simulation of the inverting amplifier using IC741.	02	CO4
24	Simulate non-inverting amplifier using IC741.		Simulation of non-inverting amplifier using IC741.	02	CO4
25*	Simulate half adder circuit to verify the truth table.		Simulation of half adder circuit to verify the truth table.	02	CO4
26*	Simulate full adder circuit to verify the truth table		Simulation of full adder circuit to verify the truth table	02	CO4
27*	Simulate 8:1 multiplexer circuit to verify the truth table		Simulation of 8:1 multiplexer circuit to verify the truth table	02	CO4
28*	Simulate 1:8 demultiplexer circuit to verify the truth table.		Simulation of 1:8 demultiplexer circuit to verify the truth table.	02	CO4
29*	Simulate the JK flipflop circuit to verify the truth table.		Simulation of JK flipflop circuit to verify the truth table.	02	CO4
30*	Simulate the RS flipflop circuit to verify the truth table.		Simulation of RS flipflop circuit to verify the truth table.	02	CO4

Note: Out of the above suggestive LLOs -

'*' Marked Practicals (LLOs) Are mandatory.

A minimum of 80% of the above list of lab experiments are to be performed.

Judicial mix of LLOs is to be performed to achieve desired outcomes.

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING):

NOT APPLICABLE

VII. LABORATORY EQUIPMENT/ INSTRUMENTS/ TOOLS/ SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	UPS Standby UPS: 5-12 ms, – average 8 ms Line-interactive UPS: 3- 8ms – average 5 ms The double conversion has a zero-second transfer time.	12
2	CCTV system Set up of CCTV installation sample-(4 CH DVR ,hard disk 500GB,IR dome camera, video cable, power supply (12V,1 Amp), regulated for controller and driver circuit, 4 CCTV cameras along with the digital video recorder (DVR).	13

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
3	Solar Power Trainer Kit Solar training kit/simulator with built-in meters for DCV, DCA, AC multifunction meter 9 for ACI, ACV power frequency, protection circuits, BS-10 terminals for making the connection, single/dual axis tracking system.	14
4	Function generator Frequency Output: 15 MHz - sine, square & triangle. 6 MHz - pulse, TTL and arbitrary. Output Channels: 2, Channels sampling rate: 266 MSa/S (vertical resolution - 14 Bits) Waveforms: sine, square, pulse (adjustable duty cycle, precise adjustment of pulse width & period), triangular Wave	15
5	SMPS power supply Input voltage: AC 100 - 240V 50 / 60Hz Output voltage: 24V DC, 5A Adjustment range: $\pm 20\%$	16
6	Cathode ray oscilloscope Bandwidth: 0 to 15 MHz Mode: auto/level/free run Power : 230 V $\pm 10\%$ 50 Hz 30W	17
7	Digital Storage Oscilloscope 100MHz DSO with colour display, 1GSa/Sec sampling rate, USB PC interface cable and software, with USB device & host	18
8	Simulation software like e-sim, Multisim, Scilab, SPICE simulator, LabVIEW, Proteus, MATLAB or any other.	19,20,21,22,23,24,25,26,27,28
9	Microphone and loudspeaker characteristics trainer kit On board Meters : dB meter Range : 40-80dB, 80-120dB	3
10	Multimeter 3 1/2 -digit display with AC and DC voltage and current measurement facility, Diode, resistor, and capacitor testing facility.	3,15,17,18
11	Regulated power supply Range: 0-30 V, 0-2 A DC	3,5
12	Tachometer Voltage: ± 5 V, 0 - 10 V, etc. Current: 0 - 20 mA, 4 -20 mA, 10 - 50 mA, etc.	6
13	Clamp-on ammeter AC: 40.00 A / 400.0 A Continuity: $\leq 30\Omega$ Capacitance: 0 to 100.0 uF / 100uF to 1000 uF Frequency: 5.0 Hz to 500.0 Hz	7

VIII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Each practical will be assessed considering: - 60% weightage to process and 40% weightage to product.	End of the term assessment, Viva-voce, workshop / Lab performance.

IX. 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	--	--	--	--	2			
CO2	2	2	--	--	--	--	2			
CO3	2	2	2	3	2	--	2			
CO4	2	2	3	3	--	--	2			

Legends:- High:03, Medium:02, Low:01, No Mapping: --

*PSOs are to be formulated at the institute level

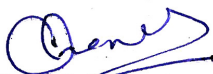
X. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Khandpur R.S.	Troubleshooting electronic equipment	McGraw Hill, 2006
2	Tomal Daniel R., Ph.D. Agajanian Aram S. , Ph.D.	Electronic Troubleshooting	McGraw Hill, 2014 ISBN: 9780071828611
3	Singh Sudeep K.	Troubleshooting & Maintenance of Electronic Equipment	S K Kataria and Sons, 2008 ISBN: 9789381348178
4	Kumar Ashok L, Indra Gandhi V. Maheswari Uma Y.	Software Tools for the Simulation of Electrical Systems.	Academic Press, 2020 ISBN: 9780128194164
2	Tomal Daniel R., Ph.D. Agajanian Aram S. , Ph.D.	Electronic Troubleshooting	McGraw Hill, 2014 ISBN: 9780071828611


XI. LEARNING WEBSITES & PORTALS

Sr. No.	Link/Portal	Description
1.	https://www.eit.edu.au/resources/practical-troubleshooting-o	https://www.eit.edu.au/resources/practical-troubleshooting-o
2.	http://www.kicad-pcb.org	http://www.kicad-pcb.org
3.	https://www.multisim.com/	https://www.multisim.com/
4.	https://esim.fossee.in/downloads	https://esim.fossee.in/downloads


Name & Signature:


Smt.C .D.Pophale
Lecturer in E&TC
(Course Experts)

Name & Signature:


Dr.Y.V.Chavan
(Programme Head)

Name & Signature:


Shri. S.B. Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE**'120- NEP'SCHEME**

PROGRAMME	DIPLOMA IN ET
PROGRAMME CODE	03
COURSE TITLE	ELECTRONICS MEASUREMENTS AND INSTRUMENTATION
COURSE CODE	ET31202
PREREQUISITE COURSE CODE&TITLE	NA
CLASS DECLARATION COURSE	NO

I. LEARNING&ASSESSMENT SCHEME

Course Code	CourseTitle	Course Type	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
			Actual Contact Hrs./Week			SLH	NLH	Theory				Based on LL & TSL				Based on SL					
			CL	TL	LL			Practical						SLA							
								FA-TH			SA-TH	Total		FA-PR		SA-PR		SLA			
												Max	Max	Max	Min	Max	Min	Max	Min	Max	
ET31202	ELECTRONICS MEASUREMENTS AND INSTRUMENTATION	DSC	2	--	2	2	6	3	--	--	--	--	25	10	50@	20	25	10	100		

Total IKS Hrs for Term: 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, *#-Online Examination, @\$-Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

- If a candidate is not securing minimum passing marks in **FA-PR**(Formative Assessment -Practical)of any course, then the candidate shall be declared as '**Detained**' in that course.
- If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
- Notional learning hours** for the semester are(**CL+LL+TL+SL**)hrs.***15Weeks**
- 1 credit** is equivalent to **30 Notional hours**.
- *Self-learning hours shall not be reflected in the Timetable.
- *Self-learning includes micro-projects/ assignments /other activities.

II. RATIONALE:

Diploma engineers have to deal with the various types of electronic circuits while maintaining various electronic equipment. The study of basic operating principles and handling of various electronic devices will help them to troubleshoot electronic equipment. This course is developed in such a way that students will be able to apply the knowledge to solve broad electronic engineering application problems. Understanding the subject will provide skills to the students for troubleshooting and testing some circuits & devices.

III. COURSE-LEVEL LEARNING OUTCOMES(CO'S)

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

- CO1: Interpret the characteristics and workings of the measuring instrument.
 CO2: Use different AC &DC Bridges for relevant parameter measurement
 CO3: Use the relevant instrument to measure specified parameters.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I FUNDAMENTAL OF ELECTRONICS MEASUREMENTS (CL Hrs-6, Marks -08)				
1.	TLO1.1: Describe the block diagram of the instrumentation system TLO1.2: Classify static and dynamic characteristics of instruments. TLO1.3: List the types of instruments. TLO1.4: Compare the types of errors.	1.1 Introduction to measurement systems. 1.2 Generalized block diagram of instrumentation system. 1.3 Classification of Instruments: Absolute, Secondary Instruments 1.4 Definitions of Static characteristics of Instruments: (Accuracy, Precision, Sensitivity, Resolution, Static error, Reproducibility, Drift, Dead Zone) 1.5 Definitions of dynamic characteristics of Instruments: (Speed of response, Lag, fidelity, Dynamic error) 1.6 Types of Errors- Gross, Systemic, Random 1.7 Definition of Standards and their classification: (International, Primary, Secondary) 1.8 Calibration: Definition, Need of calibration.	Classroom Learning, Reference books, NPTEL	CO1
UNIT-II ANALOG AND DIGITAL METERS (CL Hrs-6, Marks -08)				
2	TLO 2.1: Classify analog ammeters and voltmeters TLO 2.2: Compare Analog and digital meters. TLO 2.3: Summarize the working principle and construction of PMMC instrument TLO 2.4: Perform practicals related to AC and DC Ammeters and voltmeters.	2.1 Classification of analog ammeter and voltmeter. 2.2 Working principle and construction of PMMC instruments. 2.3 Analog DC Ammeter: Shunt resistor type, Ayrton Shunt type. 2.4 Analog DC Voltmeter: Multiplier voltmeter 2.5 Analog AC Voltmeter (No derivation)- Half Wave rectifier type, Full wave rectifier type, Multi range type. 2.6 Analog AC Ammeter.	Classroom Learning, Reference books, NPTEL	CO2
UNIT-III AC/DC BRIDGES (CL Hrs-09, Marks -12)				
3	TLO 3.1: Classify DC and AC bridges. TLO 3.2: Identify different DC and AC bridges. TLO 3.3: Implement Wheatstone Bridge. TLO 3.4: Choose a particular bridge according to the application	3.1 Bridge balance condition for DC bridge. 3.2 Study of the following DC bridges - a. Wheatstone's bridge b. Kelvin's bridge. 3.3 Bridge balance condition for AC bridge. 3.4 Study of following AC bridges. Hay bridge, Schering's bridge, Wien's bridge.	Classroom Learning, Reference books, NPTEL	CO3

UNIT-IV OSCILLOSCOPE & SIGNAL GENERATOR (CL Hrs-09,Marks -12)				
4	TLO4.1: Describe the Basic block diagram of CRO. TLO4.2: Identify various parts of CRT TLO4.3: Demonstrate practical related to applications of CRO. TLO4.4: Interpret the need for a signal generator. TLO4.5: Use function generator.	4.1 CRO: Basic Block diagram and function of each block. 4.2 CRT: Construction and working 4.3 Applications of CRO 4.4 Concept, block diagram and Operation of Single beam dual trace & Dual-beam Dual Trace CRO. 4.5 Definition and need of signal generator 4.6 Block diagram, operation and applications Function generator.	Classroom Learning, Reference books, NPTEL	CO4

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

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1*	Measure A.C. & D.C. voltage with the help of a PMMC-based instrument.	Measure DC Voltage & DC Current using a PMMC instrument.	02	CO2
2*	Prepare observation table for different sets of resistors, capacitors and inductors values using LCR Qmeter.	Measurement of R.L.C using LCR, Q meter.	02	CO3
3*	Observe and draw the front panel diagram of CRO. Using manual find out specifications of given CRO.	Study front panel controls & specifications of typical CRO.	02	CO3
4*	Observe waveform then measure frequency, voltage and phase difference using CRO.	Measure frequency, voltage, and phase difference (by time measurement) using CRO.	02	CO3
5*	Observe various waveforms (patterns) for different components such as diode, capacitor, resistor etc.	Testing of components using CRO.	02	CO3
6	Observe Lissajous pattern on CRO .Find out frequency by observing patterns.	Generate a Lissajous pattern on CRO to find the frequency of the Unknown signal.	02	CO3
7*	Observe Lissajous pattern on CRO .Find out phase differences by observing patterns.	Generate a Lissajous pattern on CRO to find the phase of the Unknown signal.	02	CO3
8*	Observe and draw the front panel diagram of the digital CRO. Using manual find out specifications of given digital CRO.	Study block diagram & front panel controls of Digital Storage Oscilloscope	02	CO3
9*	Implement the circuit by choosing proper resistors and using the formula to find out the value of the unknown resistor.	Study of Whetstone's bridge for measurement of unknown resistance.	02	CO2
10*	Implement the circuit by choosing proper component values and using the formula to find out the value of unknown L & C.	Measurement of unknown capacitance & inductance using bridge	02	CO2

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
11*	Generate different waveforms using a function generator and CRO. Measure voltage and frequency.	Measure the frequency & voltage of the different o/p waveforms of the function generator.	02	CO3
12*	Generate different waveforms using a function generator and digital CRO. Measure voltage frequency and phase difference.	Measure frequency, voltage, and phase difference (by time measurement) using DSO.	02	CO3
13*	-----	Complete a micro-project based on guidelines provided in sr.no. 11.	02	ALL

Note: A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the CO and competency. A judicious mix of a minimum of 12 or more practicals needs to be performed. Out of which, the Practicals marked as compulsory.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Microproject

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions to the project work and give a seminar presentation of it before submission. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- Analog and Digital Meters: Build and Test Voltmeter (0-10V, 1mA, 500 ohms) using PMMC.
- Analog and Digital Meters: Build and Test Ammeter (0-100mA) using PMMC.
- Signal Conditioning: Using Wheatstone Bridge design a DC signal conditioning circuit and implement it on Breadboard/ PCB.
- Function Generator: Using IC 8308 (Sine Wave, Square Wave, Triangular Wave up to 100KHz) build and test Function Generator on PCB.
- Oscilloscope, Function Generator: Prepare a report on a survey of Oscilloscope and Function Generator

Assignment/Activity

- Make a chart to compare all types of instruments and their uses.
- Make a library survey regarding different makes and specifications of the instruments.
- Study of the datasheet of CRO, DSO, and FUNCTION GENERATOR.
- Search information about front panel controls of CRO, function generator, and DSO.
- Measure various R, L, and C components in the LCR Q meter.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Analog multimeter & Digital Multimeter	1,9,10,13
2	CRO, DSO	3,4,5,6,7,8,9,10,12,13
3	Function Generator	4,6,9,10,12,13
4	Different types of cables and connectors	ALL
5	LCR Q METER	2,13

VIII. SUGGESTED FOR 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	FUNDAMENTAL ELECTRONICS MEASUREMENTS	CO1	6	-	-	-	8
2	II	ANALOG AND DIGITAL METERS	CO2	6	-	-	-	8
3	III	AC/DC BRIDGES	CO3	9	-	-	-	12
4	IV	OSCILLOSCOPE & SIGNAL GENERATOR	CO4	9		-	1	12
Grand Total				30	-	-	-	70

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)		Summative Assessment (Assessment of Learning)
1. Tests	4. Self-Learning	1. End Term Exam
2. Assignment	5. Term Work	2. Micro-project
3. Midterm Exam	6. Seminar/Presentation	

X. 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	2	2	3	-	2	1	2	2	3
CO2	3	3	2	3	1	2	2	3	2	3
CO3	3	2	2	3	-	2	2	3	2	3

Legends:-High:03,Medium:02,Low:01,NoMapping:-
 *PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

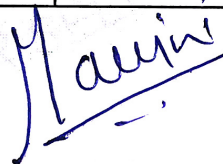
Sr.No	Author	Title	Publisher
1	A K Sawhney	Instrumentation	Dhanpat Rai Publication, Nineteenth edition, 2017 ISBN: 8177001006
2	W.D. Cooper	Modern Electronic Instrumentation & Measurement Techniques	Pearson Education, New Delhi, Third edition, 1995. ISBN :978054867272 ISBN :0711009147
3	H S Kalsi	Electronic Instrumentation	Tata McGraw Hill, Third Edition, 2010. ISBN :9780070702066 ISBN :0070702063

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://www.nptel.com	ALL ELECTRONIC INSTRUMENTS.
2.	www.slideshare.net	CRO DSO FUNCTION GENERATOR
3.	https://www.electronicsforu.com/technology-trends/learn-electronics/cro-cathode-ray-oscilloscope-working	CRO WORKING
4.	https://emanualz.wordpress.com/cathode-ray-oscilloscope-cro/	Cro function generator
5.	https://www.geeksforgeeks.org/function-generator/	Function generator

Name & Signature:

Smt.M.S.Datar
Lecturer in E&TC
(Course Experts)



Name & Signature:

Dr.Y.V.Chavan
(Programme Head)



Name & Signature:

Shri. S.B. Kulkarni
(CDC In-charge)



GOVERNMENT POLYTECHNIC ,PUNE
‘120– NEP’SCHHEME

PROGRAMME	DIPLOMA IN ET
PROGRAMME CODE	03
COURSE TITLE	MICROCONTROLLER AND APPLICATIONS
COURSE CODE	ET31207
PREREQUISITE COURSE CODE & TITLE	DIGITAL TECHNIQUES
CLASS DECLARATION COURSE	YES

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme												Total Marks
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL			
														Practical							
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
																				Max	
	MICROCONTR OLLER & APPLICATIONS	DSC	4	-	4		8	4	3	30	70	100	40	25	10	25#	10			150	

Total IKS Hrs for Term: 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, *#-Online Examination, @\$-Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

- If a candidate is not securing minimum passing marks in **FA-PR**(Formative Assessment -Practical)of any course, then the candidate shall be declared as '**Detained**' in that course.
- If a candidate does not secure minimum passing marks in **SLA** (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit **SLA** work.
- Notional learning hours** for the semester are(**CL+LL+TL+SL**)hrs.***15Weeks**
- 1 credit** is equivalent to **30 Notional hours**.
- *Self-learning hours shall not be reflected in the Timetable.
- *Self-learning includes micro-projects/ assignments /other activities.

II. RATIONALE:

Knowledge of the 8-bit microcontroller serves as a stepping stone for students who wish to explore more advanced microcontrollers and embedded systems platforms in their academic or professional careers. Working with development boards, sensors, actuators, and peripheral devices helps students reinforce theoretical concepts, develop debugging skills, and gain practical engineering experience. The Microcontroller syllabus is a crucial component of contemporary engineering education, providing students with the necessary tools to thrive in a technology-driven world. It aligns with the industry's needs and fosters a culture of innovation and problem-solving.

III. COURSE-LEVEL LEARNING OUTCOMES(CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO 1: Understand the architecture of the 8051 microcontroller.

CO 2: Develop assembly language programs for the 8051 microcontroller to perform the given operation.

CO 3: Use timers and interrupts in the 8051 microcontroller for precise timing and event-driven programming.

CO 4: Interface the 8051 microcontroller with various input/output devices.

CO 5: Develop a Serial Communication Protocol Program for the 8051 Microcontroller

CO 6: Implement simple microcontroller-based applications.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

SECTION I				
Sr. No	Theory Learning Outcomes (TLO'S) aligned to COs.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT I INTRODUCTION TO MICROCONTROLLERS & 8051 ARCHITECTURE (CL Hrs-12, Marks-15)				
1.	TLO 1.1 Differentiate Microcontroller and Microprocessor for the given parameters. TLO 1.2 List the features of 8051 Microcontroller. TLO 1.3 Enlist the selection factors for choosing a Microcontroller suitable for application. TLO 1.4 Compare Harvard architecture and Von-Neumann architecture. TLO 1.5 Describe the 8051 block diagram. TLO 1.6 Explain the functions of each block of the 8051 Microcontroller. TLO 1.7 Compare the given derivatives of the 8051 Microcontroller.	1.1 Introduction to microprocessors and microcontrollers 1.2 Features and selection criteria for Microcontroller 1.3 Types of architectures - Harvard and Von-Neumann. 1.4 8051 architecture: Internal block diagram, Memory organization (program, data, internal RAM, registers), Special Function Registers (SFRs), Pin configuration and functionalities 1.5 Selection factors of microcontroller 1.6 Derivatives of 8051.	Classroom Learning, Reference books, NPTEL	CO1

UNIT-II 8051 INSTRUCTION SET & ASSEMBLY LANGUAGE PROGRAMMING (CLHrs-12, Marks-12)				
2	<p>TLO 2.1 Describe the working given IDE.</p> <p>TLO 2.2 Explain the addressing modes of 8051 with examples.</p> <p>TLO 2.3 Describe the function of the given instruction with a suitable example.</p> <p>TLO 2.4 Explain the use of the given assembler directives with examples.</p> <p>TLO 2.5 Develop simple programs to perform the following operations: Data manipulation, Masking, Stack operation, Branching execution</p>	<p>2.1 Introduction to IDE: Editor, Assembler, Compiler, Cross-Compiler, Linker, Simulator.</p> <p>2.2 Addressing Modes: Immediate, Register, Direct, Indirect, Indexed.</p> <p>2.3 Instruction set: Data Transfer, Arithmetic, Logical, Branching, Machine control and Boolean</p> <p>2.4 Assembler Directives: ORG, DB, DW, EQU, END, CODE, DATA</p> <p>2.5 Assembly Language Programming (ALP): Data manipulation, Masking, Stack operation, Branch related programming</p>	Classroom Learning, Reference books, NPTEL	CO2
UNIT-III TIMERS /COUNTERS AND INTERRUPTS (CL Hrs- 06, Marks-08)				
3	<p>TLO 3.1 Describe the functions of Timer/ Counters, their applications, and modes of Timers.</p> <p>TLO 3.2 Generate the waveforms by using the given mode of Timer.</p> <p>TLO 3.3 Explain the interrupt mechanism with the help of a suitable example.</p>	<p>3.1 Configuration and Programming of Timer/Counter using Special Function Registers [SFRs]: TMOD, TCON, THx, TLx, Simple programs to generate the time delays</p> <p>3.2 Configuration and Programming of interrupts using SFRs: IE, IP</p>	Classroom Learning, Reference books, NPTEL	CO3
SECTION II				
UNIT-IV SERIAL COMMUNICATION AND I/O PROGRAMMING (CL Hr. -06, Marks-08)				
4	<p>TLO 4.1 Explain the operation of the given mode for Serial communication.</p> <p>TLO 4.2 Develop simple programs on Serial communication.</p> <p>TLO 4.2 Explain I/O Port Programming.</p>	<p>4.1 Serial Communication SFRs: SCON, SBUF, PCON, Modes of serial communication,</p> <p>4.2 Introduction to UART in 8051 microcontroller</p> <p>4.3 Simple Programs on Serial Communication.</p> <p>4.4 Configuration and Programming of I/O Port : P0, P1, P2, P3.</p>	Classroom Learning, Reference books, NPTEL	CO4

UNIT-V 8051 INTERFACING (CL Hrs-12, Marks-12)				
5	<p>TLO 5.1 Interface Input / Output Devices with 8051 microcontroller</p> <p>TLO 5.2 Interface ADC with 8051 microcontroller</p> <p>TLO 5.3 Interface DAC with 8051 microcontroller.</p> <p>TLO 5.4 Describe with a neat sketch the interfacing of the given external memory.</p> <p>TLO 5.5 Describe the procedure to troubleshoot the given I/O device.</p>	<p>5.1 I/O Interfacing: Keyboard, Relays, LED, LCD, Seven Segment display</p> <p>5.2 Interfacing ADC 0808/09 with 8051. Simple programs for ADC interfacing</p> <p>5.3 Interfacing DAC 0808/09 with 8051. Simple programs for DAC interfacing</p> <p>5.4 Memory Interfacing: Program and Data Memory.</p>	Classroom Learning, Reference books, NPTEL	CO5
UNIT-VI APPLICATIONS OF THE 8051 MICROCONTROLLER (CL Hrs- 12, Marks-15)				
6	<p>TLO 6.1 Generate the given waveform using 8051 and DAC.</p> <p>TLO 6.2 Interface Analog Input devices with 8051 microcontroller.</p> <p>TLO 6.3 Program 8051 for the given application.</p> <p>TLO 6.4 Interface Stepper motor to 8051.</p> <p>TLO 6.5 Describe the procedure to troubleshoot the given microcontroller-based application.</p>	<p>6.1 Square and Triangular waveform generation using DAC</p> <p>6.2 Temperature sensor (LM35) interfacing using ADC to 8051</p> <p>6.3 Water Level controller design using 8051</p> <p>6.4 Stepper Motor Interfacing to 8051 to rotate in clockwise and anticlockwise direction</p>	Classroom Learning, Reference books, NPTEL	CO6

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

Sr.No.	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1 Identify the functions of various blocks of the 8051 microcontroller development board.	* Identification of various blocks of the 8051 microcontroller development board	2	CO1
2	LLO 2.1 Develop an Assembly Language Program (ALP) for the addition of two numbers using various addressing modes and assembler directives.	Assembly Language Program using various addressing modes	2	CO2
3	LLO 3.1 Develop an ALP to perform arithmetic operations: addition, subtraction, multiplication and division on 8-bit data.	* ALP to perform arithmetic operations on 8-bit data	2	CO2
4	LLO 4.1 Develop an ALP to perform arithmetic operations: addition, and subtraction on 16-bit data.	* ALP to perform arithmetic operations on 16-bit data	2	CO2

Sr.No.	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
5	LLO 5.1 Develop an ALP to perform the addition of BCD data stored externally and store results in internal memory.	* ALP to perform the addition of BCD data	2	CO2
6	LLO 6.1 Develop an ALP for the sum of series stored in RAM locations 40-49H. Find the sum of the values at the end of the program the lower byte stored in 30H the higher byte in 31H.	* ALP for series addition	2	CO2
7	LLO 7.1 Develop an ALP to transfer data from source to destination locations of internal/ external data memory.	* Array data transfer from source locations to destination locations	2	CO2
8	LLO 8.1 Develop an ALP to exchange block of data from source to destination location of internal/ external data memory.	* Block exchange of data from source locations to destination location	2	CO2
9	LLO 9.1 Develop an ALP for identifying the smallest number from the given data bytes stored in internal/ external data memory.	* Finding the smallest number from the given databytes	2	CO2
10	LLO 10.1 Develop an ALP for identifying the largest number from the given data bytes stored in internal/ external data memory.	Finding the largest number from the given data bytes	2	CO2
11	LLO 11.1 Develop an ALP for arranging numbers in ascending order stored in internal/ external data memory.	* Arranging the numbers in ascending order	2	CO2
12	LLO 12.1 Develop an ALP for arranging numbers in descending order stored in internal/ external data memory.	Arranging numbers in descending order	2	CO2
13	LLO 13.1 Write an ALP to generate delay using a timer register.	* Generate delay using timer register	2	CO3
14	LLO 14.1 Develop an ALP to transfer 8-bit data serially on the serial port.	* Serial 8-bit data transfer on serial port	2	CO4
15	LLO 15.1 Interface LED with microcontroller and turn it 'ON' with microcontroller interrupt.	LED interfacing to 8051	2	CO5
16	LLO 16.1 Develop an ALP to generate pulse and square wave by using timer delay.	Generating Pulse and Square wave using timer delay	2	CO5
17	LLO 17.1 Interface 4 X 4 LED matrix with 8051 to display various patterns.	LED matrix Interfacing to 8051	2	CO5
18	LLO 18.1 Interface 7-segment display to display the decimal number from 0 to 9.	* Seven Segment Display interface for displaying decimal numbers	2	CO5
19	LLO 19.1 Interface relay with microcontroller and turn it 'ON' and 'OFF'.	* Relay interfacing to Microcontroller	2	CO5
20	LLO 20.1 Interface LCD with 8051 microcontrollers to display the characters and decimal numbers.	* LCD interfacing to 8051 to display characters and decimal numbers	2	CO5

Sr.No.	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
21	LLO 21.1 Interface the given keyboard with 8051 and display the key pressed.	Keyboard interfacing to 8051	2	CO5
22	LLO 22.1 Interface ADC with 8051 microcontroller and verify input/output.	* ADC interfacing to 8051	2	CO5
23	LLO 23.1 Interface DAC with 8051 microcontrollers to generate square waves.	* DAC Interfacing to generate the waveform	2	CO5
24	LLO 24.1 Interface DAC with 8051 microcontrollers to generate the triangular wave, saw-tooth wave.	DAC interfacing to generate the waveforms	2	CO5
25	LLO 25.1 Interface stepper motor to the microcontroller and rotate in a clockwise direction at the given angles.	* Stepper Motor interfacing to 8051	2	CO6
26	LLO 26.1 Interface stepper motor to the microcontroller and rotate in an anti-clockwise direction at the given angles.	Stepper Motor interfacing to 8051 for rotating anti-clockwise	2	CO6
27	LLO 27.1 Design a water level controller using any suitable open-source simulation software to detect and control the water level in a tank.	Water Level Controller using 8051	2	CO6
28	LLO 28.1 Interface temperature sensor LM35 to 8051 to read the temperature, convert it to decimal and send the value to Port 0 with some delay.	Temperature Sensor interfacing to detect and measure temperature	2	CO6

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions to the project work and give a seminar presentation of it before submission. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- Build a class period bell using microcontroller 8051.
- Build a circuit using the 8051 microcontroller to blink the LED.
- Build a circuit to display numbers 0 to 9 with a given delay.
- Build a digital clock with an 8051 microcontroller.
- Develop a Fire Detection System using Smoke and Temperature sensors.

Student Activity

- Prepare a PowerPoint presentation on applications of microcontrollers.
- Undertake a market survey of different microcontrollers.

Assignment

- Prepare a chart of various features using data sheets of the 8051 microcontroller and its derivatives.
- Prepare a chart of the stepper motor to display its features and steps for its operations using data sheets.
- Prepare a chart of various types of ADC and DAC to display their features and pin functions using data sheets.
- Prepare a chart of various types of LCDs to display their features, pin functions and steps of operations using data sheets.
- Prepare a PowerPoint presentation on 8051 interfacing/applications.

VII. LABORATORY EQUIPMENT/ INSTRUMENTS/ TOOLS/ SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	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-up scans be stored.	13,16,23,24
2	4X4 LED matrix suitable to interface with 8051 trainer kit	17
3	7-segment LED Display	18
4	Relay trainer board suitable to interface with 8051 trainer kit	19
5	LCD trainer board	20
6	Keyboard: 4 x 4 trainer board	21
7	ADC(0808) trainer board	22
8	DAC (0808) trainer board	23,24
9	Stepper Motor: 50/100 rpm	25,26
10	Water level controller kit	27
11	Temperature Controller trainer board	28
12	Temperature Sensor LM35: 5V operating voltage, Operating temperature range (°C) -55 to 150, analog output	28
13	8051 Microcontroller kit: On-chip 64 KB ISP+IAP flash, 1KB SRAM, 5V operating voltage, 0 to 40 MHz 64 kB of on-chip Flash program memory	All
14	Desktop PC with microcontroller simulation software.	All

VIII. SUGGESTED FOR 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
SECTION I								
1	I	INTRODUCTION TO MICROCONTROLLERS & 8051 ARCHITECTURE	CO1	12	3	8	4	15
2	II	INSTRUCTION SET & ASSEMBLY LANGUAGE PROGRAMMING	CO2	12	2	4	6	12
3	III	TIMERS /COUNTERS AND INTERRUPTS	CO3	6	2	2	4	8
								35
SECTION II								
4	IV	SERIAL COMMUNICATION AND I/O PROGRAMMING	CO4	6	2	2	4	8
5	V	8051 INTERFACING	CO5	12	2	4	6	12
6	VI	APPLICATIONS OF THE 8051 MICROCONTROLLER	CO6	12	3	4	8	15
								35
Grand Total				60	14	24	32	70

IX. ASSESSMENT METHODOLOGIES /TOOLS

Formative assessment (Assessment for Learning)		Summative Assessment (Assessment of Learning)
1. Tests	4. Self-Learning	1. End Term Exam
2. Assignment	5. Term Work	2. Micro-project
3. Midterm Exam	6. Seminar/Presentation	

X. 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	1	1	1	-	1			
CO2	2	2	2	2	1	-	2			
CO3	2	2	2	1	1	1	2			
CO4	2	2	2	2	1	-	2			
CO5	2	3	2	2	1	2	2			
CO6	2	2	3	3	2	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at the institute level

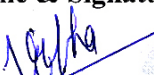



XI. SUGGESTED LEARNING MATERIALS/ BOOKS

Sr.No	Author	Title	Publisher with ISBNNumber
1	Mazidi Muhammad Ali, Mazidi Janice Gillispe, Mckinlay Rolin D	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Pearson Publication, 2017 ISBN: 9788131710265
2	Ayala Kenneth J	The 8051 Microcontroller	Thomson DelmarLearning, 2004, ISBN: 9781401861582
3	Deshmukh Ajay V	Microcontroller: Theory and Application	McGraw Hill, 2011 ISBN: 9780070585959
4	Pal Ajit	Microcontrollers: Principle and Application	PHI Learning, 2014 ISBN: 978812034394
5	Chattopadhyay Santanu	Microcontroller and Applications	All India Council for Technical Education, 2023 ISBN: 9788196057602

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://vlabs.iitkgp.ac.in/rtes/#	Keyboard-MCU interfacing takes input from keypad and displays it on the LCD
2	https://studytronics.weebly.com/8051microcontroller.html	8051 Microcontroller Architecture, Internal Memory, Instruction Set, Timers and Counters, Interrupts
3	https://archive.nptel.ac.in/courses/108/105/108105102/	S. Chattopadhyay, SWAYAM/NPTEL course on "Microprocessors and Microcontrollers"
4	https://sthcphy.files.wordpress.com/2015/09/stepper-motor-interfacing.pdf	Stepper Motor Interfacing with 8051
5	https://www.keil.com/download/product/	Introduction to KEIL tool for 8051 programming
6	https://www.dnatechindia.com/Interfacing-LCD-to-8051.html	Interfacing LCD to 8051
7	https://web.mit.edu/6.115/www/document/8051.pdf	MCS@51 Microcontroller family user's manual
8	https://econtent.msbtte.edu.in/econtent/marathi_econtent.php	Microcontroller and Applications Learning Material In Marathi-English

Note: Teachers are requested to check the Creative Commons license status/financial implications of the suggested online educational resources before use by the students

Name & Signature:  Smt. V.G. Mahindra Lecturer in E&TC		Name & Signature:  Smt. A.P. Ghode Programme Head	
(Course Experts)			
Name & Signature:  Dr. Y.V. Chavan (Programme Head)		Name & Signature:  Shri. S. B. Kulkarni (CDC In-charge)	

GOVERNMENT POLYTECHNIC, PUNE
'120- NEP'S SCHEME

PROGRAMME	DIPLOMA IN ET
PROGRAMME CODE	03
COURSE TITLE	COMPUTER NETWORK AND DATA COMMUNICATION
COURSE CODE	ET51203
PREREQUISITE COURSE CODE & TITLE	NA
CLASS DECLARATION COURSE	YES

I. LEARNING & ASSESSMENT SCHEME

Course Code	CourseTitle	Course Type	Learning Scheme						Credits	Assessment Scheme												Total Marks
			Actual Contact Hrs./Week			SLH	NLH	Paper Duration		Theory				BasedonLL&TSL				Basedon SL				
			CL	TL	LL					Practical												
										FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA				
																				Max	Max	
ET51203	COMPUTER NETWORK AND DATA COMMUNICATION	DSC	3	1	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150		

Total IKS Hrs for Term: 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, *#-Online Examination, @\$-Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

- If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment -Practical) of any course, then the candidate shall be declared as '**Detained**' in that course
- If a candidate does not secure minimum passing marks in **SLA** (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit **SLA** work.
- Notional learning hours** for the semester are **(CL+LL+TL+SL)hrs.*15Weeks**
- 1 credit** is equivalent to **30 Notional hours**.
- *Self-learning hours shall not be reflected in the Timetable.
- *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Computer Networks and Data Communication course for diploma engineering students aims to balance theoretical knowledge with practical application. The course begins with foundational concepts, progressing through each network layer, and culminates in hands-on learning and real-world applications. Diploma Engineers should be able to select, classify, install, troubleshoot and maintain different industrial data communication networks. This course gives the important concepts and techniques related to data communication and enable students to maintain and troubleshoot computer networks.

III. COURSE-LEVEL LEARNING OUTCOMES (CO'S)

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

CO1:- Analyze the functioning of Data Communication and Computer Network.

CO2:- Implement relevant Network Topology using Networking Devices.

CO3:- Select relevant transmission media and switching techniques for networking.

CO4:- Configure different TCP/IP services.

CO5:- Understand the functions of different network protocols.

CO6:- Compare IPV4 and IPV6

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
SECTION - I				
UNIT-I FUNDAMENTALS OF DATA COMMUNICATION AND NETWORK TOPOLOGY (CL Hrs-08, Marks-12)				
1.	<p>TLO1.1: Explain each components of data communication system.</p> <p>TLO1.2: Explain given data transmission methods.</p> <p>TLO 1.3: Classify network technologies based on transmission technologies, physical size and architecture.</p>	<p>1.1 Introduction to data communication</p> <p>1.2 Basic block diagram of data communication system</p> <p>1.3 Data Transmission: Serial, Parallel</p> <p>1.4 Mode of data transmission: Synchronous, Asynchronous</p> <p>1.5 Transmission characteristics: Signaling rate, data rate, bit rate, baud rate</p> <p>1.6 Need of computer networks, Network criteria, advantages of networking</p> <p>1.7 Network Classification: Based on Transmission Technologies: Point to-point, Multipoint, Broadcast Based on physical size(scale): PAN, LAN, MAN, WAN</p>	Classroom Learning, Reference books, NPTEL	CO1
UNIT - II TRANSMISSION MEDIA AND SWITCHING (CL Hrs-07, Marks-11)				
	<p>TLO 2.1 Explain with sketches the construction of a given type of cable.</p> <p>TLO 2.2 Explain with sketches the characteristics of the given type of unguided transmission media.</p> <p>TLO 2.3 Describe with sketches the working principle of the given Switching technique.</p> <p>TLO 2.4 Compare different Switching techniques on the given parameter.</p>	<p>2.1 Communication Media: Guided Transmission Media Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable</p> <p>2.2 Unguided Transmission Media: Radio Waves, Microwaves, Infrared, Satellite</p> <p>2.3 Line-of-Sight Transmission, Point-to-Point, Broadcast</p> <p>2.4 Switching: Circuit-switched network, Packet switched network</p>	Classroom Learning, Reference books, NPTEL	CO2

UNIT – III NETWORK TOPOLOGIES AND NETWORK DEVICES (CL Hrs-07,Marks-12)

	<p>TLO 3.1 Compare different computing models on the given parameter.</p> <p>TLO 3.2 Identify relevant network topology for the given situation.</p> <p>TLO 3.3 Compare different topologies on the given parameter.</p> <p>TLO 3.4 Select network connecting device for the given situation.</p> <p>TLO 3.5 Describe with sketches the procedure to configure the given networking device.</p>	<p>3.1 Network Computing Model: Peer To Peer, Client Server, advantages of Client Sever over Peer-to-Peer Model.</p> <p>3.2 Network Topologies: Introduction, Definition, Selection criteria, Types of Topology- Star ,Mesh, Tree, Hybrid</p> <p>3.3 Network Connecting Devices: Switch, Router, Repeater, Bridge, Gateways and Modem</p>	Classroom Learning, Reference books, NPTEL	CO3
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SECTION-II**UNIT IV-NETWORK REFERENCE MODELS (CL Hrs-09,Marks-11)**

4	<p>TLO 4.1: Compare ISO-OSI and TCP/IP model</p> <p>TLO 4.2: Explain addressing schemes in TCP/IP.</p> <p>TLO 4.3: Describe the function of the given layer of TCP/IP Reference model.</p>	<p>4.1 The ISO-OSI model (Functions of each Layer & Protocols used): Physical layer, Data Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, and Application Layer.</p> <p>4.2 TCP/IP Layers and their functions: Host To Network Layer, Internet Layer, Transport Layer, Application Layer</p>	Classroom Learning, Reference books, NPTEL	CO4
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UNIT V- Network Protocols (CL Hrs-07, Marks-12)

5	<p>TLO 5.1 Explain given protocols of internet layer</p> <p>TLO 5.2 Explain given protocols of Transport layer</p> <p>TLO 5.3 Describe given protocols of Application layer</p>	<p>5.1 Host To Network Layer protocols- SLIP, PPP</p> <p>5.2 Internet Layer protocols- IP, ARP, RARP</p> <p>5.2 Transport Layer Protocols -TCP and UDP</p> <p>5.3 Application Layer protocols - FTP, HTTP, SMTP, TELNET, BOOTP, DHCP</p>	Classroom Learning, Reference books, NPTEL	CO5
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UNIT VI- Network Addressing (CL Hrs-07,Marks-12)

6	<p>TLO 6.1 Classify IP Addresses on the basis of its class from the given set of addresses.</p> <p>TLO 6.2 Distinguish between IPv4 and IPv6 on the given parameters.</p> <p>TLO 6.3 Describe with sketches the procedure to configure the given TCP/IP service.</p>	<p>6.1 Addressing: Physical Address, Logical Address, Port Address</p> <p>6.2 IP Address- Concept, Notation, Address Space</p> <p>6.3 IPv4: header format</p> <p>6.4 IPv4 Addressing: Classful and Classless Addressing, subnet mask</p> <p>6.5 IPV6 header format and Addressing scheme</p> <p>6.6 Comparison IPv4 and IPv6.</p>	Classroom Learning, Reference books, NPTEL	CO6
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V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1*	Survey existing network infrastructure.	Identification of components of network in your Computer Network Lab.	02	CO1,3
2*	Identify the type of network topology used in your lab and prepare technical specification for it.	Analyse the type of network topology used in your lab and prepare technical specification for it.	02	CO1,3
3	Create bus topology and transfer data	Connect computers in bus topology and transfer the data.	02	CO2,3
4*	Create star topology and transfer data	Connect computer in star topology using wired medium.	02	CO2,3
5*	Use Network simulator CISCO packet tracer	Create Tree topology using CISCO packet tracer software	02	CO2,3
6*	Prepare of patch cord and cross connection cables, use to connect the devices on the LAN.	Preparation of patch cord and cross connection cables, use to connect the devices on the LAN.(RJ-45)	02	CO2,3
7*	Install network printer.	Installation of shared devices. (For e.g. printer)	02	CO2,3
8*	Transfer a file from one computer to another.	Sharing the file and folder in network.	02	CO4,5
9	Implement Wireless network	Implementation of Wireless network	02	CO1,2,3,6
10*	Test internet connectivity	Configure/Test Internet connectivity.	02	CO5
11	Configure router(Home or Small office home office Device)	Configuration for router (Home or Small office home office Device)	02	CO3
12*	Install wire-shark software and configure it as a packet sniffer	Installation of wire-shark software and configure it as a packet sniffer	02	CO4,5
13*	Use wire shark packet sniffer software.	Create a network based on IPv6 address using a simulator	02	CO6
14*	Configure IP address (Statically and Dynamically)	Configure IP address (Statically and Dynamically)	02	CO6
15*	Troubleshoot computer network using commands	Run network diagnostic commands : ipconfig, ping ,tracert, netstat, route	02	CO5
16*		Visit to any one Industries to observe computer networking	02	all

Note: A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the Cos and competency. A judicious mix of a minimum of 12 or more practical needs to be performed. Out of which, the Practical's marked as '*' are compulsory.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Microproject

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In special situations where group share to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs (Affective Domain Outcomes). Each student will have to maintain an activity chart consisting of individual contributions to the project work and give a seminar presentation of it before submission. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- Install and configure NIC and find MAC Address of Device
- Design a network using any topology and do fault identification
- Create a tool that monitors network bandwidth usage in real-time

Assignment/Activity

- Make a chart for identification of different topology.
- Market survey regarding different computer networking devices.
- Give a seminar on any relevant topic.
- Collect information of wired and wireless network.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Desktop Computer with basic configuration	All
2	Network Tool Kit: Crimping Tool for RJ-45 connector, 3 in 1 modular crimping tool for RJ-45 UTP CAT-5/CAT-6 Networking Cable, LAN Cutter 8P/6P/4P All-in-One or similar, Cable Tester/LAN Tester (Specification: Network Cable Tester for LAN RJ-45/CAT5/CAT6 UTP Wire Test Tool or similar)	All
3	Network Accessories: RJ45 connector, UTP cable, optical fiber cable, Coaxial cable, various connectors, 1000Mbps NIC	All
4	Network Printer	7

VIII. SUGGESTED FOR 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
Section-I								
1	I	Fundamentals Of Data Communication And Network Topology	CO1	08	4	4	4	12
2	II	Transmission Media And Switching	CO2	07	4	4	4	11
3	III	Network Topologies And Network Devices	CO3	07	2	3	6	12
Total								35
Section-II								
4	IV	Network Reference Models	CO4	09	4	4	4	11
5	V	Network Protocols	CO5	07	4	4	4	12
6	VI	Network addressing	CO6	07	2	3	6	12
Total								35
Grand Total				45	20	22	28	70

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)			Summative Assessment (Assessment of Learning)		
1. Tests	4. Self-Learning		1. End Term Exam		
2. Assignment	5. Term Work		2. Micro-project		
3. Midterm Exam	6. Seminar/Presentation				

X. 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	1	3	2	-	2	3	-	-	-
CO2	-	-	-	1	-	2	3	-	-	-
CO3	1	-	1	2	-	2	3	-	-	-

Legends: -High:03, Medium:02, Low:01, No Mapping:-




*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	A.S.Godbole	Data Communication and Networking	McGraw- Hill, 2nd Edition, June 13, 2011 ISBN: 9780071077705
2	Andrew S. Tanenbaum	Computer Networks	Prentice Hall, 5th Edition, January 2010 ISBN: 978-9332576223
3	Behrouz A. Forouzan	Data Communication and Networking	McGraw-Hill Higher Education, 4th Edition, January 2007 ISBN: 978-0072967753
4	Bobbi Sandberg	Networking The Complete Reference	Tata McGraw Hill, 3rd Edition, June 24, 2015 ISBN: 9339222199 • 789339222192

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link/Portal	Description
1.	https://www.tutorialspoint.com/data_communication_computer_network/index.htm	Data Communication and Computer Network
2.	https://nptel.ac.in/courses/106105183	Computer Networks and data communication
3.	https://www.geeksforgeeks.org/data-communication-definition-components-types-channels/	Data Communication-Definition, types and components
4.	https://nptel.ac.in/courses/106105081	Computer Networks and data communication

Name & Signature:  P.G. Gahukar Lecturer in E&TC (Course Experts)	
Name & Signature:  Dr. Y.V. Chavan (Programme Head)	Name & Signature:  Mr. S.B. Kulkarni (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMA IN ET
PROGRAMME CODE	03
COURSE TITLE	ELECTRONIC EQUIPMENT MAINTENANCE AND SIMULATION
COURSE CODE	ET41201
PREREQUISITE COURSE CODE & TITLE	NA
CLASS DECLARATION COURSE	YES

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											Total Marks
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TSL				Based on SLA			
			CL	TL	LL					FA-TH	SA-TH	Total	Practical		FA-PR	SA-PR				
													Max	Min					Max	
																	Max	Min		
ET41201	ELECTRONIC EQUIPMENT MAINTENANCE AND SIMULATION	SEC	--	--	4	--	4	2	--	--	--	--	50	20	50#	20			--	--

Total IKS Hrs for Term: 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, *# - Online Examination, @\$ - Internal Online Examination

Note:

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

II. RATIONALE:

Introducing a course on the Indian Constitution can provide students with a comprehensive understanding of the country's legal framework and democratic principles. Such a course could cover the historical context of its creation, the structure and functions of the government it establishes, and the fundamental rights and duties of citizens. It could also explore the significant amendments and judicial interpretations that have shaped its evolution over time. This foundational knowledge is not only for fostering informed and engaged citizens who can contribute to the nation's democratic processes but also enriches the educational experience by fostering a sense of national identity and ethical responsibility among future engineers. Furthermore, embedding Electoral Literacy and Voter Education in diploma engineering programs strategically empowers these future professionals with an awareness of their electoral privileges and the workings of democracy.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's):

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Choose a maintenance policy for specified Equipment/Appliances/Gadgets.

CO2: Select troubleshooting tools for the given electronic equipment.

CO3: Comprehend the distribution of legislative, executive, and financial powers between the Union and the State Maintain electronic appliances and laboratory equipment.

CO4: Test the performance of electronic circuits using simulation tools.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I ELECTRONIC EQUIPMENT MAINTENANCE MANAGEMENT (CL HRS-NIL, MARKS -NIL)				
1	TLO 1.1 Describe different types of electronic maintenance. TLO 1.2 Explain the maintenance policy for the given equipment. TLO 1.3 Choose the service option for the maintenance of the given equipment with justification. TLO 1.4 Illustrate the procedure to install application software. TLO 1.5 Differentiate maintenance and troubleshooting process of equipment.	1.1 Objective of maintenance management service, types of maintenance: preventive, predictive, & corrective maintenance 1.2 Maintenance policy: Concept of warranty and guarantee, equipment service options 1.3 Interpretation of the service and operation manuals, software installation procedure and policies 1.4 Maintenance versus troubleshooting versus calibration. 1.5 Fault finding tools and instruments 1.6 troubleshooting technique and measures 1.7 S/W installation procedure and policies.	Classroom Learning, Reference books, NPTEL	CO1
UNIT-II FUNDAMENTALS OF TROUBLESHOOTING (CL HRS-NIL, MARKS -NIL)				
2	TLO 2.1 Describe the circuit and wiring diagram of the given equipment. TLO 2.2 Illustrate general troubleshooting procedure. TLO 2.3 Identify with proper justification the use of relevant tools for troubleshooting of given equipment. TLO 2.4 Choose the relevant measure to troubleshoot the given equipment with justification.	2.1 Block, circuit, wiring/line diagram of available equipment 2.2 General troubleshooting procedure 2.3 General troubleshooting techniques 2.4 Fault-finding tools, test and measuring instruments, temperature-sensitive intermittent problems and corrective actions, situations where repairs should not be attempted 2.5 General troubleshooting measure	Classroom Learning, Reference books, NPTEL	CO2

UNIT-III MAINTENANCE OF ELECTRONIC EQUIPMENT (CL HRS-NIL, MARKS -NIL)				
3	<p>TLO 3.1 Illustrate common steps of maintenance of given home appliances.</p> <p>TLO 3.2 Describe common steps of installation of UPS and DTH.</p> <p>TLO 3.3 Explain the working procedure of the given laboratory equipment using It's a block diagram.</p> <p>TLO 3.4 State the principle of power generation of solar PV cells.</p> <p>TLO 3.5 Write the installation procedure of the CCTV Surveillance system.</p> <p>TLO 3.6 Explain the block diagram of the central processing unit.</p>	<p>3.1 Electronic appliances: Maintenance of home appliances, battery charger, water level controller, emergency light system, SMPS, Public address (PA) system.</p> <p>3.2 Installation, operation, and fault finding of offline/online. uninterruptible power supply (UPS).</p> <p>3.3 Laboratory equipment: Operation and testing of meter, electrometer, and voltmeter.</p> <p>3.4 Installation and testing of solar power system</p> <p>3.5 Installation and testing of surveillance system.</p> <p>3.6 Assembling of computer system.</p>	<p>Classroom Learning, Reference books, NPTEL</p>	CO3
UNIT-IV SIMULATION SOFTWARE (CL HRS-NIL, MARKS -NIL)				
4	<p>TLO 4.1 State need for EDA tools.</p> <p>TLO 4.2 Describe the procedure to create a new file in the given EDA tool software.</p> <p>TLO 4.3 Design given analog circuits using EDAtool.</p> <p>TLO 4.4 Sketch given Digital and Op-Amp-based circuits using the EDA tool.</p> <p>TLO 4.5 Design real-life applications using any simulation software</p>	<p>4.1 Introduction to Electronic Design Automation (EDA) tools, need of simulation software.</p> <p>4.2 MATLAB or others.</p> <p>4.3 Main features of EDA tool: Open file, create a new file, run, simulation, virtual instrument, edit windows, functions, controls, file formats and report generation</p> <p>4.4 Circuit analysis: Analog circuits (RL, RC, RLC), OpAmp-based circuits (inverting/non-inverting amplifiers), digital circuits (adder, multiplexer and flip flops)</p> <p>4.5 Simulation of various real-life applications like water level controller, and temperature controller.</p>	<p>Classroom Learning, Reference books, NPTEL</p>	CO4

COURSE TITLE : ELECTRONIC EQUIPMENT MAINTENANCE AND SIMULATION COURSE CODE :ET41201

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

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles/Tutorial Titles	Number of hrs.	Relevant COs
1*	Prepare the work order for the maintenance of electronic equipment	Preparation of work order for the maintenance of electronic Equipment.	02	CO1
2	Prepare Bin cards for the maintenance of given electronic equipment.	Preparation of Bin cards for the maintenance of given electronic equipment.	02	CO1
3*	Test electronic components such as loudspeakers, microphones, relays, solenoids, switches, etc. in equipment.	Performance of electronic components	02	CO2
4*	Test the performance of the given stepper motor	The performance of the given stepper motor.	02	CO2
5*	Rectify the fault of the regulated power supply.	Troubleshooting the regulated power Supply	02	CO3
6*	Rectify the fault of a tachometer.	Troubleshooting of speed measuring device	02	CO3
7	Troubleshoot the photovoltaic solar panel power system.	Troubleshooting the photovoltaic solar panel power system.	02	CO3
8*	Install DTH unit	Installation of DTH System.	02	CO3
9*	Troubleshoot the data projector	Troubleshooting of the data projector	02	CO3
10*	Assemble various parts of the computer system and install the operating system, applications software and antivirus.	Assembling various parts of the computer system and installing an operating system, applications software and antivirus.	02	CO3
11*	Install offline/online UPS.	Installation of online/offline UPS.	02	CO3
12	Test the performance of online/offline UPS.	Installation of offline/online UPS.	02	CO3
13*	Install a CCTV network on the institute premises.	Installation of CCTV.	02	CO3
14*	Install and Test solar power system.	Installation and testing of solar power System.	02	CO3
15*	Rectify the fault of the function generator.	Troubleshooting of function generator.	02	CO3
16	Rectify the fault of SMPS.	Troubleshooting of SMPS	02	CO3
17	Rectify the fault of DSO.	Troubleshooting of DSO.	02	CO3
18*	Install the available EDA tool software.	Installation of EDA tool.	02	CO4
19*	Measured AC voltage and current in RL, RC, and RLC circuits using EDA tools.	Measurement of AC voltage and current in RL, RC, and RLC circuits using EDA tools	02	CO4
20*	Test the output of regulated power supply circuit at different points using the EDA tool.	Simulation of the regulated power supply using the EDA tool.	02	CO4
21	Test the output of the half-wave rectifier circuit using the EDA tool.	Simulation of Half-Wave rectifier circuit using EDA tool.	02	CO4

COURSE TITLE : ELECTRONIC EQUIPMENT MAINTENANCE AND SIMULATION COURSE CODE :ET41201

Sr. No	Practical/Tutorial/Laboratory Outcome (LLO)	Learning	Laboratory Experiment / Practical Titles/Tutorial Titles	Number of hrs.	Relevant COs
22*	Test the output of full wave bridge rectifier circuit using the EDA tool.		Simulation of full-wave bridge rectifier circuit using the EDA tool	02	CO4
23*	Simulate inverting amplifier using IC741.		Simulation of the inverting amplifier using IC741.	02	CO4
24	Simulate non-inverting amplifier using IC741.		Simulation of non-inverting amplifier using IC741.	02	CO4
25*	Simulate half adder circuit to verify the truth table.		Simulation of half adder circuit to verify the truth table.	02	CO4
26*	Simulate full adder circuit to verify the truth table		Simulation of full adder circuit to verify the truth table	02	CO4
27*	Simulate 8:1 multiplexer circuit to verify the truth table		Simulation of 8:1 multiplexer circuit to verify the truth table	02	CO4
28*	Simulate 1:8 demultiplexer circuit to verify the truth table.		Simulation of 1:8 demultiplexer circuit to verify the truth table.	02	CO4
29*	Simulate the JK flipflop circuit to verify the truth table.		Simulation of JK flipflop circuit to verify the truth table.	02	CO4
30*	Simulate the RS flipflop circuit to verify the truth table.		Simulation of RS flipflop circuit to verify the truth table.	02	CO4
<p>Note: Out of the above suggestive LLOs -</p> <p>* Marked Practicals (LLOs) Are mandatory.</p> <p>A minimum of 80% of the above list of lab experiments are to be performed.</p> <p>Judicial mix of LLOs is to be performed to achieve desired outcomes.</p>					

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING):

NOT APPLICABLE

VII. LABORATORY EQUIPMENT/ INSTRUMENTS/ TOOLS/ SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	UPS Standby UPS: 5-12 ms, – average 8 ms Line-interactive UPS: 3- 8ms – average 5 ms The double conversion has a zero-second transfer time.	12
2	CCTV system Set up of CCTV installation sample-(4 CH DVR ,hard disk 500GB,IR dome camera, video cable, power supply (12V,1 Amp), regulated for controller and driver circuit, 4 CCTV cameras along with the digital video recorder (DVR).	13

COURSE TITLE : ELECTRONIC EQUIPMENT MAINTENANCE AND SIMULATION COURSE CODE :ET41201

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
3	Solar Power Trainer Kit Solar training kit/simulator with built-in meters for DCV, DCA, AC multifunction meter 9 for ACI, ACV power frequency, protection circuits, BS-10 terminals for making the connection, single/dual axis tracking system.	14
4	Function generator Frequency Output: 15 MHz - sine, square & triangle. 6 MHz - pulse, TTL and arbitrary. Output Channels: 2, Channels sampling rate: 266 MSa/S (vertical resolution - 14 Bits) Waveforms: sine, square, pulse (adjustable duty cycle, precise adjustment of pulse width & period), triangular Wave	15
5	SMPS power supply Input voltage: AC 100 - 240V 50 / 60Hz Output voltage: 24V DC, 5A Adjustment range: $\pm 20\%$	16
6	Cathode ray oscilloscope Bandwidth: 0 to 15 MHz Mode: auto/level/free run Power : 230 V $\pm 10\%$ 50 Hz 30W	17
7	Digital Storage Oscilloscope 100MHz DSO with colour display, 1GSa/Sec sampling rate, USB PC interface cable and software, with USB device & host	18
8	Simulation software like e-sim, Multisim, Scilab, SPICE simulator, LabVIEW, Proteus, MATLAB or any other.	19,20,21,22,23,24,25,26,27,28
9	Microphone and loudspeaker characteristics trainer kit On board Meters : dB meter Range : 40-80dB, 80-120dB	3
10	Multimeter 3 ½ -digit display with AC and DC voltage and current measurement facility, Diode, resistor, and capacitor testing facility.	3,15,17,18
11	Regulated power supply Range: 0-30 V, 0-2 A DC	3,5
12	Tachometer Voltage: ± 5 V, 0 - 10 V, etc. Current: 0 - 20 mA, 4 - 20 mA, 10 - 50 mA, etc.	6
13	Clamp-on ammeter AC: 40.00 A / 400.0 A Continuity: $\leq 30\Omega$ Capacitance: 0 to 100.0 μ F / 100 μ F to 1000 μ F Frequency: 5.0 Hz to 500.0 Hz	7

VIII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Each practical will be assessed considering: - 60% weightage to process and 40% weightage to product.	End of the term assessment, Viva-voce, workshop / Lab performance.

IX. 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	--	--	--	--	2			
CO2	2	2	--	--	--	--	2			
CO3	2	2	2	3	2	--	2			
CO4	2	2	3	3	--	--	2			

Legends:- High:03, Medium:02, Low:01, No Mapping: --

*PSOs are to be formulated at the institute level


X. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Khandpur R.S.	Troubleshooting electronic equipment	McGraw Hill, 2006
2	Tomal Daniel R., Ph.D. Agajanian Aram S., Ph.D.	Electronic Troubleshooting	McGraw Hill, 2014 ISBN: 9780071828611
3	Singh Sudeep K.	Troubleshooting & Maintenance of Electronic Equipment	S K Kataria and Sons, 2008 ISBN: 9789381348178
4	Kumar Ashok L, Indra Gandhi V. Maheswari Uma Y.	Software Tools for the Simulation of Electrical Systems.	Academic Press, 2020 ISBN: 9780128194164
2	Tomal Daniel R., Ph.D. Agajanian Aram S., Ph.D.	Electronic Troubleshooting	McGraw Hill, 2014 ISBN: 9780071828611

XI. LEARNING WEBSITES & PORTALS

Sr. No.	Link/Portal	Description
1.	https://www.eit.edu.au/resources/practical-troubleshooting-o	https://www.eit.edu.au/resources/practical-troubleshooting-o
2.	http://www.kicad-pcb.org	http://www.kicad-pcb.org
3.	https://www.multisim.com/	https://www.multisim.com/
4.	https://esim.fossee.in/downloads	https://esim.fossee.in/downloads


Name & Signature:


Smt.C.D.Pophale
Lecturer in E&TC
(Course Experts)

Name & Signature:


Dr.Y.V.Chavan
(Programme Head)

Name & Signature:


Shri. S.B. Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMA IN CE/EE/ET/ME/MT/CM/IT/DDGM
PROGRAMME CODE	01/02/03/04/05/06/07/08
COURSE TITLE	SOCIAL AND LIFE SKILLS
COURSE CODE	HU21204
PREREQUISITE COURSE CODE & TITLE	NA
CLASS DECLARATION COURSE	NO

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme												Total Marks
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TSL				Based on SL				
			Practical																		
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
												Max	Min	Max	Min	Max	Min	Max	Min		
	SOCIAL AND LIFE SKILLS	VEC	1	--	2	1	4	2	--	--	--	--	25	10	--	--	25	10	50		

Total IKS Hrs for Term: 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,*# - Online Examination,@\$ - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

- If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
- If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
- Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
- 1 credit** is equivalent to **30 Notional hours**.
- * Self-learning hours shall not be reflected in the Timetable.
- * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

The introduction of a social and life skills course for diploma engineers is indeed a significant step forward in shaping well-rounded professionals. By integrating soft skills training with technical education, this curriculum addresses the growing need for engineers who are not only experts in their field but also adept in interpersonal communication, collaboration, and leadership. Such skills are crucial for success in the modern workforce, where the ability to navigate complex social dynamics can be just as important as technical know-how. Moreover, the emphasis on ethical decision-making prepares engineers to approach their work with integrity and responsibility. As these professionals progress in their careers, the benefits of this comprehensive education will manifest in their ability to innovate, lead, and contribute positively to their communities and the broader society. This forward-thinking approach ensures that the engineers of tomorrow are equipped not just with the tools to excel in their careers, but also with the vision to drive societal progress.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Achieve shared goals through effective teamwork in executing sustainable community development projects.

CO2: Improve cooperation and understanding through refined communication skills.

CO3: Encourage ethical choices and compassionate behaviour by nurturing moral values.

CO4: Foster ethical judgment, honesty, and societal accountability to shape principled and conscientious professionals.

CO5: Equip students with practical financial literacy skills for efficient financial management.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I ENGAGEMENTS WITHIN UNNAT MAHARASHTRA ABHIYAN (UMA) (CL Hrs-03, Marks-NIL)				
1.	<p>TLO1.1: Recognize the importance of addressing societal needs and involving relevant stakeholders in problem-solving efforts.</p> <p>TLO1.2: Integrate academia, society, and technology to devise comprehensive solutions for complex societal issues.</p> <p>TLO1.3: Enhance communication and negotiation skills to effectively engage stakeholders, ensuring diverse perspectives and productive collaboration in problem-solving.</p> <p>TLO1.4: Utilize critical data sources such as economic surveys, and environmental data to guide decision-making and solution development in problem-solving endeavours.</p> <p>TLO1.5: Identify key stakeholders and delineate their roles and interests in addressing societal challenges.</p> <p>TLO1.6: Identify essential attributes for measurement in the problem-solving process.</p> <p>TLO1.7: Explore diverse tools and templates for data</p>	<p>1.1 Identifying Regional Societal Challenges: Recognizing Community Needs Requiring Engineering Solutions.</p> <p>1.2 Integrating Multidisciplinary Approaches: Linking Academia, Society, and Technology</p> <p>1.3 Involving Diverse Stakeholders: Engaging Various Actors in the Problem-Solving Process</p> <p>1.4 Accessing Secondary Data Sources: Utilizing Resources like Census and Economic Surveys</p> <p>1.5 Mapping Problems and Stakeholders: Understanding Activities' Relevance to System Components and Key Stakeholders</p> <p>1.6 Defining Measurement Metrics: Identifying Essential Attributes for Evaluation</p> <p>1.7 Employing Data Collection Tools: Exploring Surveys and Measurement Equipment</p> <p>1.8 Establishing Measurement Standards: Developing Survey Forms and Piloting Processes</p> <p>1.9 Conducting Field Surveys: Quantifying Local Systems such as Agriculture and Transportation</p> <p>1.10 Analyzing Data and Creating Reports: Summarizing Data and</p>	<p>Considering the unit design, it's vital to consider the following factors during the implementation of the unit:</p> <p>i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort.</p> <p>ii) Allocate multiple student groups evenly among all faculty members involved in the course.</p> <p>iii) A team of course faculty will visit local governing bodies like Municipal Corporations, Villages, Panchayats, Zilla Parishads, and Panchayat Samitis to assess small-scale technological or engineering needs within their jurisdiction.</p> <p>iv) The team of course instructors will conduct initial field visits to explore various scenarios and options</p>	CO1

	<p>collection, including surveys and measurement equipment.</p> <p>TLO1.8: Establish a structured framework for measuring identified attributes, including the development of survey forms and piloting the measurement process.</p> <p>TLO1.9: Gain practical experience in conducting fieldwork to gather primary data, such as agricultural output, rainfall, and transportation networks.</p> <p>TLO1.10: Develop proficiency in data analysis to draw meaningful conclusions, informing decision-making and solution development processes.</p>	<p>Reflections in Reports, Utilizing Various Formats like Tables and Graphs</p>	<p>for student-led fieldwork to assess and quantify different parameters and characteristics.</p> <p>a) Session I will introduce the development approach, fieldwork methodology, and the utilization of case studies as instructional tools.</p> <p>b) Sessions II - VII will cover topics such as societal dynamics, stakeholder engagement, value creation, establishing metrics, basic analysis, and preliminary reporting.</p> <p>c) Session VIII will wrap up the program with feedback collection and assessment.</p> <p>d) Field Work:</p> <ol style="list-style-type: none"> 1. Pilot Visit - Testing the survey instrument 2. Survey Visit 1 - Gathering data/information Survey. 3. Visit 2- Further data collection. 4.Summary Visit- Concluding activities post-analysis. 	
UNIT - II NATIONAL SERVICE SCHEME (NSS) (CL Hrs-03, Marks- NIL)				
2	<p>TLO2.1: Enhance communication and leadership abilities to effectively interact with local leaders.</p> <p>TLO2.2: Develop proficiency in conducting socio-economic surveys using appropriate data collection techniques and analysis methods to understand community needs.</p> <p>TLO2.3: Identify suitable villages and devise activity plans based on community</p>	<p>2.1 Engaging with Village/Area</p> <p>2.2 Conducting initial socio-economic surveys in nearby villages.</p> <p>2.3 Selecting villages for adoption and initiating project activities.</p> <p>2.4 Conducting thorough socio-economic surveys in the adopted village or area.</p> <p>2.5 Identifying key issues and challenges within the community.</p> <p>2.6 Raising awareness about advancements in agriculture, watershed management, wasteland reclamation, renewable energy, affordable housing, sanitation,</p>	<p>Considering the unit design, it's vital to consider the following factors during the implementation of the unit:</p> <p>i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort.</p> <p>ii) Allocate multiple student groups evenly among all faculty members involved in the course.</p>	CO2

	<p>needs and available resources.</p> <p>TLO2.4: Analyze survey findings to discern socio-economic patterns, obstacles, and potential avenues for progress.</p> <p>TLO2.5: Prioritize community issues according to their significance and impact on community welfare.</p> <p>TLO2.6: Communicate information on agriculture, watershed management, renewable energy, housing, sanitation, nutrition, and hygiene effectively.</p> <p>TLO2.7: Cultivate networking and advocacy skills to foster collaboration among government agencies, development organizations, and the community.</p>	<p>nutrition, and personal hygiene. Also, informing about skill enhancement programs, income generation opportunities, government initiatives, legal aid, consumer rights, and related topics.</p> <p>2.7 Facilitating collaboration between the government and development agencies to implement various schemes in the adopted village or slum.</p>	<p>iii) Before selecting a village or slum for NSS activities, it's advisable for teachers to conduct an initial visit.</p> <p>iv) The selected area should have a dense population.</p> <p>iv) Community members should exhibit a willingness to improve their living conditions and actively engage in projects initiated by the NSS for their benefit.</p> <p>vi) NSS units should avoid areas with a history of political conflicts.</p> <p>vii) The chosen area should be conveniently accessible for NSS volunteers to conduct regular visits to the slums.</p>	
UNIT - III UNIVERSAL HUMAN VALUES (CL Hrs-03, Marks- NIL)				
3	<p>TL03.1: Apply love and compassion to promote harmony and well-being.</p> <p>TL03.2: Demonstrate honesty and transparency to build trust and authenticity.</p> <p>TL03.3: Utilize non-violent approaches to resolve conflicts and enhance empathy.</p> <p>TL03.4: Align actions with moral principles to promote justice and fairness.</p> <p>TL03.5: Employ peace-building strategies for harmony and reconciliation.</p> <p>TL03.6: Engage in acts of service to cultivate empathy and social responsibility.</p> <p>TL03.7: Prioritize others' needs to foster altruism and generosity.</p>	<p>4.1 Exploring Love and Compassion (Prem and Karuna): Learning about and embodying the principles of love and compassion in daily life.</p> <p>4.2 Embracing Truth (Satya): Understanding the significance of truthfulness and integrating it into one's actions and interactions.</p> <p>4.3 Embracing Non-Violence (Ahimsa): Understanding the importance of non-violence and applying it in personal and societal contexts.</p> <p>4.4 Upholding Righteousness (Dharma): Exploring the concept of righteousness and practising it through ethical conduct and moral values.</p> <p>4.5 Cultivating Peace (Shanti): Reflecting on the essence of peace and cultivating</p>	<p>Proposed Learning Approaches for:</p> <p>i) Lecture Delivery</p> <p>ii) Demonstrations</p> <p>iii) Case Studies</p> <p>iv) Role-playing exercises</p> <p>v) Observational Learning</p> <p>vi) Portfolio Development</p> <p>vii) Simulations</p> <p>viii) Inspirational Talks from Industry Professionals</p> <p>ix) On-site Visits to sites or Industries</p>	CO3

	<p>TL03.8: Exhibit behaviours that uphold gender equality and respect for diversity to create an inclusive</p>	<p>inner tranquillity while promoting harmony in relationships and communities.</p> <p>4.6 Embracing Service (Seva): Understanding the value of selfless service and actively engaging in acts of kindness and support for others.</p> <p>4.7 Embracing Renunciation (Sacrifice) Tyaga: Understanding the concept of renunciation and willingly letting go of self-interest for the greater good. and attitudes.</p> <p>4.8 Promoting Gender Equality and Sensitivity: Recognizing the importance of gender equality and fostering an environment of inclusivity and respect for all genders through actions and attitudes.</p>		
UNIT - IV VALUE EDUCATION (UNNATI FOUNDATION) (CL Hrs-03, Marks- NIL)				
4	<p>TLO4.1: Display comprehension of one's own identity, values, and beliefs.</p> <p>TLO4.2: Recognize and express personal strengths and weaknesses effectively.</p> <p>TLO4.3: Demonstrate adeptness in active listening by providing feedback and demonstrating empathy.</p> <p>TLO4.4: Acquire strategies for handling conflicts constructively and respectfully.</p> <p>TLO4.5: Assess and reflect on moral values and principles that influence personal actions and choices.</p> <p>TLO4.6: Analyze and assess the moral values and principles guiding individual actions and decisions.</p>	<p>4.1. Self-awareness and Personal Development Self-understanding, Identification of strengths and weaknesses, Setting goals and devising plans, Building self-esteem and confidence</p> <p>4.2. Interpersonal Skills and Effective Communication Engaging in active listening, Resolving conflicts, Cultivating healthy relationships</p> <p>4.3. Ethics and Morality Grasping ethical concepts, Upholding moral values and principles, Making ethical decisions, Demonstrating integrity and honesty</p> <p>4.4. Social Values and Responsibility Being punctual and initiating conversation, Managing emotions effectively, Introducing oneself and others, Maintaining a positive attitude Valuing family bonds, Creating favourable impressions,</p>	<p>i) Video Demonstrations ii) Flipped Learning Environment iii) Case Studies iv) Role-playing Activities v) Group-based Learning vi) Team-based Learning vii) Utilization of Chalkboard</p>	CO4

		Communicating effectively, Emphasizing cleanliness, hygiene, and organization, Expressing preferences, Fostering confidence Enhancing listening skills, Demonstrating appropriate greetings, Promoting gender equality and sensitivity, Exercising responsibility, Integrating visual and verbal learning, Establishing and pursuing goals, Observing social media etiquette, Efficiently managing time and daily routines		
UNIT - V FINANCIAL LITERACY (CL Hrs-03, Marks- NIL)				
5	<p>TLO5.1:Comprehending Savings and Investment Practices.</p> <p>TLO5.2:Cultivating Proficiency in Financial Planning.</p> <p>TLO 5.3:Developing Competence in Transaction Handling.</p> <p>TLO5.4:Achieving Proficiency in Income, Spending, and Budget Management.</p> <p>TLO 5.5:Attaining Understanding of Inflation Concepts.</p> <p>TLO 5.6: Fostering Competence in Loan Administration.</p> <p>TLO5.7: Acknowledging the Significance of Insurance.</p>	<p>5.1. Fundamentals of Finances: Grasping concepts of income, expenses, and savings, Employing budgeting techniques, Understanding assets and liabilities, and Recognizing the significance of emergency funds.</p> <p>5.2. Banking Essentials Initiating and managing bank accounts, Familiarizing oneself with various account types (savings, checking, etc.), Comprehending interest rates, and Safely utilizing ATMs.</p> <p>5.3. Management of Credit and Debt Interpreting credit scores and reports, Identifying different credit types (credit cards, loans, etc.), Responsible debt management, and Preventing involvement in predatory lending.</p> <p>5.4. Foundations of Investment Understanding investment types (stocks, bonds, mutual funds, etc.), Assessing risk and return, Implementing diversification strategies, and Formulating investment approaches.</p> <p>5.5. Financial Planning and Goal Establishment Establishing financial objectives, Crafting a personalized financial blueprint, Continuously monitoring and adjusting financial goals, and Engaging in long-term financial</p>	<p>i) Video Demonstrations ii) Presentations iii) Case Studies iv) Chalkboard Utilization v) Collaborative Learning</p>	CO5

		<p>strategizing.</p> <p>5.6. Consumer Rights and Duties Familiarizing oneself with consumer entitlements, Safeguarding against financial scams and fraudulent activities Exercising responsible borrowing and spending practices, Upholding financial privacy and security measures.</p> <p>5.7. Essentials of Insurance Exploring different insurance categories (health, life, auto, home, etc.), Understanding insurance policy specifics, Recognizing the importance of insurance coverage, and Navigating the insurance claims process.</p> <p>5.8. Economic Literacy Grasping fundamental economic principles, Understanding the concepts of inflation and deflation, Analyzing market trends, and Interpreting economic indicators.</p>		
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V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO1.1: Communicating and interacting with residents or children with compassion and empathy, demonstrating an understanding of their needs and emotions.	1.1 Encouraging empathy and kindness through volunteer work at: i) a nearby nursing home ii) a care centre for children from disadvantaged families or similar types of facilities.	2	CO3
2	LLO 2.1 Enhance goal-setting abilities by engaging in collaborative planning, analyzing obstacles, and reflecting on personal aspirations to align them with broader academic or career goals.	2.1 Pathway to Success: Goal-Setting Exercise	2	CO4
3	LLO3.1: Develop effective communication skills by demonstrating compassion, empathy, and understanding towards residents or children, while acknowledging and addressing their needs and emotions.	3.1 Exploring Your Inner World: Self-Reflection Activity	2	CO4
4	LLO4.1: Laboratory Learning Outcome: Cultivate structured self-reflection skills to assess personal strengths and weaknesses.	4.1 Strengths and Weaknesses Identification and Analysis Exercise	2	CO4

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
5	LLO 5.1: Display proficiency in time management through the creation and adherence to structured timelines for task coordination.	5.1 Time Management Simulation for Coordinating Industrial Visits	2	CO4
6	LLO 6.1: Demonstrate competency in social media etiquette through engaging in activities and adhering to established norms and guidelines.	6.1 Activity on Social Media Etiquette	2	CO4
7	LLO 7.1: Develop skills in mapping and analyzing family income and expenses through structured exercises.	7.1. Exercise on Mapping and Analyzing Family Income and Expenses	2	CO5
8	LLO 8.1: Apply their knowledge of interest rate calculation to real-world financial situations, improving decision-making skills.	8.1 Exploring Simple and Compound Interest: A Hands-On Exercise on Interest Rate Calculation and Its Impact on Savings and Loans.	2	CO5
9	LLO9.1: Enhance comprehension of interest rates and their impact on financial dealings, encompassing savings accounts, Fixed Deposits (FDs), and loans.	9.1 Interest Rate Comparison Exercise: Analyzing Rates for Savings, Fixed Deposits, and Loans.	2	CO5
10	LLO10.1: Mastering and implementing safety protocols for ensuring secure ATM transactions.	10.1 Safety Precautions for ATM Usage: Exploring Tips for Secure Transactions	2	CO5

Note: Out of the above suggestive LLOs –

1. A judicious mix of LLOs is to be performed to achieve the desired outcomes

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

SELF-LEARNING - MICRO PROJECT/ASSIGNMENT/ACTIVITIES (ANY ONE)

The following list provides examples of activities that can be pursued under the program. Each group has the flexibility to choose from these options or undertake any other activity deemed suitable based on local requirements. The group focuses on the holistic development of the selected area, whether it is a village or a slum.

a) Community clean-up drives

Group tasks for community clean-up drives are,

1. Site Survey and Planning: Identify areas needing attention and plan tasks.
2. Logistics Management: Coordinate supply distribution to volunteers.
3. Volunteer Coordination: Welcome, register, and assign tasks to volunteers.
4. Trash Collection and Segregation: Collect and sort waste into categories.
5. Street Sweeping and Cleaning: Sweep and clean streets, sidewalks, and public areas.
6. Beautification and Landscaping: Enhance aesthetics by planting and trimming.
7. Safety and First Aid: Ensure volunteer safety and manage emergencies.
8. Documentation and Reporting: Capture progress through photos and reports.
9. Community Engagement: Educate and raise awareness among residents.
10. Post-Clean-up Evaluation: Review success and plan future initiatives.

b) Tree plantation initiatives**Group tasks for Tree plantation initiatives,**

1. Community Awareness: Workshops to educate on tree benefits.
2. Community Participation: Engage locals in all planting
3. Team Building: Group activities to strengthen community bonds.
4. Leadership Development: Empower individuals to lead initiatives.
5. Communication Workshops: Enhance effective messaging.
6. Problem-solving Discussions: Address planting challenges.
7. Environmental Responsibility: Foster care for green spaces.
8. Cultural Integration: Incorporate local traditions into initiatives.
9. Sustainability Education: Teach sustainable planting practices.
10. Monitoring and Evaluation: Assess impact and plan improvements.

c) Environmental conservation awareness**Group tasks for Environmental conservation awareness**

1. Educational Workshops: Teach about conservation methods.
2. Art Competitions: Promote environmental themes through art.
3. Street Plays: Perform interactive skits in public spaces.
4. Awareness Walks: Organize marches with environmental messages.
5. Tree Plantation: Plant trees to enhance green spaces.
6. Clean-up Campaigns: Remove litter from local areas.
7. Guest Lectures: Invite experts to discuss environmental issues.
8. Film Screenings: Show documentaries on conservation topics.
9. Social Media Campaigns: Spread awareness through online platforms.
10. Community Workshops: Educate on waste management and sustainability.

d) Health and sanitation programs

1. Health Education Sessions: Conduct informative sessions on hygiene, disease prevention, and nutrition.
2. Sanitation Infrastructure Evaluation: Assess the effectiveness of existing sanitation facilities and propose improvements.
3. Community Clean-up Events: Organize collective efforts to clean and maintain public spaces for better health outcomes.
4. Distribution of Hygiene Kits: Provide essential hygiene items such as soap, toothpaste, and sanitary products to community members.
5. Vaccination Drives: Coordinate vaccination campaigns to protect against prevalent diseases and promote community health.
6. Water Quality Testing: Conduct regular testing of water sources to ensure safe drinking water for residents.
8. Personal Hygiene Workshops: Offer workshops focusing on personal grooming, handwashing techniques, and menstrual hygiene.
9. First Aid Training: Provide basic first aid training to community members to equip them with life-saving skills.
10. Community Health Surveys: Conduct surveys to assess health needs and gather feedback for future program planning.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	Basic engineering measurement instruments, GPS data collection devices, and open-source GIS software like Google Earth and QGIS, along with the Microsoft Office suite.	ALL

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**NOT APPLICABLE****IX. ASSESSMENT METHODOLOGIES/TOOLS**

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Formative assessment (Assessment for Learning) Report and presentation of fieldwork activities, Self- Learning (Assignment)	--

X. SUGGESTED COS- POS MATRIX FORM**NOT APPLICABLE****XI. SUGGESTED LEARNING MATERIALS/BOOKS**

Sr.No	Author	Title	Publisher
1	Mark Stafford Smith and Pamela Matson	Sustainable Development: Principles, Frameworks, and Case Studies	Oxford University Press, ISBN: 9780199588952
2	Katar Singh	Rural Development: Principles, Policies and Management	SAGE Publications Pvt. Ltd, ISBN:978-9351502867.
3	Anand Kumar, Asim Kumar Mandal, and R. Venkata Rao	Maharashtra: Governance and Development"	Routledge India, ISBN: 978-0367709133
4	Dalai Lama and Howard C. Cutler	The Art of Happiness	Riverhead Books, and the ISBN: 978-1594488894.
5	Stephen R. Covey	The 7 Habits of Highly Effective People	Simon & Schuster, ISBN : 978-1982137274.
6	Local college students, UMA staff	Sample Case Studies on the UMA website	IITB-UMA team

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://www.ugc.gov.in/pdfnews/4371304_LifeSkill_JeevanKaushal_2023.pdf	UHV: UGC Course on life skills. Unit 4 i.e. Course 4 is to be referred
2	https://nss.gov.in/	The National Service Scheme (NSS) website provides information about the NSS program in India. It includes details about the objectives, history, and structure of NSS. Additionally, the website offers resources for NSS volunteers and coordinators, such as program guidelines, training materials, and reports.
3	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201601131501523808.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan
4	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201606151454073708.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan Guidelines
5	https://www.humanvaluesfoundation.com/	The Human Values Foundation website offers educators resources for teaching human values and social-emotional learning to children and youth. It provides curriculum-based programs, lesson plans, and activities to foster character development, resilience, and positive behaviour. Additionally, the website shares insights into the foundation's mission, values, and the global impact of its programs in schools.


Name & Signature:


Mr. S.B. KulkarniLecturer in Mechanical Engineering
(Course Experts)

Name & Signature:


Dr. Y.V. Chavan
(Programme Head)

Name & Signature:


Shri. S.B. Kulkarni
(CDC In-charge)