Curriculum of Diploma Programme

in

Ev-Technology

Department of Science, Technology and Technical Education (DSTTE), Govt. of Bihar

State Board of Technical Education (SBTE), Bihar

Semester – II
Teaching & Learning Scheme

Course Codes	Category of course	Course Titles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
2421102	**PCC**	**Fundamentals of Electronics Engg.**	03	-	04	02	09	06
2400103B	**ASC**	**Applied Chemistry -B** (CSE, AIML, EE, ELX, ELX (R))	03	-	04	02	09	06
2400104	**HSC**	**Communication Skills (English)** (Common for all Programmes)	03	-	04	02	09	06
2425104	**BEC**	**Engg. Mechanics** (CE, EE, ME, ME (Auto), MIE, FTS, AE, CRE, CHE, ELX, ELX (R), TE)	03	-	04	02	09	06
2400105C	**ASC**	**Applied Mathematics -C** (EE, ELX, ELX (R))	02	01	-	02	05	04
2400006	**NRC**	**Environmental Education and Sustainable Development** (Common for All Programmes)	01	-	01	01	03	02
Total			**15**	**1**	**17**	**11**	**44**	**30**

Note: Prefix will be added to Course Code if applicable (T for Theory, P for Practical Paper and S for Term Work)

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - II
Assessment Scheme

Course Codes	Category of course	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment(LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2421102	**PCC**	**Fundamentals of Electronics Engg.**	30	70	20	30	20	30	200
2400103B	**ASC**	**Applied Chemistry -B** (CSE, AIML, EE, ELX, ELX (R))	30	70	20	30	20	30	200
2400104	**HSC**	**Communication Skills (English)** (Common for all Programmes)	30	70	20	30	20	30	200
2425104	**BEC**	**Engg. Mechanics** (CE, EE, ME, ME (Auto), MIE, FTS, AE, CRE, CHE, ELX, ELX (R), TE)	30	70	20	30	20	30	200
2400105C	**ASC**	**Applied Mathematics -C** (EE, ELX, ELX (R))	30	70	20	30	-	-	150
2400006	**NRC**	**Environmental Education and Sustainable Development** (Common for All Programmes)	15	-	10	-	10	15	50
Total			**165**	**350**	**110**	**150**	**90**	**135**	**1000**

Note: Prefix will be added to Course Code if applicable (T for Theory, P for Practical Paper and S for Term Work)

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

A) Course Code : 2421102(T2421102/P2421102/S2421102)

B) Course Title : Fundamentals of Electronics Engineering

C) Pre- requisite Course(s) : Applied Physics

D) Rationale :

Currently, most of the state-of-art electronic equipment like mobiles, computers, ATM, TV, music system, air conditioners, automobiles are embedded with analog and digital circuits. Hence Fundamentals of Electronics Engineering course is a vital component for an electrical engineering curriculum. They provide students with a solid foundation in circuit analysis, design, and troubleshooting, enabling them to work with a wide range of electronic devices, systems, and applications. For this work, knowledge and skills related with semiconductor devices, logic gates, combinational circuits, sequential circuits, and memory is a must.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

CO-1 Use diode for rectification and voltage regulation.

CO-2 Test the functionality of electronic circuit having transistor as a component.

CO-3 Minimize the Boolean expressions and implement it using logic gates.

CO-4 Test simple combinational and sequential circuits.

CO-5 Use data converters and memory in digital electronic systems.

F) Suggested Course Articulation Matrix (CAM):

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**
CO-1	3	2	2	2	-	1	1		
CO-2	3	2	2	2	-	1	1		
CO-3	3	2	2	2	-	1	1		
CO-4	3	2	2	2	-	1	-		
CO-5	3	2	2	2	2	1	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Teaching & Learning Scheme (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2421102	Fundamentals of Electronics Engineering	03	-	04	02	09	06

Legend:

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H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2421102	Fundamentals of Electronics Engineering	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

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I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self-Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2421102

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the working of PN junction diodes under different biasing conditions. TSO 1b. Explain the working principle of the Zener diode. TSO 1c. Compare Zener and avalanche breakdown. TSO 1d. Construct voltage regulator using IC 7805. TSO 1e. Describe the construction and basic operation of half-wave rectifier circuit. TSO 1f. Describe the construction and basic operation of full-wave rectifier circuits	**Unit-1.0 Semiconductor Diodes and its Applications** 1.1. PN junction diode basics: Overview of formation and working of PN junction, V-I characteristics of PN junction diode 1.2. Zener Diode: • Avalanche and Zener Breakdown • V-I characteristics of Zener diode. • Voltage regulator circuits using Zener diode/IC 7805. 1.3. Half-wave Rectifiers: • Construction • Working • Waveform 1.4. Full-wave Rectifier (Centre tap & Bridge rectifier): • Construction • Working • Waveform	**CO1**
TSO 2a. Describe the working of NPN and PNP transistors. *TSO 2b.* Calculate the terminal current and terminal voltage of the given circuit. *TSO 2c.* Compare CE, CB, and CC configuration of BJT. *TSO 2d.* Explain thermal runaway. *TSO 2e.* Describe the working of JFET & MOSFET with the help of suitable sketch. *TSO 2f.* Calculate the drain current and V_{DS} voltage of the given circuit.	**Unit-2.0 Transistors** *2.1.* Bipolar Junction Transistor (BJT) • Introduction • Construction and symbol and types • Mode of operation of BJT • Working of NPN and PNP BJT • Transistor configuration (CE, CB, and CC) • Relationship between the current gain of CE, CB, and CC configuration • Thermal runaway *2.2.* Field Effect Transistor (FET) • Introduction to JFET: Symbol, Construction, and Working Principles of JFET. • Introduction to MOSFET: Symbol, Construction, Types, D-MOSFET and E-MOSFET and there working. • MOFET as a Switch	**CO1, CO2**
TSO 3a. Explain the given number systems. *TSO 3b.* Convert the one number system into another. *TSO 3c.* Perform the specific arithmetic operation with respect to provided number in a given number systems. *TSO 3d.* Determine 1's and 2's complement of given binary number. *TSO 3e.* Represent negative number in 1's and 2's complement. *TSO 3f.* Use 1's and 2's complement for subtraction. *TSO 3g.* Minimize the given Boolean expression using Boolean algebra and K-map. *TSO 3h.* Realize the logical expression using logic gates.	**Unit-3.0 Number Systems, Boolean Algebra and Logic Gates** 3.1 Different number systems: • Binary, Octal, Decimal, Hexadecimal. • Conversion from one number system to another number systems. 3.2 Arithmetic operation of Binary, Octal, Hexadecimal number systems. 3.3 Complements: 1's and 2's complement. 3.4 Data Representation: • Representation of negative number in 1's and 2's complement • Subtraction using 1's and 2's complement 3.5 Boolean Algebra:	**CO2, CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	• Rules and laws of Boolean Algebra • De-Morgan's Theorem 3.6 Standard Boolean Representation: • Sum of Product (SOP) • Product of Sum (POS) 3.7 Minimization: • Karnaugh's Map (K-map) up to three variables. • Simplification of Boolean expressions using Boolean laws and K-map. 3.8 Logic Gates and applications: • AND, OR, NOT, Buffer, NAND, NOR, XOR, XNOR (Symbol, Truth table, Logic expression and its applications) 3.9 Implementation • Implementation of Boolean expressions using basic gates.	
TSO 4a. Develop simple arithmetic circuits using logic gates. *TSO 4b.* Implement multiplexer and de-multiplexer using logic gates. *TSO 4c.* Use encoder and decoder in digital circuits. *TSO 4d.* Differentiate combinational and sequential circuits. *TSO 4e.* Explain the ripple counter for up/down sequence with block diagram. *TSO 4f.* Differentiate synchronous and asynchronous counter. *TSO 4g.* Explain the ring counter with block diagram.	**Unit-4.0 Combinational and Sequential Logic Circuits** 4.1 Arithmetic Circuits • Half Adder and Full Adder • Half Subtractor and Full Subtractor 4.2 Multiplexer: • 2 to 1 MUX • 4 to 1 MUX • Application 4.3 De-multiplexer: • 1 to 2 DEMUX • 1 to 4 DEMUX • Applications 4.4 Encoder and Decoder 4.5 Flip-Flops: SR, JK, T, D, and JK, Master Slave JK 4.6 Shift Registers: • Serial in Serial Out • Serial in Parallel Out • Parallel in Serial Out • Parallel in Parallel Out 4.7 Counters: • Modulus of counter • Asynchronous Counter: Ripple up/down counter. • Synchronous Counter: Ring Counter	**CO3, CO4**
TSO 5a. Calculate the output voltage of given Op-amp circuit. *TSO 5b.* Explain the DAC and ADC. *TSO 5c.* Compare various type of memory in terms of its functionality. *TSO 5d.* List the memory chip.	**Unit-5.0 Data Converters and Memory Devices** 5.1 Data Converters: • Op-Amp: Introduction (Inverting and Non-inverting) • Digital to analog and Analog to digital converter: Uses 5.2 Random Access Memory: Introduction and its types. 5.3 Read Only Memory: Introduction and its types. 5.4 E-Waste	**CO5**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2421102

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Identify the IC number of Zener diode. *LSO 1.2* Build the circuit using Zener diode. *LSO 1.3* Plot the V-I characteristic of Zener diode.	1.	Test the performance of Zener Diode.	CO1
LSO 2.1 Build the circuit of Half wave rectifier using diode on breadboard/ trainer kit. *LSO 2.2* Verify the output waveform of Half wave rectifier.	2.	Test the functionality of Half wave rectifier.	CO1
LSO 3.1 Build the circuit of Full wave rectifier using diode on breadboard/ trainer kit. *LSO 3.2* Verify the output waveform of Full wave rectifier.	3.	Test the functionality of Full wave rectifier.	CO1
LSO 4.1 Build the circuit of power supply using IC 7805. *LSO 4.2* Verify the output of power supply.	4.	Construct the power supply of +5V.	CO1
LSO 5.1 Build the circuit of power supply using IC 7905. *LSO 5.2* Verify the output of power supply.	5.	Construct the power supply of -5V.	CO1
LSO 6.1 List the IC number of BJTs provided. *LSO 6.2* Identify the terminal of BJT using multimeter. *LSO 6.3* Verify the terminal of BJT with data sheet.	6.	Identify the given transistor.	CO2
LSO 7.1 Build the CE configuration circuit *LSO 7.2* Verify the input and output characteristics.	7.	Test the input and output characteristics of the CE amplifier.	CO2
LSO 8.1 Build the CC configuration circuit. *LSO 8.2* Verify the input and output characteristics.	8.	Test the input and output characteristics of the CC amplifier.	CO2
LSO 9.1 Build the CB configuration circuit. *LSO 9.2* Verify the input and output characteristics.	9.	Test the input and output characteristics of the CB amplifier.	CO2
LSO 10.1 Build the CE configuration circuit. *LSO 10.2* Measure the voltage gain & current gain of the CE configuration.	10.	Measure the voltage gain and current gain of CE configuration.	CO2
LSO 11.1 Construct the CC configuration circuit. *LSO 11.2* Measure the voltage & current gain of the CC configuration.	11.	Measure the voltage gain and current gain of CC configuration.	CO2
LSO 12.1 Construct the CB configuration circuit. *LSO 12.2* Measure the voltage & current gain of the CB configuration.	12.	Measure the voltage gain and current gain of CB configuration.	CO2
LSO 13.1 List the IC number of different types of logic gates. *LSO 13.2* Verify the truth table of identified logic gate.	13.	Test the functionality of given logic gates using ICs.	CO3
LSO 14.1 Build the circuit on breadboard for making AND gate using NOR gate. *LSO 14.2* Verify the truth table of the developed AND gate. *LSO 14.3* Build the circuit on breadboard similarly for other gates using NOR gate. *LSO 14.4* Verify the truth table of the developed gate.	14.	Implement logic gates using universal NAND gate IC.	CO3
LSO 15.1 Build the circuit on breadboard for making AND gate using NOR gate. *LSO 15.2* Verify the truth table of the developed AND gate. *LSO 15.3* Build the circuit on breadboard similarly for other gates using NOR gate. *LSO 15.4* Verify the truth table of the developed gate.	15.	Implement logic gates using universal NOR gate IC.	CO3
LSO 16.1 Build the circuit of Half adder using basic gates on breadboard. *LSO 16.2* Test the functionality of Half Adder.	16.	Implement Half adder and Half subtractor using basic gates.	CO3, CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 16.3 Build the circuit of Half Subtractor on breadboard. *LSO 16.4* Test the functionality of Half Subtractor.			
LSO 17.1 Build the circuit of Full Adder using basic gates on breadboard. *LSO 17.2* Check the result of binary addition on the developed circuit.	17.	Implement Full Adder using basic gates.	CO3, CO4
LSO 18.1 Build the circuit of full subtractor using NOR gate on breadboard. *LSO 18.2* Check the result of binary subtraction on the developed circuit.	18.	Implement Full Subtractor using basic gates.	CO3, CO4
LSO 19.1 Build the circuit connection of multiplexer on trainer kit. *LSO 19.2* Test whether the particular input line is available at output for given data select line.	19.	Test the functionality of multiplexer on trainer kit.	CO4
LSO 20.1 Build the circuit connection of De-multiplexer. *LSO 20.2* Test whether the given data available at input is distributed correctly to output for given data select line.	20.	Build and test the functionality of de-multiplexer on trainer kit.	CO4
LSO 21.1 Build the circuit of SR flip-flop on breadboard. *LSO 21.2* Verify the characteristic table of SR flip-flop.	21.	Verify the function of SR flip-flop using NAND/NOR gate.	CO3, CO4
LSO 22.1 Construct the circuit diagram of D and T flip-flop on breadboard. *LSO 22.2* Test the functionality of D and T flip-flop.	22.	Test the functionality of D and T flip-flop using IC 7476.	CO4
LSO 23.1 List the IC number of DAC and ADC. *LSO 23.2* Test its functionality.	23.	Test the functionality of DAC and ADC using IC.	CO5

L) Suggested Term Work and Self-Learning: S2421102 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs. Some sample assignments are given below:

- Explain the working of Zener diode and draw its V-I characteristic.
- Calculate the output voltage of given Op-amp.
- Explain the working of BJT.
- Explain the working of E-MOSFET.
- Explain the working of D-MOSFET.
- Define Boolean algebra with its law.
- Minimize the Boolean Function F (W, X, Y, Z) = ∑ (0,1,4,5,8,9,13,15) using K-map method.
- Implement all logic Gates using NOR Gate.
- Draw logic circuit of Boolean function F = AB + $\bar{A}$C + B$\bar{C}$ using AND, OR and NOT gates only.
- Draw logic diagram of Full subtractor and write its truth table.
- Explain the Encoder with suitable circuit diagram.
- Write any four difference between Synchronous and Asynchronous counter.
- Explain SR flip-flop with the help of logic diagram and write its truth table.

b. Micro Projects:

1. Build a DC power supply of 5V.
2. Build a circuit to implement 4-bit adder.
3. Build a circuit for LED flasher.

4. Build a simple light sensor circuit using an LDR (Light Dependent Resistor).
5. Build a trainer kit of 4 to 1 multiplexer.
6. Build a circuit to test seven segment display.
7. Build a circuit to display the pin code of your college using seven segment display.
8. Undertake a market survey of different digital IC's required for different applications.

c. Other Activities:

1. Seminar Topics:

- Biometric voting machine
- Night vision technology
- Digital locker
- Barcodes Reader
- Handling electronic waste.

2. Visits: Visit nearby radio station/industry/ electronic shops. Prepare report of visit with special comments of electronics component/batch production/mass production and cost of component.

3. Self- learning topics:

- Atomic structure of the semiconductor
- PCB design technique
- Key board encoder
- 2-bit comparator
- Carry look ahead adder
- Self-complimentary code like 2421, 3321

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	15%	20%	20%	15%	20%
CO-2	25%	25%	10%	20%	20%	30%	20%
CO-3	20%	20%	15%	20%	20%	20%	20%
CO-4	20%	20%	30%	20%	20%	25%	20%
CO-5	15%	15%	30%	20%	20%	10%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Semiconductor Diodes and its Applications	9	CO1	15	4	5	6
Unit-2.0 Transistors	9	CO1, CO2	17	5	6	6
Unit-3.0 Number Systems, Boolean Algebra and Logic Gates	10	CO2, CO3	14	4	5	5
Unit-4.0 Combinational and Sequential Logic Circuits	10	CO3, CO4	14	4	5	5
Unit-5.0 Data Converters and Memory Devices	10	CO5	10	3	3	4
Total	**48**	**-**	**70**	**20**	**24**	**26**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	V-I characteristics of Zener diode.	CO1	30	60	10
2.	Test the functionality of Half wave rectifier.	CO1	40	50	10
3.	Test the functionality of Full wave rectifier.	CO1	40	50	10
4.	Construct the power supply of +5V.	CO1	40	50	10
5.	Construct the power supply of -5V	CO1	40	50	10
6.	Identify the given transistor.	CO2	30	60	10
7.	Test the input and output characteristics of the CE amplifier.	CO2	30	60	10
8.	Test the input and output characteristics of the CC amplifier.	CO2	30	60	10
9.	Test the input and output characteristics of the CB amplifier.	CO2	30	60	10
10.	Measure the voltage gain and current gain of CE configuration.	CO2	30	60	10
11.	Measure the voltage gain and current gain of CC configuration.	CO2	30	60	10
12.	Measure the voltage gain and current gain of CB configuration.	CO2	30	60	10
13.	Test the functionality of given logic gates using ICs.	CO3	30	60	10
14.	Implement logic gates using universal NAND gate IC.	CO3	40	50	10
15.	Implement logic gates using universal NOR gate IC.	CO3	40	50	10
16.	Implement Half adder and Half subtractor using basic gates.	CO3, CO4	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
17.	Implement Full Adder using basic gates.	CO3, CO4	40	50	10
18.	Implement Full Subtractor using basic gates.	CO3, CO4	40	50	10
19.	Test the functionality of multiplexer on trainer kit.	CO4	30	60	10
20.	Build and test the functionality of de-multiplexer on trainer kit.	CO4	30	60	10
21.	Verify the function of SR flip-flop using NAND/NOR gate.	CO4	40	50	10
22.	Test the functionality of D and T flip-flop using IC 7476	CO3, CO4	40	50	10
23.	Test the functionality of DAC and ADC using IC.	CO5	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools, and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Oscilloscope	Dual Channel 20MHz	All
2.	Function generator	100MHz Function & Arbitrary Generator, 500MSa/s-DG4102	All
3.	Digital IC Trainer Kits	Power Supply: +5V, +/- 12V Display Type: 2 Digit BCD to Decimal Display	All
4.	Logic Gates and other ICs	Basic Gates, IC 7476, multiplexer, de-multiplexer, ADC, DAC IC's	13 to 23
5.	Bread Board	MB 102 Breadboard with Power Supply Module, Jumper Wires, Battery Clip,830 & 400 tie-Points	All
6.	Digital Multimeter	DM-86 Digital Multimeter AC Frequency Response: 40-400Hz Low Battery Display: Approx. < 7.5V	All
7.	IC Tester	• Package: Digital ICs of 14, 16, 18,20,24,28 & 40 pins dual in line. • Range: Tristate, Open Collector & Bidirectional TTL/CMOS ICs. • Method: Truth table comparison. • Sockets: 20 and 40 pin ZIF. • Keyboard: 24 feather touch keys. • Display: 16 digit 0.5" Seven segment LED display. • Voltage: 230 volts + 10% 50Hz, AC.	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Digital principles & Applications	Albert Paul Malvino & Donald P. Leach	McGraw Hill Education; Eighth edition, ISBN: 978- 9339203405
2.	Digital Electronics, Principles and Applications	Roger L. Tokheim	McGraw-Hill Education, International Second Revised edition ISBN: 978-0071167963
3.	Digital Electronics – An Introduction to Theory and Practice	William H. Gothmann	Prentice Hall India Learning Private Limited; Second edition ISBN: 978-8120303485
4.	Fundamentals of Logic Design	Charles H. Roth, Larry L. Kinney	Jaco Publishing House; First edition ISBN: 978- 8172247744
5.	Digital Electronics	R. Anand	Khanna Publications, New Delhi (Edition 2018) ISBN: 978-93-82609445
6.	Electronics Devices and circuit theory	Boylestad & Nash-elsky	Pearson Education India; Elventh edition (2015) ISBN: 978-9332542600
7.	Electronic Devices and Circuits	S. Salivahanan and N. Suresh Kumar	McGraw Hill Education; Fourth edition (1 July 2017) ISBN: 978-9339219505
8.	Electronics Devices & Circuits	Jacob Millman	McGraw Hill Education; Fourth edition (2015) ISBN: 978-9339219543

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/108105132
2. https://onlinecourses.nptel.ac.in/noc22_ee55/preview
3. https://archive.nptel.ac.in/courses/108/105/108105132/
4. https://in.coursera.org/learn/digital-systems
5. Virtual Labs: https://www.vlab.co.in/
6. https://www.iitg.ac.in/cseweb/vlab/Digital-System-Lab/experiments.php

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Operating / Manufacturers' Manuals
2. Lab Manuals
3. Data books / Data sheets of digital components (TTL, CMOS, etc.)
4. Software's like NI Circuit Design Suite/ Xcircuit / easyEDA/ circuitlab & like.

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A) Course Code : **2400103B(T2400103B/P2400103B/S2400103B)**

B) Course Title : Applied Chemistry- B (CSE, AIML, EE, ELX, ELX (R))

C) Pre- requisite Course(s) :

D) Rationale :

The diploma programmes in Computer Science and Engineering (CSE), Artificial Intelligence and Machine Learning (AIML), Electrical Engineering, and Electronics Engineering all require applied chemistry course as prerequisite. The fundamental tenets of chemistry, such as chemical bonding, water, engineering materials, solid state and electrochemistry are the main topics of the applied chemistry course which are the need for programmes mentioned above. Through this course, they will be able to understand structural arrangement of fundamental particles, atoms and molecules. The knowledge of chemical bonding will help the engineers and scientist to design new engineering materials and form chemical compounds with desirable properties. The study of basic concept of solid state will be needed in various emerging and technological applications.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Solve various engineering problems applying the basic concepts of atomic structure, chemical bonding, and solutions.
- **CO-2** Use relevant **water treatment** techniques to solve domestic and industrial problems.
- **CO-3** Solve emerging problems using concept of engineering materials and properties.
- **CO-4** Analyze the behavior of given materials under different temperature and pressure conditions.
- **CO-5** Solve the engineering problems using the concept of electrochemistry and corrosion.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof 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**
CO-1	3	2	1	-	-	-	1		
CO-2	3	3	2	2	2	1	1		
CO-3	3	2	1	2	-	1	1		
CO-4	3	1	1	-	2	-	1		
CO-5	3	2	1	1	-	1	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400103B	Applied Chemistry- B	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400103B	Applied Chemistry- B	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400103B

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Describe the three subatomic particles in an atom. *TSO 1b.* Explain Rutherford model of atom. *TSO 1c.* Apply the different atomic theories and principles for structural illustration. *TSO 1d.* Calculate uncertainty in position and momentum. *TSO 1e.* Draw the shapes of s, p and d orbitals. *TSO 1f.* Write the electronic configuration of different elements. *TSO 1g.* Differentiate between ionic, covalent, and coordinate compounds based on the type of chemical bonding. *TSO 1h.* Explain the unique behavior of water. *TSO 1i.* Prepare the solution of given concentration.	**Unit-1.0 Atomic Structure and Chemical Bonding and Solutions:** 1.1. Atoms and its fundamental particles, 1.2. Rutherford Model of Atom, 1.3. Bohr's Theory, Hydrogen spectrum explanation based on Bohr's Model of Atom, 1.4. Wave Mechanical model of atom, de Broglie relationship, Heisenberg Uncertainty Principle 1.5. Quantum Numbers, Shapes of Atomic Orbitals, 1.6. Pauli's Exclusion Principle, Hand's Rule of Maximum Multiplicity, Aufbau Principle, Electronic Configuration (till atomic number 30). 1.7. Concept of Chemical bonding - Causes of chemical bonding, Types of Bonds: Ionic Bond (NaCl, $CaCl_2$, MgO), Covalent Bond, Polar and Nonpolar Covalent Bonds (H_2. F_2. HF, HCl) & Co-ordinate Bond (CO, NH_4+, O_3, H_2SO_4). 1.8. Dipole Moment (NH_3, NF_3), Hydrogen bonding. 1.9. Solution- (solute, solvent) and their strength- Molarity, Normality, Molality. 1.10. Indian Chemistry: -Philosophy of atom by Acharya Kanad. (IKS)	**CO1**
TSO-2a. Classify hard and soft water based on their properties. *TSO-2b.* List the impurities responsible for hardness. *TSO-2c.* Calculate the hardness of water. *TSO-2d.* Determine the hardness by EDTA method. *TSO-2e.* Apply different water softening techniques to soften the hard water. *TSO-2f.* Calculate the amount of lime and soda required for removal of hardness. *TSO-2g.* Differentiate between BOD and COD. *TSO-2h.* Use the Indian standard specification of drinking water.	**Unit-2.0 Water** 2.1 Introduction, Sources of Water. Hardness of Water- Temporary & Permanent hardness. 2.2 Degree of Hardness (In terms of CaCO3 equivalent), Unit of Hardness, Quantitative Measurement of Water Hardness by EDTA method. 2.3 Municipal supply of Water, Treatment of water, Water Softening Technique-Soda Lime Process, Zeolites method and ion exchange method, 2.4 Water Quality Index - Biological Oxygen Demand, Chemical Oxygen Demand, Determination of Dissolved Oxygen 2.5 Indian standard specification of drinking water.	**CO2**
TSO 3a. List ores of metals. *TSO 3b.* Describe ore, gangue, matrix. *TSO 3c.* Select Appropriate metallurgical processes for concentration, extraction, and purification of given ore. *TSO 3d.* Describe alloy with examples. *TSO 3e.* Write the constituent of given alloy. *TSO 3f.* Write the composition properties and uses of ferrous and non-ferrous alloys. *TSO 3g.* Distinguish homopolymer, copolymer.	**Unit-3.0 Engineering Materials** 3.1 Natural Occurrence of Metals- Minerals, ores. 3.2 Metallurgy - General principles of Metallurgy, Gangue, Flux and Slag, Steps involved in metallurgy. 3.3 Ancient Indian Metallurgy (IKS) 3.4 Extraction of Aluminium, Iron and Copper from their important ores along with reactions, Properties and uses. 3.5 Alloys – Definition, Purpose of alloying, Ferrous	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3h. Write the monomers of given polymers. *TSO 3i.* Explain vulcanization process.	and Non-Ferrous Alloy with suitable examples, Composition, Properties, and their applications. 3.6 Polymers-Homopolymers and Copolymers, Natural polymers and synthetic polymers, Addition and Condensation polymerization, Thermoplastic and Thermosetting plastic. 3.7 Monomers, applications, and synthesis of Polythene, PVC, Orlon, Terylene, Nylon 66, Nylon 6, Bakelite. 3.8 Natural Rubber and its vulcanization, advantages of vulcanized rubber.	
TSO 4a. Differentiate between crystalline and amorphous solid. *TSO 4b.* Classify crystalline solid based on binding forces. *TSO 4c.* Classify unit cells based on structure. *TSO 4d.* Describe imperfections in solid. *TSO 4e.* Differentiate between metals and semiconductors using band theory. *TSO 4f.* Explain ferromagnetism and diamagnetism. *TSO 4g.* Describe Bragg's law. *TSO 4h.* Describe kjeldahl method to determine melting point of crystalline solid.	**Unit-4.0 Solid State** 4.1 General characteristics of solid state, crystalline and amorphous solid. 4.2 Classification of crystalline solid- Molecular, ionic, metallic, covalent solids. 4.3 Crystal lattice and unit cells- Primitive, BCC, FCC 4.4 Imperfections of solid, Types of point defects- stoichiometric defects, impurity defects, non-stoichiometric defects. 4.5 Electrical properties, conduction of electricity in metals and semiconductors- Band theory. 4.6 Magnetic properties- Ferromagnetism, Para magnetism, diamagnetism, anti-ferro magnetism and ferrimagnetism. 4.7 General introduction to X ray diffraction method- *Bragg's* law. 4.8 Melting point determination of crystalline solid by Kjeldahl method.	
TSO-5a. Describe Electrolyte and Nonelectrolyte. *TSO-5b.* Describe Metallic and electrolytic conduction. *TSO-5c.* Explain the faraday law of electrolysis. *TSO-5d.* Calculate the mass of metal deposited after passing a certain amount of current. *TSO-5e.* Calculate the emf at different temperature, pressure, and molar concentration. *TSO-5f.* Predict the feasibility of a cell. *TSO-5g.* Explain the working of a cell. *TSO-5h.* Describe corrosion. *TSO-5i.* Explain the different methods to prevent corrosion.	**Unit-5.0 Electrochemistry** 5.1. Introduction, Electrolyte and Nonelectrolyte, Electrolytic and Metallic Conduction, Factors affecting Electrolytic Conductance. 5.2. Molar Conductivity and Equivalent Conductivity. Variation of Molar Conductivity, Kohlrausch's law. 5.3. Faraday's Laws of Electrolysis. 5.4. Galvanic Cell, Electrode Potential, Measurement of Electrode Potential SHE (Standard Hydrogen electrode), EMF, Electrochemical Series, Nernst Equation for Electrode Potential. 5.5. Batteries, Primary Cells-Dry cell, Secondary cell - Lead storage battery, Fuel cells. 5.6. Corrosion, their types (Dry & Wet corrosion) and prevention.	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400103B

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Calculate amount of oxalic acid required. *LSO 1.2.* Prepare N/10 oxalic acid solution.	1.	Preparation of 250 ml of N/10 Oxalic acid Solution	CO1
LSO 2.1. Calculate amount of Sodium carbonate required. *LSO 2.2.* Prepare N/10 Sodium Carbonate Solution	2.	Preparation of 250ml of N/10 Sodium Carbonate Solution	CO1
LSO 3.1. Perform acid base titration. *LSO 3.2.* Prepare oxalic acid solution.	3.	Determination of strength of Sodium Hydroxide solution by titrating against Oxalic Acid Solution.	CO1
LSO 4.1. Perform Complexometric titration. *LSO 4.2.* Standardize EDTA solution.	4.	Determination of the total hardness of tap water by EDTA method.	CO2
LSO 5.1. Perform double displacement reaction. *LSO 5.2.* Test the presence of sulphate.	5.	Preparation Barium Sulphate from Barium Chloride.	CO2
LSO 6.1. Perform acid base titration using pH meter.	6.	Determination of pH of given solution by pH meter.	CO2
LSO 7.1. Perform iodometry titration. *LSO 7.2.* Use of starch as indicator.	7.	Determination of Dissolved Oxygen in given Sample of water.	CO2
LSO 8.1. Calculate pH.	8.	Determination pH of soil using baking soda and vinegar.	CO2
LSO 9.1. Carry out Polymerization. *LSO 9.2.* Set the environment for carrying out polymerization	9.	Preparation of Phenol Formaldehyde Resin (Bakelite)	CO3
LSO-10.1. Seal capillary tube. *LSO 10.1.* Measure the melting point of acetanilide.	10.	Determination of the melting point of Acetanilide crystals.	CO4
LSO 11.1. Seal capillary tube *LSO 11.2.* Measure the melting point of benzoic acid.	11.	Determination of the melting point of Benzoic acid crystals.	CO4
LSO-12.1. Construct Daniel cell. *LSO-12.2.* Compare the effect of dilution of electrolytes on the emf of a Daniel cell.	12.	Comparison of the effect of dilution of electrolytes on the emf of a Daniel cell.	CO5

L) Suggested Term Work and Self Learning: S2400103B Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted Cos such as

1. Write electronic structure of given atoms.
2. Compare the wavelengths of different macroscopic and microscopic particles moving with same velocity.
3. Prepare a model to find the soap lather forming capacity of tap water on addition of lime.
4. Prepare chart showing different industrial application of metal and relate it with required property or properties using internet.
5. Compare the EMF of Zinc - Copper cell with different cathodic concentration and predict which increases EMF out of low and high cathodic concentration?
6. Explain different types of defects in solid with diagram.
7. Identify polymers used at your home and institute and write their monomers.

   Prove the statement mathematically. "It is impossible to determine the position and momentum simultaneously with accuracy."

b. Micro Projects:

1. Form three groups of students in the class. Consider a hypothetical situation of exchanging/ sharing/giving of different items/belongings and demonstrate the type of ionic, covalent, and co-ordinate bonding amongst the students in a simulated situation. Present your findings.
2. Model of electronic configurations for different atoms (Z=30)
3. Prepare a model to demonstrate the application of electrolysis cells.
4. Collect three metallic strips of Al, Cu, Fe, strips, Place them in different acidic and alkaline solutions of the same concentration. Observe and record the loss in weight of metals due to acidic and alkaline environments. Discuss the findings with your teacher and colleagues.
5. Classify the surrounding corrosion into dry corrosion and wet corrosion.
6. Collect different samples of utensils reinforced materials, iron, copper, brass, bronze, and other alloys. Place them in an open environment under tin shade. Observe the corrosive properties over a period of four weeks. Record your observations. Discuss the findings with your teacher and colleagues.
7. Collect the water sample from different sources of ground and surface water (at least five). Explore the new and simplest softening and **water treatment** methods and perform the same at your home by creating the different assemblies and manipulative techniques at home. Determine the turbidity and pH of water (using pH paper).
8. Collection of data of various cement, glass, paints, and varnishes available in the market.
9. Compare the EMF of a given cell using different fruit juice as electrolyte.
10. Compare the hardness of different sample water by measuring the time required for forming lather.

c. Other Activities:

1. Seminar Topics:
   - Water Softening techniques.
   - Advantages and drawbacks of different atomic structures proposed by different scientists.
   - Properties of good lubricants.
   - Application of Nernst equation

2. Visits:
   - Visit nearby **water treatment** plant and prepare a report of the visit.
   - Visit a nearby battery shop and prepare a report of the visit.

3. Self-Learning Topics:
    - Type of hardness.
    - Discovery of electrons, proton, and neutron.
    - Blast furnace.
    - Octane number and cetane number.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	15%	-	-	20%	20%
CO-2	20%	20%	10%	25%	-	20%	20%
CO-3	20%	20%	15%	25%	33%	15%	20%
CO-4	15%	15%	30%	25%	33%	15%	20%
CO-5	25%	25%	30%	25%	34%	30%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Atomic Structure and Chemical Bonding	11	CO1	14	4	4	6
Unit-2.0 Water	9	CO2	14	4	4	6
Unit-3.0 Engineering Material	8	CO3	14	4	6	4
Unit-4.0 Solid State	8	CO4	10	4	3	3
Unit-5.0 Electrochemistry	12	CO5	18	4	5	9
Total	**48**		**70**	**20**	**22**	**28**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Preparation of 250 ml of N/10 Oxalic acid Solution	CO1	40	50	10
2.	Preparation of 250ml of N/10 Sodium Carbonate Solution.	CO1	30	60	10
3.	Determination of strength of Sodium Hydroxide solution by titrating against Oxalic Acid Solution.	CO1	30	60	10
4.	Determination of the total hardness of tap water by EDTA method.	CO2	30	60	10
5.	Preparation Barium Sulphate from Barium Chloride.	CO2	30	60	10
6.	Determination of pH of given solution by pH meter.	CO2	40	50	10
7.	Determination of Dissolved Oxygen in given Sample of water.	CO2	30	60	10
8.	Determination pH of soil using baking soda and vinegar.	CO2	30	60	10
9.	Preparation of Phenol Formaldehyde Resin (Bakelite)	CO3	30	60	10
10.	Determination of the melting point of Acetanilide crystals.	CO4	40	50	10
11.	Determination of the melting point of Benzoic acid crystals.	CO4	40	50	10
12.	Comparison of the effect of dilution of electrolytes on the emf of a Daniel cell	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools, and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Electronic balance,	Scale range of 0.001g to 500g. Pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt.	1,2,3,5,6,7,8,9
2.	Electric oven	Inner size 18''x18''x18''; temperature range 100 to 250^0 C. with the capacity of 40lt.	5
3.	Ostwald Viscometer	Size 120x1 mm(length x internal diameter) Overall Height 237 nm Material- Glass	7

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Engineering Chemistry	Jain & Jain	Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2015, ISBN: 93-521-6000-2
2.	A Textbook of Engineering Chemistry	Dr S. S. Dara & Dr S. S. Umare	S. Chand & Co.(P) Ltd., New Delhi, 2014, ISBN:81-219-0359-9
3.	Textbook of Chemistry for Class XI & XII (Part-I & II)	NCERT	NCERT, New Delhi, 2017-18, Class-XI, ISBN: 81-7450-494-X (part-I), 81-7450-535-O (part-II), Class-XII, ISBN: 81-7450-648-9 (part-I), 81-7450-716-7 (part-II)
4.	Engineering Chemistry	Shikha Agarwal	Cambridge Uni. Press, New Delhi, 2019, ISBN: 978-1-108-72444-9
5.	Understanding Chemistry	C.N.R. Rao	World scientific publishing Co., 2009, ISBN: 9789812836045
6.	Engineering Chemistry	Dr. Vikram, S.	Wiley India Pvt. Ltd., New Delhi, 2013, ISBN: 9788126543342
7.	Applied Chemistry Laboratory Practices, Vol. I & II	Dr. G.H. Hunger & Prof. A.N. Pathak.	NITTTR, Chandigarh, Publication, 2013-14
8.	Chemistry for Engineers	Rajesh Agnihotri	Wiley India Pvt. Ltd., 2014, ISBN: 9788126550784
9.	Fundamental of Electrochemistry	V. S. Bagotsky	Wiley International N. J.,2005, ISBN: 9780471700586
10.	Applied Chemistry with Lab manual	Anju Rawlley Devdatta V. Saraf	Khanna Book Publishing Co. (P) Ltd. New Delhi, 2021, ISBN- 978-93-91505-44-8.

(b) Online Educational Resources:

1. www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2. www.visionlearning.com (Atomic structure and chemical bonding)
3. www.chem1.com (Atomic structure and chemical bonding)
4. https://www.ancient-origins.net/history-famous-people/indian-sage-acharya-kanad-001399 (IKS)
5. https://www.wastewaterelearning.com/elearning/ (Water Treatment)
6. www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
7. www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel & Combustion)
8. PhET: Free online physics, chemistry, biology, earth science and math simulations (colorado.edu)
9. Courses: NPTEL
10. Virtual Labs (vlab.co.in)
11. https://iksindia.org (IKS)
12. olabs.edu.in
13. Khan Academy | Free Online Courses, Lessons & Practice

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Lab Manuals
2. Learning Packages.
3. Lab Manuals.
4. Manufacturers' Manual
5. Users' Guide

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A) Course Code : 2400104(T2400104/P2400104/S2400104)

B) Course Title : Communication Skills (English) (Common for all Programmes)

C) Pre-requisite Course(s) :

D) Rationale

Communication forms a crucial element in the success of any organization or industry in the globalized economy. The global village gives due weightage to the English language and it enjoys a privileged status. Engineering students with English as a communicative language are open to many opportunities across the globe. This course will develop Listening, Speaking, Reading, and Writing Skills (LSRW) in the students for effective dissemination of their ideas, projects, patents, and research in the form of presentations, reports, research papers, memos, circulars, etc. Additionally, it will help students of diploma in engineering to present concepts and designs effectively along with writing CVs, Group Discussions, and Mock Interview sessions in placements and job recruitments. Though communication skills in SBTE, Bihar largely emphasizes to communicate effectively in English communication in Hindi is also focused to some extent at the diploma level. Effective Communication can be easily learned through Indian mythological scriptures like Bhagwat Geeta, Ramayana, Mahabharata, and others. (IKS)

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of the following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor, and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to

- **CO-1** Communicate contextually in different situations.
- **CO-2** Use Verbal Communication Effectively
- **CO-3** Deploy Non-Verbal Communication Contextually.
- **CO-4** Write various texts using vocabulary and correct grammar.
- **CO-5** Draft effective business correspondence with brevity and clarity.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof 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**
CO-1	3	-	-	-	-	3	3		
CO-2	-	-	-	-	-	3	3		
CO-3	-	-	-	-	-	3	3		
CO-4	-	-	-	-	3	3	3		
CO-5	3	-	-	-	-	3	3		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400104	Communication Skills (English)	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem-based learning, etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field, or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro-projects, industrial visits, any other student activities, etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources, etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of the teacher to ensure the outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400104	Communication Skills (English)	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW), and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to the attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020-related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS), and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400104 The details of TSOs and units for communication in English is mentioned in Part – A while communication in Hindi is mentioned in Part – B in the following table.

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
Part -A (English) TSO1.a Define communication and its different forms. TSO1.b Explain the elements of communication with Case Studies from Bhagwat Geeta's conversation between Krishna and Arjun before the war. (IKS) TSO1.c Explain the linkages between different stages of communication with the help of a diagram. TSO1.d Apply the principles of effective communication and state two examples of communication from Ramayana (IKS) TSO1.e State eight for explaining different types of barriers to communication Case Studies from Mahabharata - the conversation between Kauravas and Pandavas in the war field (IKS) TSO1.f Identify the barriers to communication. TSO1.g Suggest the ways to overcome/minimize communication barriers.	**Unit-1.0 Communication** 1.1 Communication: Role, Relevance, Elements (Context-Sender-Message-Channel-Receiver-Feedback) 1.2 Process / Stages: Ideation- Encoding, Selecting Proper Channel, Transmission, Receiving, Decoding, Giving Feedback 1.3 7 Cs / Principles of Effective Communication: Considerate, Correct, Concrete, Concise, Clear, Complete. Courteous 1.4 Barriers to Communication: Physiological, Physical, Psychological, Mechanical, Semantic/Language, Cultural. Overcome/ minimize Barriers. 1.5 Case Studies from: • Bhagwat Geeta's conversation between Krishna and Arjun before the war (IKS) • Mahabharata the conversation between Kauravas and Pandavas in the war field (IKS)	**CO1** **CO2**
TSO 2a. Distinguish between formal and informal communication Case Studies from Bhagwat Geeta and the different conversations of Krishna and Arjun during the war (IKS). *TSO 2b.* Illustrate the types of Formal Communication with examples. *TSO 2c.* Define verbal & non-verbal communication. *TSO 2d.* TSO 2d. Explain the advantages of oral and written Communication. *TSO 2e.* Interpret non-verbal codes from Mahabharata (IKS) *TSO 2f.* Explain the role of tables, charts & graphs in communication. *TSO 2g.* Differentiate Intrapersonal and Interpersonal Communication with Case Studies *TSO 2h.* List the advantages and disadvantages of Group Communication.	**Unit- 2.0 Types of Communication** **2.1** Based on organizational structure: Formal (Vertical, Horizontal, Diagonal), Informal (Grapevine) 2.2 Based on the method of expression: Verbal-Oral & Written communication. Non-verbal communication and its Codes- Kinesics, Chronemics, Proxemics, Haptics, Vocalics/Paralanguage, Artifacts, Graphic and Visual Communication 2.3 Based on the number of people involved: Interpersonal, and Group Communication. 2.4 Case Studies from Bhagwat Geeta's different conversations with Krishna and Arjun during the war (IKS).	**CO3**
TSO 3a. Prepare a glossary of new words from the given texts. TSO 3b. Summarize the given texts in your own words. TSO 3c. Recognize the types of sentences in the given texts.	**Unit-3.0 Reading Comprehension** Comprehension, vocabulary enhancement and grammar exercises based on the reading of the following texts: **Section-1 (Prose)**	**CO4** **CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3d. Find out idioms and phrases used in the given texts. TSO 3e. Write a short biography of the given writers. TSO 3f. Identify the figures of speech used in the given texts. TSO 3g. Classify the forms of poetry. TSO 3h. Elaborate the central idea / theme of the given poems in your own words.	3.1 An Astrologer's Day by R K Narayan 3.2 Indian Civilization and Culture by M K Gandhi 3.3 The Secret of Work by Swami Vivekanand 3.4 My Struggle for an Education by Brooker T Washington **Section-2 (Poetry)** 3.5 Where the Mind is without Fear by R N Tagore 3.6 Ode on Solitude by Alexander Pope 3.7 Stopping by Woods on a Snowy Evening by Robert Frost 3.8 A Psalm of Life by H W Longfellow	
TSO 4a. Form new words adding prefix and suffix to the given root words. *TSO 4b.* Write synonyms and antonyms of the given words. *TSO 4c.* Use the given idioms and phrases in your own sentences. *TSO 4d.* Distinguish between acronym and abbreviation. *TSO 4e.* Prepare a list of technical jargons of your respective branch. *TSO 4f.* Identify the parts of speech of the specific words in the given sentences. *TSO 4g.* Fill in the blanks with suitable verb forms in the given sentences. *TSO 4h.* Transform the given sentences as directed. *TSO 4i.* Punctuate the given paragraphs.	**Unit-4.0 Vocabulary and Grammar** 4.1 Word Formation: Prefix, Suffix, Acronym 4.2 Synonyms, Antonyms, Homonyms, One Word Substitution, Idioms and Phrases 4.3 Technical Jargons -Related to the respective program 4.4 Parts of speech 4.5 Time and Tense 4.6 Transformation: Voice, Narration, Removal of 'Too', Question Tag 4.7 Punctuation	**CO4, CO5**
TSO 5a. Write the precis of the given passage with suitable title. TSO 5b. Draft letters and applications for the given purpose. TSO 5c. Compose E-mails, Notices, Memos, and Circulars. TSO 5d. Prepare reports of the projects of your respective branch. TSO 5e. Write a report on the events organized in your institute.	**Unit-5.0 Professional Writing** 5.1 Precis Writing 5.2 Business Letters / Applications 5.3 Drafting E-mails, Notices, Memos, Circulars 5.4 Report Writing: Project and Event/ Incident Report Writing	**CO5**
Part -B (हिंदी) *TSO 1a* सम्प्रेषण कौशल का अर्थ स्पष्ट कर सकेंगे. *TSO 1b* भाव एवं सम्प्रेषण में अंतर बता पाएँगे. *TSO 1c* सम्प्रेषण की प्रक्रिया का उल्लेख कर सकेंगे. *TSO 1d* श्रवण अविव्यक्ति, वाचन और लेखन की अवधारणा को स्पष्ट कर सकेंगे. *TSO 1e* सम्प्रेषण कौशल के निर्धारिक तत्वों का विवेचन कर सकेंगे. *TSO 1f* प्रभावशाली सम्प्रेषण के सिद्धांतों का समावेश अपने वार्तालाप में कर सकेंगे.	**Units-1.0: सम्प्रेषण सिद्धान्त एवं व्यवहार** 1.1 सम्प्रेषण : परिचय , अर्थ एवं परिभाषा 1.2 सम्प्रेषण की प्रक्रिया एवं तत्त्व 1.3 सम्प्रेषण के प्रकार : औपचारिक एवं अनौपचारिक, शाब्दिक एवं अशब्दिक 1.4 प्रभावशाली सम्प्रेषण के सिद्धांत एवं सम्प्रेषण व्यवधान कुरुक्षेत्र में श्रीकृष्ण- अर्जुन संवाद	**CO1, CO2, CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	महाभारत युद्ध प्रारम्भ होने से पहले कुरुक्षेत्र में श्री कृष्ण ने अर्जुन के प्रश्नों के उत्तर देते हुए जीवन के सूत्र समझाए थे।ये उपदेश श्रीमद्भागव गीता में मिलते	
TSO 2a तकनीकी कौशल एवं व्यव्हार कौशल में अन्तर बता पाएँगे . TSO 2b व्यव्हार कौशल का म महत्व स्पष्ट कर पाएँगे . TSO 2c आत्मा जागरूकता एवं आत्मा विश्लेषण का विवेचन सोदाहरण कर पाएँगे . TSO 2d भावनात्मक बुद्धिमत्ता एवं करुणा, अनुकूलनशीलता एवं लचीलापन का विकास कर पाएँगे. TSO 2e दैनिक जीवन में अनुकूलनशीलता एवं लचीलापन को आत्मसात कर पाएँगे .	**Unit-2.0: व्यावसायिकउत्कृष्टता हेतु व्यव्हार कौशल** 2.1 परिचय : तकनीकी कौशल एवं व्यवहार कौशल 2.2 व्यवहार कौशल का महत्त्व 2.3 जीवन कौशल : आत्म जागरूकता एवं आत्म विश्लेषण 2.4 वनात्मक बुद्धिमत्ता एवं करुणा, अनुकूलनशीलता एवं लचीलापन, व्यवहार कौशल का उपयोग श्रीराम केवट संवाद श्रीराम जब लक्ष्मण और सीता के साथ वन गमन के लिए प्रस्थान करते हैं तब सरयू नदी के पार उतारने लिए केवट से अनुरोध करते हैं।	**CO1**
TSO 3aपठित गद्यांश एवं पद्यांश से प्राप्त नयी शब्दावली विकसित कर पाएँगे TSO 3b दिए गये कहानियों, कविताओं एवं निबंधों का सारांश अपने शब्दों में लिख पाएँगे. TSO 3c दिए गये कहानियों, कविताओं एवं निबंधों में प्रयुक्त मुहावरों एवं अलंकारों को बता पाएँगे . TSO 3d कविताओं का भावार्थ स्पष्ट कर पाएँगे .	**Unit-3.0: पाठ-बोध : शब्दावली परिवर्धन एवं व्याकरण अभ्यास** 3.1 नमक का दरोगा, ईदगाह – मुंशी प्रेमचंद 3.2 बात (निबंध)- प्रताप नारायण मिश्र 3.3 वह प्रदीप जो दिख रहा है झिलमिल दूर नहीं है – रामधारी सिंह दिनकर 3.4 नर हो न निराश करो मन को – मैथिलीशरण गुप्त 3.5 कबीर के दोहे -काल्ह करे सो आज कर , जाति न पूछो साधू की , ऐसी वाणी बोलिए	**CO4**
TSO 4a अपनी शाखा से सम्बन्धित तकनीकी शब्दावली का चयन कर पाएँगे . TSO 4b पर्यायवाची एवं विलोम शब्दों से सम्बंधित शब्दावली तैयार कर सकेंगे . TSO 4c दिये गये गद्यांशों में विराम चिह्नों का सही प्रयोग कर पाएँगे .	**Unit-4.0: शब्दावली एवं व्याकरण** 2 Hrs 4.1 सामान्य शब्दावली 4.2 प्रशासनिक शब्दावली 4.3 शब्द भेद, अनेक शब्दों के लिए एक शब्द 4.4 विराम चिन्ह 4.5 मुहावरें एवं कहावतें	**CO4** **CO5**
TSO 5a दिए गये दिए गये गद्यांशों का संक्षेपण कर पाएँगे . TSO 5b विभिन्न प्रकार के पत्रों, आवेदनों ,सूचनाओं, विज्ञप्तियों को लिख पाएँगे . TSO 5c अपनी शाखा से सम्बंधित प्रतिवेदन लेखन कर पाएँगे . TSO 5d अपने संस्थान में हुए आयोजनों का प्रतिवेदन लिख पाएँगे.	**Unit-5.0: लेखन कौशल** 5.1 सार- लेखन 5.2 औपचारिक एवं व्यवसायिक पत्र लेखन 5.3 प्रारूप लेखन – सूचना, निविदा लेखन, प्रतिवेदन लेखन, बायोडाटा	**CO5**

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400104 These practical's are common for both Part – A and Part -B.

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.a Identify the emotions of the speakers.	1	Emotions of the speakers.	CO1
LSO2.a Interpret instructions of audio transcripts.	2	Instructions of audio transcripts.	CO1
LSO3.a Solve the language puzzles based on the audio transcript.	3	Language puzzles.	CO1
LSO4.a Repeat words on language lab software after listening to them.	4	Repetition of words	CO1
LSO5.a Summarize the excerpt in their own words.	5	Summarize the excerpt.	CO1
LSO6.a Answer the questions based on the listening excerpt	6	Listening excerpt	CO2
LSO7.a Differentiate the sounds of minimal pairs, syllables, words, etc.	7	Sounds of minimal pairs, syllables words etc.	CO2
LSO8.a Pronounce the words/ sentences correctly based on the phonetic transcription.	8	Phonetic transcription.	CO2
LSO9.a Read out the words and sentences based on stress and intonation marks.	9	Stress and intonation.	CO2
LSO10.a Apply the paralanguage codes in verbal dialogues to show different emotions.	10	Paralanguage Codes	CO2
LSO11.a Integrate the non-verbal codes in their verbal dialogues.	11	Non-verbal Codes	CO2
LSO12.a Correct the verbal and non-verbal presentations of their peer while giving feedback.	12	Feedback on Presentations	CO2
LSO13.a Differentiate the sounds of minimal pairs, syllables, words, etc.	13	Syllables and Words	CO2
LSO14.a Locate the dictated words from the excerpt.	14	Dictated words	CO3
LSO15.a Arrange the correct and logical sequence of the jumbled sentences.	15	Jumbled Sentences.	CO3
LSO16.a Read the given texts aloud with proper pauses and proper pronunciation.	16	Pronunciation.	CO3
LSO17.a Compare the point of view with their peers.	17	Point of view of Self and Peers	CO4
LSO18.a Identify the main ideas of the excerpt	18	Main ideas of the excerpt	CO4
LSO19.a Prepare a list of technical jargon and register specific to their program /industry.	19	Technical Jargons	CO5
LSO20.a Write the specifications of the machines/ equipment available in the workshops/labs.	20	Specifications of the machines/ equipment	CO5
LSO21.a Write a report on the projects of their respective branches.	21	Report on the Projects	CO5

L) Suggested Term Work and Self-Learning: S2400104 Some sample suggested assignments, micro-projects, and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Visit your institute's library/ web search and enlist the books, journals, and magazines related to your respective branches to prepare a bibliography consisting of names of the authors, titles of the books, publication, and place of publication.
2. SWOT Analysis: Analyze yourself concerning your strengths and weaknesses, opportunities, and threats for your communication.
3. Interview an eminent personality and write a report on it.
4. Deliver a seminar for 10-12 minutes using PPT on the topic given.
5. Prepare your timetable for a week and prioritize your activities.
6. Visit any historical places/offices/farms/industries/development sites etc. near your city and prepare a report on it.
7. Prepare a video of effective professional communication after listening to Bhagwat Geeta's conversation between Arjun and Krishna in the war field (IKS).

b. Micro Projects:

i. Book review – students should read a book and then write their reviews about the book and present it in the class.
ii. Interview any successful person in your locality in context with his life journey, inspiration social contribution, role model, and keys to success.
iii. Prepare a register of technical jargon of the industry related to their specific branch.
iv. Prepare a presentation on environmental issues of their locality with their solution.
v. Listen to the dialogues of the conversation between Krishna and Arjun before the war for specific and effective Communication (IKS)

c. Other Activities:

1. Arrange a Blood Donation Camp in collaboration with a blood bank and prepare a communication plan for the same.
2. Organize a cleanliness campaign in your campus premises and nearby places and prepare hoardings, boards, collages, and posters for the same.
3. Organize a campaign on educational awareness in the nearby places and prepare an advertising campaign for the same.

d. Self- learning topics:

- Listen to different Conversations of Ramayana,(the Rama -Bharat conversation before going to Vanvaas) Mahabharata (Bheem and Arjun Conversation during War), and Bhagwat Geeta (discussions of Strategies before War) to develop effective communication Skills (IKS)
- Collect new words from daily newspapers.
- Observe negotiation skills in the nearby shops.
- Watch educational channels for improving English communication.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use the appropriate assessment strategy and its weightage in theory, laboratory, and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**. This matrix has been prepared considering both Part – A and Part -B.

COs (Includes in Part -A & B)	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	20%	15%	20%	-	20%	20%
CO-2	10%	15%	10%	20%	25%	10%	20%
CO-3	20%	25%	15%	20%	25%	15%	20%
CO-4	25%	20%	30%	20%	25%	15%	20%
CO-5	30%	20%	30%	20%	25%	40%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self-learning, seminars, visits, surveys, product development, software development, etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
(Part - A) **Unit-1.0** Communication Theory and Practice	5	CO1, CO2	10	3	3	4
Unit- 2.0 Types of Communication	5	CO3	8	2	2	4
Unit-3.0 Reading Comprehension	8	CO4, CO5	12	3	3	6
Unit-4.0 Vocabulary and Grammar	7	CO4, CO5	10	3	3	4
Unit-5.0 Professional Writing	7	CO5	10	3	4	3
(Part-B) **Units-1.0:** सम्प्रेषण सिद्धान्त एवं व्यवहार	2	CO1, CO2	3	1	1	1
Unit-2.0: व्यावसायिक उत्कृष्टता हेतु व्यव्हार कौशल	2	CO3	3	1	1	1
nit-3.0: पाठ-बोध :शब्दावली परिवर्धन, एवं व्याकरण अभ्यास	5	CO4, CO5	5	1	1	3
Unit-4.0: शब्दावली एवं □□□□□□□	4	CO5	5	1	1	3
Unit-5.0: लेखन कौशल	3	CO5	4	2	1	1

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Total	48	-	70	20	20	30

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1	Emotions of the Speakers.	CO1	30	60	10
2	Instructions of Audio Transcripts.	CO1	30	60	10
3	Language Puzzles.	CO1	30	60	10
4	Repetition of Words.	CO1	30	60	10
5	Summarize the Excerpts.	CO1	30	60	10
6	Listening Excerpts.	CO2	30	60	10
7	Sounds of minimal Pairs, Syllables and Words etc.	CO2	30	60	10
8	Phonetic Transcription.	CO2	30	60	10
9	Stress and Intonation.	CO2	30	60	10
10	Paralanguage Codes	CO2	30	60	10
11	Non-Verbal Codes	CO2	30	60	10
12	Verbal and Non-Verbal Presentations	CO2	30	60	10
13	Sounds of minimal pairs, syllables and words	CO2	30	60	10
14	Locate the Dictated Words	CO3	30	60	10
15	Jumbled Sentences.	CO3	30	60	10
16	Pronunciation.	CO3	30	60	10
17	Compare the Point of view with their Peers.	CO4	30	60	10
18	Main Ideas of the Excerpt	CO4	30	60	10
19	Technical Jargons	CO5	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
20	Specifications of the machines/ equipment	CO5	30	60	10
21	Report on the Projects	CO5	30	60	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	High end computers	Intel® Core™ i5-9400 (6-Core, 9MB Cache, up to 4.1GHz with Intel® Turbo Boost Technology) RAM: 8GB DDR 4 HDD: 3.5" 1TB 7200RPM SATA Hard Drive OS: Windows 10 Pro 64bit OEM License Other ports: Gigabyte LAN card	1 to 21
2.	Language Lab software	Teacher console supporting audio-visual language lab	1 to 21
3.	Printer	LaserJet printer	1 to 21
4.	Head Phones with microphones	Logitech H111 wired on headphones	1 to 21
5.	Computer Furniture	Computer Desk, chair	1 to 21
6.	Smart Projector	Standard Specification	1 to 21

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Communication Skills in English (AICTE Prescribed Text Book)	Dr. Anjana Tiwari	Khanna and Khanna, New Delhi
2.	Business Communication	Dr. Nishith Rajaram Dubey, Anupam Singh	Publisher: Indra Publishing House, 2023, ISBN- 978-93-93577-69-6
3.	Communication Skills	Sanjay Kumar & Pushap Lata	Oxford University Press, India
4.	Employability Skills	Dr. Nishith Rajaram Dubey, Anupam Singh	Indra Publishing House, 2023 ISBN - 978-93-93577-68-9

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
5	Technical Communication for Engineers	Shalini Verma	S. Chand
6.	English Grammar	Raymond Murphy	S. Chand
7.	British English Grammar and Composition	Dr. Ashok Kumar Singh	Student's Friends
8.	A Textbook of English Phonetics	T. Balasubramanian	Macmillan Publishers
9.	Thesaurus of English Words and Phrases	Roget	Simon and Schuster
10	Better English Pronunciation	J. D. O'Connor	Cambridge: Cambridge University Press, 1980
11	An English Grammar: Comprehending Principles and Rules	Lindley Murray.	London: Wilson and Sons, 1908.
12	Effective Communication Skills	Kulbhushan Kumar	Khanna Publishing House, New Delhi (Revised Edition 2018)
13	Examine your English	Margaret M. Maison	Orient Longman: New Delhi, 1964
14	Collin's English Dictionary	Harper Collins	Harper Collins, Glasgow
15	संप्रेषण कौशल	डॉ प्रवीण कुमार अग्रवाल , डॉ अवनीश कुमार मिश्रा	साहित्य भवन पब्लिकेशन : आगरा
16	आधुनिक हिंदी व्याकरण और रचना	डॉ वासुदेवनंदन प्रसाद	भारती भवन पब्लिकेशन

(b) Online Educational Resources:

1. https://www.academia.edu/37871134/COMMUNICATION_SKILLS_1ST_YR_2_pdf
2. https://socialsci.libretexts.org/Courses/Butte_College/Exploring_Intercultural_Communication_(Grothe)/05%3A_Nonverbal_Processes_in_Intercultural_Communication/5.02%3A_Types_of_Nonverbal_Communication
3. http://muhamadjaelani35.blogspot.com/2014/11/inquiry-letter-order-letter-complaint.html?m=1
4. https://www.slideshare.net/sundaredu/barriers-of-communication-53545680
5. https://allpoetry.com/where-the-mind-is-without-fear
6. https://www.poetryfoundation.org/poems/46561/ode-on-solitude
7. https://www.poetryfoundation.org/poems/44644/a-psalm-of-life
8. https://www.poetryfoundation.org/poems/42891/stopping-by-woods-on-a-snowy-evening
9. https://www.hindisamay.com/content/
10. http://kavitakosh.org/
11. https://bundelkhand.in/maithilisharan-gupt/nar-ho-na-nirash-karo-man-ko
12. https://etc.usf.edu/lit2go/92/up-from-slavery/1575/chapter-3-the-struggle-for-an-education/
13. https://oursmartstudy.com/english-chapter-1-class-12-pdf-download/
14. https://ve-iitg.vlabs.ac.in/Listening%20Skills(Procedure).html
15. https://nptel.ac.in/courses/109104031

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. https://nptel.ac.in/courses/

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A) Course Code : **2425104(T2425104/P2425104/S2425104)**

B) Course Title : Engineering Mechanics
(ELX, ELX (R), TE, CE, ME, EE, ME (Auto), MIE, FTS, AE, CRE, CHE)

C) Pre- requisite Course(s) :

D) Rationale :

In day-to-day working we come across different types of structures created for different purposes and functions, while designing the structures, analysis of forces and stresses' is an important and prerequisite step. Correct analysis is possible only when one knows the types and effects of forces acting on the structures. This course provides the scope to understand fundamental concepts of laws of mechanics and their applications to different engineering problems. This course is designed to provide basic understanding about the different types of forces, moments and their effects on structural elements and to analyze different structural systems. The aim of this course is to help the student to comprehend the importance of applied mechanics and apply the principles of engineering mechanics to solve engineering problems.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Compute the force to solve the problems
- **CO-2** Analyse various analytical and graphical conditions required for equilibrium of engineering systems.
- **CO-3** Apply the principles of friction in various conditions to solve problems.
- **CO-4** Calculate centroid, center of gravity and moment of Inertia of different geometrical shapes.
- **CO-5** Select the relevant lifting machine(s) for the given purposes.

F) Suggested Course Articulation Matrix (CAM):

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**
CO-1	3	-	-	2	1	-	-		
CO-2	2	3	3	3	2	-	-		
CO-3	3	3	3	2	2	1	1		
CO-4	3	3	3	2	2	1	1		
CO-5	3	2	2	3	3	1	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2425104	Engineering Mechanics	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2425104	Engineering Mechanics	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2425104

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain concepts of the given terms. *TSO 1b.* Use relevant units of various quantities in the given situations. *TSO 1c.* Explain effects of a force on the given object. *TSO 1d.* Resolve the given single force. *TSO 1e.* Calculate the resultant of the given force system. *TSO 1f.* Find the resultant of the given force system using law of parallelogram *TSO 1g.* Determine graphically the resultant of the given force system by triangle law and polygon law.	**Unit-1.0 Mechanics and Force System** 1.1 Significance and relevance: Mechanics, applied mechanics, statics and dynamics. 1.2 Space, time, mass, particle, body, rigid body. 1.3 Scalar and vector quantity, Units of measurement (SI units) Fundamental units and derived units. 1.4 Force - unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force. Force system and its classification. 1.5 Resolution of a force - Orthogonal and Non-Orthogonal components of a force, moment of a force, Avignon's Theorem. 1.6 Composition of forces - Resultant, analytical method of determination of resultant for concurrent, non-concurrent and parallel co-planar force systems -Law of triangle, Law of parallelogram and law of polygon of forces. 1.7 Graphic statics, graphical representation of force, Space diagram, force diagram, polar diagram and funicular polygon, Graphical method of determination of resultant for concurrent and parallel co-planar force systems.	**CO1, CO2**
TSO 2a. Draw the free body diagram for the given condition. *TSO 2b.* Determine unknown force in the given situation using Lami's theorem. *TSO 2c.* Identify the types of beams required for the given situation. *TSO 2d.* Determine reactions in the given type of beam analytically. *TSO 2e.* Solve problems using free body diagram and Lami‟s theorem.	**Unit-2.0 Static Equilibrium** 2.1 Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical conditions of equilibrium. 2.2 Equilibrium of force systems analytically 2.3 Lami's Theorem. 2.4 Types of beam (determinate and indeterminate), supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, distributed load, load, couple), span of beam. 2.5 Beam reaction for cantilever, simply supported beam with or without overhang - subjected to combination of Point load and LTD load or Vertical Point load and couple. 2.6 Beam reaction for simply supported beam subjected to vertical loads only.	**CO1, CO2**
TSO 3a. Calculate force of friction and coefficient of friction for the given condition or situation *TSO 3b.* Describe the conditions for friction for the given situation. *TSO 3c.* Identify the various forces acting on a ladder for the given conditions using free body diagram.	**Unit 3.0 Friction** 3.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between	**CO3, CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3d. Compare the value of coefficient of friction between different surfaces. *TSO 3e.* Interpret the effect of change of masses, change of angle of inclination or both on the coefficient of friction *TSO 3f.* Calculate forces acting on a body that is moving on a horizontal rough surface *TSO 3g.* Determine the forces acting on a body that is moving on an inclined plane	co-efficient of friction and angle of friction. 3.2 Equilibrium of bodies on level surface subjected to force parallel and 3.3 inclined to plane. 3.4 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. FBD of ladder in friction.	
TSO 4a. Distinguish between centroid and center of gravity *TSO 4b.* Calculate the centroid of geometrical plane figures. *TSO 4c.* Calculate centroid of the given composite plane lamina *TSO 4d.* Determine centre of gravity of the given simple solid. *TSO 4e.* Determine centre of gravity of the given composite solid. *TSO 4f.* Calculate Moment of Inertia of different geometric shapes.	**Unit 4.0 Centroid, Centre of Gravity and Moment of Inertia** 4.1 Introduction to Centroid, Centre of Gravity and Areas 4.2 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle). 4.3 Centroid of composite figures composed of not more than three geometrical figures and centroid of perforated section, axis of symmetry 4.4 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere). 4.5 Centre of Gravity of composite solids composed of not more than two simple solids. 4.6 Moment of inertia - Introduction, calculation of moment of inertia by integration method, theorem of perpendicular axis, theorem of parallel axis, moment of inertia of a rectangular section, hollow rectangular section, circular section, hollow circular section, triangular section	**CO4**
TSO.5a Describe the components of the given lifting machine. TSO.5b Differentiate the working principle of the given two types of lifting machines. TSO.5c Determine velocity ratio, efficiency of the given lifting machine. TSO.5d Calculate effort required and load lifted by the given lifting machine. TSO.5e Draw the graph with the given data TSO.5f Interpret the given graphs TSO.5g Select the relevant lifting machine for the given purpose with justification	**Unit-5.0 Simple Lifting Machine** 5.1 Simple lifting machine, load, effort, mechanical advantage, Applications and advantages. Velocity ratio, efficiency of machines, Law of machine. 5.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility 5.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Screw jack, Weston's differential pulley block, geared pulley block. 5.4 Graphs of Load verses Effort, Load verses ideal Effort, Load verses Effort lost in friction, Load verses MA, Load verses Efficiency.	**CO2, CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425104

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use force polygon table to determine the resultant of concurrent forces	1.	Determine resultant of concurrent coplanar force system using force polygon table.	CO1, CO2
LSO 2.1 Apply Lami's theorem LSO 2.2 Use simply supported beams to find reactions	2.	Determine unknown force in a concurrent balance force system using Lami's Theorem.	CO1, CO2
	3	Find reactions at the supports of a simply supported beam and compare the results with analytical values.	
	4	Determine the support reactions for simply supported beam by • Beam reaction apparatus • Circular dial type weight	
LSO 3.1. Apply law of friction on horizontal plane and inclined plane *LSO 3.2.* Coefficient of friction between different materials *LSO 3.3.* Coefficient of friction between belt and pulley.	5	Determine coefficient of friction on horizontal and inclined plane.	CO2, CO3
	6	Determine the co efficient of friction between two surfaces by • angle of repose methods • friction plane method	
	7	Find the coefficient of friction between belt and pulley in a belt friction set up.	
LSO 4.1. Determine the centroid of different geometrical figures. *LSO 4.2.* Find moment of inertia	8	Determine the centroid of geometrical plane figures (squares, rectangle, triangle)	CO4
	9	Determine the moment of inertia of a fly wheel	
LSOs 5.1 Use simple screw jack *LSOs 5.2* Use differential axle and wheel *LSOs 5.3* Use single and double purchase crab winch *LSOs 5.4* Use jib crane *LSOs 5.5* Use worm and worm wheel apparatus	10	Find M.A, V.R and efficiency of screw jack.	CO5
	11	Find M.A, V.R and efficiency of differential wheel and axle	
	12	Calculate the efficiency of single purchase crab winch and double purchase crab winch	
	13	Determine forces in jib crane.	
	14	Determine the efficiency of worm and worm wheel.	

L) Suggested Term Work and Self Learning: S2425104 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

- Visit nearby tool room/industry and collect information regarding lifting machine used with their technical specification and their application and prepare comparison chart.
- prepare model of simple lifting machine.
- Prepare models of beam subject to point load, uniformly distributed loads, simply supported, overhang beam.
- Prepare chart showing real-life examples including various types of forces.

c. Other Activities:

1. Seminar Topics:
   - Collision of elastic bodies
   - Law of **conservation of energy**
   - concept of parallel axis and perpendicular axes theorem

2. Visits: Visit nearby tool room/industry with workshop facilities. Prepare report of visit with special comments of simple lifting machine to be used.

3. Self-Learning Topics:
   - Types of load and beam.
   - Various force system.
   - Simple lifting machine.
   - Centroid of various plane figure

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	30%	15%	-	-	20%	20%
CO-2	10%	20%	10%	25%	-	10%	20%
CO-3	15%	20%	15%	25%	33%	15%	20%
CO-4	30%	10%	30%	25%	33%	15%	20%
CO-5	30%	20%	30%	25%	34%	40%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Mechanics and force system	14	CO1, CO2	16	5	3	8
Unit-2.0 Static Equilibrium	10	CO1, CO2	14	4	2	8
Unit-3.0 Friction	8	CO2, CO3	14	5	3	6
Unit-4.0 Centroid, Centre of gravity and Moment of Inertia	6	CO4	12	2	2	8
Unit-5.0 Simple Lifting Machine	10	CO2, CO5	14	4	4	6
Total	**48**	**-**	**70**	**20**	**14**	**36**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine resultant of concurrent coplanar force system using force polygon table.	CO1	45	45	10
2.	Determine unknown force in a concurrent balance force system using Lami's Theorem.	CO2	40	50	10
3.	Find reactions at the supports of a simply supported beam and compare the results with analytical values.	CO2	30	60	10
4.	Determine the support reactions for simply supported beam by • Beam reaction apparatus • Circular dial type weight	CO1, CO2	30	60	10
5.	Determine coefficient of friction on horizontal and inclined plane.	CO2, CO3	40	50	10
6.	Determine the co efficient of friction between two surfaces by • Angle of repose method • Friction plane method	CO2, CO3	40	50	10
7.	Find the coefficient of friction between belt and pulley in a belt friction set up.	CO2, CO3	30	60	10
8.	Determine the centroid of geometrical plane figures (squares, rectangle, triangle)	CO4	40	50	10
9.	Determine the moment of inertia of a fly wheel	CO4	40	50	10
10.	Find M.A, V.R and efficiency of screw jack.	CO2, CO5	30	60	10
11.	Find M.A, V.R and efficiency of differential wheel and axle	CO2, CO5	30	60	10
12.	Calculate the efficiency of single purchase crab winch and double purchase crab winch	CO2, CO5	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Determine forces in jib crane.	CO1, CO2	40	50	10
14.	Determine the efficiency of worm and worm wheel	CO2, CO5	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment and Tools	Broad Specifications	Relevant Experiment/Practical Number
1.	Differential axle and wheel	wall mounted unit with the wheel of 40 cm diameter and axles are insteps of 20 cm and 10 cm reducing diameter	11
2.	Simple screw Jack	Table mounted metallic body, screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	10
3.	Worm and worm wheel	wall mounted unit with threaded spindle. load drum. effort wheel: with necessary slotted weights. hanger and thread.	14
4.	Single Purchase Crab winch	Table mounted heavy cast iron body. The wheel is of C.L material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	12
5.	Double Purchase Crab winch	Having assembly same as above but with double set of gearing arrangement.	11
6.	Weston's Differential pulley block	Consisting of two pulleys; one bigger and other smaller	13
7.	Weston's Differential worm geared pulley block	Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weight.	13
8.	Universal Force Table	Consists of a circular 40 cm dia. Aluminum disc. graduated into 360 degrees. with all accessories.	1, 2
9	Beam Reaction apparatus	The apparatus is with two circular dial type 10 kg.	3,4
10.	Friction apparatus for motion along horizontal and inclined plane	Base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees_ pan. Two weight boxes (each of 5 gm.10 cm, 2-20 gm. 2-50 gm, 2-100 gm, weight.	5,6
11	Set-up for belt friction apparatus	V and Flat Belt, Cap screw, Spring balance, Belt pulley, Torque cord, Load hanger x2, Weights	7

S. No.	Name of Equipment and Tools	Broad Specifications	Relevant Experiment/Practical Number
12	Fly wheel apparatus	flywheel, weight hanger with slotted weights, stop clock, metre scale etc	9
13	Jib crane	Jib Apparatus, Weight, Meter Rod, Set Square	13
14	Models of geometrical figures	Models of geometrical figures	8

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Applied Mechanics	R.S. Khurmi	S.Chand &Co. New Delhi 2014 ISBN: 9788121916431
2.	Engineering Mechanics	S. Ramamrutham	S Chand & Co. New Delhi 2008ISBN:9788187433514
3.	Foundations and Applications of Applied Mechanics	H.D. Ram A.K Chauhan	Cambridge University Press. Thomson Press India Ltd., NewDelhi, 2015, ISBN: 9781107499836
4.	Engineering Mechanics- Statics, Vol.1	J.L. Meriam L.G Kraige	Wiley Publication, New Delhi, ISBN: 978-81-265-4396
5.	Applied mechanics	R.K.Rajput	Laxmi publications (p) ltd. ISBN-13: 8105809631
6	Engineering Mechanics	A.R. Basu	TMH Publication, New Delhi
7	Engineering Mechanics	Timosheenko, Young & Rao	TATA McGraw-Hill Education, New Delhi

(b) Online Educational Resources:

1. http://www.asnu.com.au
2. www.youtube.com for videos regarding machines and applications, friction
3. www.nptel.ac.in
4. www.discoveryforengineers.com

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

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A) Course Code : 2400105C(T2400105C/S2400105C)

B) Course Title : Applied Mathematics- C (EE, ELX, ELX (R))

C) Prerequisite Course(s) : Basic Engineering Mathematics

D) Rationale :

This course provides a strong foundation in mathematical concepts and techniques that can be applied in a variety of settings and can help them develop important problem-solving and logical thinking skills that are valuable in a variety of career paths. Integral calculus and differential equations are fundamental tools in the study of mathematics and are used in a wide range of fields, especially including problems related to electrical and electronic engineering applications. Numerical methods provide a way to solve problems quickly and easily compared to analytic solutions. Laplace Transform methods have a key role to play in the modern approach to the analysis and design of engineering systems. Laplace Transform is also widely used by Electronic Engineers to solve quickly differential equations occurring in the analysis of electronic circuits and to simplify calculations in system modeling. Complex numbers are used by Electrical and Electronic Engineers to define the AC concept of Impedance, and in Fourier analysis, they are used in the processing of radio, telephone, and video signals. Fourier series is used in designing electrical circuits, signal processing, signal analysis, image processing & filtering. Fourier Transform has wide applications in cell phones, LTI systems & circuit analysis, and also in solving differential equations.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of the following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor, and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Demonstrate the ability to solve engineering-related problems based on applications of integration.
- **CO-2** Use differential equations as a tool to solve problems related to electrical and electronic engineering.
- **CO-3** Select a suitable method to solve nonlinear equations based on engineering applications.
- **CO-4** Use Laplace transforms to solve given differential equations based on engineering applications.
- **CO-5** Apply Fourier series and Fourier transform to solve broad-based electrical and electronic engineering-related problems.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Program 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**
CO-1	3	1	-	-	-	-	-		
CO-2	3	2	-	-	-	-	-		
CO-3	3	2	-	-	-	-	-		
CO-4	3	3	2	1	-	-	1		
CO-5	3	3	1	1	-	-	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400105C	Applied Mathematics - C	02	01	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/ implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/ practical performances / problem-based experiences in laboratory, workshop, field or other locations using different instructional/ Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1xCIhours) + (0.5xLIhours) + (0.5xNotionalhours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400105C	Applied Mathematics - C	30	70	20	30	-	-	150

Legend:

PTA: Progressive Theory Assessment in the classroom (includes class test, mid-term test, and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro-projects, industrial visits, self-learning, any other student activities, etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignments, micro-projects, seminars, and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria for internal as well as external assessment may vary as per the requirement of the respective course. For valid and reliable assessment, the internal faculty should prepare a checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW), and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to the attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020-related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS), and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400105C

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Use standard forms of integration to find the integral of given simple functions. *TSO 1b.* Apply suitable Trigonometric transformation to solve a given Integration problem. *TSO 1c.* Solve given problems using the properties of the definite integral. *TSO 1d.* Invoke the concept of Integration to solve problems based on the area and volume of irregular shapes.	**Unit-1.0 Integral Calculus and its Applications** 1.1 Concept and Definition of Integration. 1.2 Working rules and Integral of standard Functions. 1.3 Method of Substitution, Trigonometric transformation, Integration by parts, and Partial fraction. 1.4 Applications: Area and volume.	**CO1**
TSO 2a. Find the order and degree of given differential equations. *TSO 2b.* Solve differential equations using the variable-separable method. *TSO 2c.* Obtain the solution of a given homogeneous differential equation. *TSO 2d.* Solve the given linear differential equation based on engineering application. *TSO 2e.* Solve the given Bernoulli differential equation. *TSO 2f.* Solve the homogeneous linear differential equations of second order with constant coefficient.	**Unit-2.0 Differential Equations** 2.1 Concept and Definition, Order, and Degree of Differential Equation. 2.2 Differential equation of first order and first degree, Variable-Separable Method. 2.3 Homogeneous, linear Differential equation and Bernoulli equation. 2.4 Homogeneous linear differential equations of second order with constant coefficient.	**CO2**
TSO 3a. Find the root of the given equation using iterative methods up to the desired accuracy. *TSO 3b.* Calculate the root of given equations using the Newton-Raphson Method. *TSO 3c.* Apply the Newton-Raphson Method for engineering applications. *TSO 3d.* Solve problems using the Bakhshali iterative method for finding approximate square roots. (IKS)	**Unit-3.0 Numerical Solution of Nonlinear Equations** 3.1 Algebraic and Transcendental equations. 3.2 Iterative Methods. 3.3 Newton-Raphson Method. 3.4 Bakhshali iterative method for finding the approximate square root. (IKS)	**CO3**
TSO 4a. Solve given problems based on the algebra of complex numbers. *TSO 4b.* Use Laplace transform to solve the given problems. *TSO 4c.* Solve the given problems based on properties of Inverse Laplace transform for engineering applications. *TSO 4d.* Apply Laplace transform to solve differential equations occurring in the analysis of electronic circuits.	**Unit-4.0 Complex Numbers and Laplace Transform** 4.1 Complex numbers: Cartesian, Polar and Exponential form, Algebra of complex numbers. 4.2 Laplace transform of standard functions (without proof). 4.3 Properties of Laplace transform such as linearity, first and second shifting properties (without proof). 4.4 Inverse Laplace transforms using the partial fraction method. 4.5 Laplace transforms applications to differential equations.	**CO4**
TSO 5a. Find the Fourier series of Square wave and triangular wave functions.	**Unit-5.0 Fourier Series and Fourier Transform**	**CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5b. Obtain Fourier transform of given functions. *TSO 5c.* Plot the graph of the Fourier series of the given function. *TSO 5d.* Plot the graph of the Fourier transform of the given function.	5.1 Periodic and Non-Periodic Functions. 5.2 Fourier series. 5.3 Fourier Transforms. 5.4 Fourier Transform of Simple Functions.	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Tutorials and Outcomes:

Outcomes	S. No.	Tutorials Titles	Relevant COs Number(s)
1.1 Calculate the area of the hexagon using integration. 1.2 Calculate the average temperature of a city over a certain period. 1.3 Measure the current-voltage characteristics of a semiconductor diode using integration. 1.4 Determine the total power consumed by an electrical device using Integration techniques. 1.5 Apply the concept of definite integration to find the volume.	1.	• Area of irregular shape using integration. • Average value of a function using integration. • Analysis of the performance of a diode through integration. • Calculation of power consumption using integration. • Volume of an irregular shape using integration.	**CO1**
2.1 Solve population dynamics using first-order ODEs. 2.2 Use first-order ODEs to calculate the charging and discharging of a capacitor in an electrical circuit. 2.3 Calculate the concentration of a reactant in a chemical reaction over time. 2.4 Calculate mechanical vibrations using second-order ODEs.	2.	• Analysis of a population model through differential equations. • Analysis of charging and discharging in an electrical circuit through differential equations. • Analysis of chemical system using ODEs • Vibrations of a mass-spring system.	**CO2**
1.1 Use Newton's method to find the roots of a non-linear equation in one variable. 1.2 Use the concept of Newton's method to solve financial modeling-related problems based on the Black-Scholes model. 1.3 Calculate the electric field (that satisfies Maxwell's equations) around a wire with a given shape and current, using Newton-Raphson's method. 1.4 Use Bakhshali iterative methods for finding the approximate value of the square root. (IKS)	3.	• Applications of iterative techniques. • Application of Newton-Raphson's method. • Iterative scheme using Newton's method. • Bakhshali iterative methods for finding the approximate value of square root. (IKS)	**CO3**
1.1 Use Laplace transform techniques to compare the performance of given control systems. 1.2 Use the Laplace transform to calculate the response of a given system to a step input.	4.	• Performance of control systems using Laplace transforms techniques. • Analysis of the performance through Laplace transforms techniques.	**CO4**

Outcomes	S. No.	Tutorials Titles	Relevant COs Number(s)
1.3 Use Laplace transform to analyze the dynamic behavior of given circuits.		• Analysis of the circuit's dynamic behavior through Laplace transforms techniques.	
1.1 Model Square wave and triangular wave as a Fourier series. 1.2 Analyze the frequency content of signals using Fourier series and Fourier transform.	5.	• Representation of waves through Fourier series. • Frequency distribution through Fourier series.	**CO5**

L) Suggested Term Work and Self-Learning: S2400105C Some sample suggested assignments, micro-projects, and other activities are mentioned here for reference.

a. Assignments: Questions/ Problems/ Numerical/ Exercises to be provided by the course teacher in line with the targeted COs.

1. Find the area of the region enclosed between two curves; also verify the obtained result geometrically using any open source software.
2. Evaluate the Integral of functions using open-source software.
3. Consider an RLC circuit with resistance R (measured in ohms) Inductance (measured in Henries) Capacitance C (measured in Faraday) and varying Voltage V(t) measured in Volts. Its current I(t) (measured in Amperes) satisfies L I''(t) + RI'(t)+1/c I(t)= V'(t). Solve the second-order differential equation with initial value conditions using open-source software.
4. Use open-source software to plot the family of curves and compute its differential equation.
5. Write down a program to compute the roots of transcendental equations by the Newton-Raphson method and execute the result.
6. Write down a program to compute the roots of nonlinear equations using the Iterative method and execute the result.
7. Graphical representation of Addition, Subtraction, and Multiplication of Complex numbers through any open-source software.
8. Use Fourier Transform to transform a signal sampled in time or space to the same signal sampled in temporal or spatial frequency with the help of any open source software.
9. Use the concept of Fourier Series to transform a signal from the time domain to the frequency domain.
10. Prepare notes on the Application of the Fourier Series in Control Theory.
11. Apply the Fourier Transform to solve a differential equation that relates the input and output of a system.

b. Micro Projects:

1. Prepare charts displaying various standard integration formulas.
2. Explore the use of Integral calculus to calculate the velocity and acceleration of a particle.
3. Prepare charts showing the area and volume of various geometrical shapes using Integral calculus.
4. Prepare a model as Differential equations to calculate the electric potential in a region.
5. Prepare a model showing the applications of differential equations for Newton's law of cooling.
6. Prepare a simulated environment to study the motion of a particle under the influence of gravity.
7. Prepare a comparative chart showing the convergence of various iterative techniques.
8. Prepare a chart consisting of 8-10 nonlinear equations made of real-world problems.
9. Download 5-7 videos based on applications of the Laplace transform using ordinary differential equations in the analysis of electronic circuits, watch them, and write a report to detail the mathematical steps involved.

10. Make a short video of duration 5-7 minutes for the use of Laplace transform to calculate the response of a system to an input signal.
11. Download 5-7 videos based on applications of Fourier transform for cell phones, LTI systems & circuit analysis, watch them, and write a report to detail the mathematical steps involved.
12. Make a short video of duration 10-15 minutes on engineering applications of Fourier series and Fourier transform especially related to the transmission of electromagnetic waves.

c. Other Activities:

1. Seminar Topics:
    - Applications of Integral calculus in control systems, dynamics, and vibrations.
    - Applications of Integral calculus in production and cost analysis.
    - Applications of Integral calculus in algorithms and optimization.
    - Applications of Integral calculus in population dynamics and bio-mathematics.
    - Applications of Integral calculus in filtering and feature extraction.
    - Solving Differential Equations through SCILAB.
    - Applications of Differential Equations in population dynamics and epidemiology.
    - Applications of Numerical Methods for electrical and electronics engineering.
    - Numerical Solution of Nonlinear Equations using Root-Finding Algorithms: Techniques and Applications.
    - Complex Numbers and their engineering applications: Electrical and electronics engineering.
    - Differential Equations with discontinued input via Laplace Transform: Techniques and Applications.
    - Laplace Transform in Control Systems: Applications in feedback systems, transfer function, and stability analysis.
    - Laplace Transform in Electrical Engineering: Applications in circuit analysis and network theory.
    - Fourier series in Signal Processing: Applications in filtering and feature extraction.
    - Fourier Transform in Engineering: Applications in control systems and dynamics.
    - Fourier Transform in Financial Mathematics: Applications in option pricing and portfolio optimization.

   Visits: Visiting the following places would provide students an opportunity to see the application of various branches of mathematics in different fields. This will also help students to comprehend the career opportunities available in the field of mathematics.
    - Visit to a mathematics museum.
    - Visit to a mathematics laboratory.
    - Visit to a Data Science Center.
    - Visit the mathematics department of a college or university.
    - Visit to a software Company.
    - Visit to a Space Agency.
    - Visit to a Gaming Studio.
    - Visit to a library.
    - Participation in mathematics-based competitions.

2. Self-Learning Topics:
    - Integration Techniques and Applications.
    - Participate in MOOCs on Ordinary Differential Equations: Methods and Applications.
    - The Newton-Raphson Method: rate of convergence.
    - Watching videos on Laplace Transformation: Concepts and Applications.
    - Watching video on the Fourier series Representation of Periodic Functions.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use the appropriate assessment strategy and its weightage in theory, laboratory, and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	20%	15%	-	-
CO-2	20%	20%	20%	20%	25%	-	-
CO-3	10%	10%	10%	20%	10%	-	-
CO-4	30%	30%	30%	20%	25%	-	-
CO-5	25%	25%	25%	20%	25%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	**-**	**-**
			50				

Legend:

*: Other Activities include self-learning, seminars, visits, surveys, product development, software development, etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentages given are approximate
- In the case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided among all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to the achievement of each CO.

N) Suggested Specification Table for End Semester Theory Assessment: The specification table represents the reflection of sample representation of assessment of the cognitive domain of the full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Integral Calculus and its Applications	8	CO1	12	4	4	4
Unit-2.0 Differential Equations	12	CO2	14	4	6	4
Unit-3.0 Numerical Solution of Nonlinear Equations	6	CO3	08	2	4	2
Unit-4.0 Complex Numbers and Laplace Transform	12	CO4	20	6	8	6
Unit-5.0 Fourier Series and Fourier Transform	10	CO5	16	4	6	6
Total	**48**	**-**	**70**	**20**	**28**	**22**

Note: A similar table can also be used to design class/ mid-term/ internal question papers for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lectures, Tutorial, Case Methods, Group Discussions, Industrial visits, Industrial Training, Field Trips, Portfolios, Learning, Role Play, Live Demonstrations in Classrooms, Labs, Field Information, and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	High-end computers	Processor Intel Core i7 with Compilers and Programming Languages, RAM 32 GB, DDR3/DDR4, HDD 500 GB, OS Windows 10.	All
2.	Software	Scientific Calculators, Graphing Calculator, SCILAB, GraphEq^2.13, Micro soft Mathematics, GeoGebra, Math3D	1,2,3,4,5
3.	Printer	High Speed Duplex Printer	4,5
4.	Scanner	Handheld 3D scanner, Accuracy up to 0.1 mm, Resolution up to 0.2 mm, Wireless technology with an inbuilt touch screen and battery, Extended field of view for capturing both large and small objects.	4,5

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Elementary Engineering Mathematics	B. S. Grewal	Khanna Publishers, 15th Edition. ISBN: 978-81-7409-257-1
2.	Engineering Mathematics (Third edition)	Croft, Anthony	Pearson Education, New Delhi, 2014. ISBN 978-81-317-2605-1
3.	Calculus and Its Applications	Marvin L. Bittinger David J. Ellenbogen Scott A. Surgent	Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1
4.	Calculus and Analytic Geometry	G. B. Thomas, R. L. Finney	Addison Wesley, 9th Edition, 1995. ISBN 978-8174906168
5.	Understanding Engineering Mathematics	John Bird	Routledge; First Edition ISBN 978-0415662840
6.	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publ., New Delhi,2014, ISBN: 978-0-470-45836-5
7.	Studies in the History of Indian Mathematics	C. S. Seshadri	Hindustan Book Agency (India) P 19 Green Park Extension New Delhi. ISBN 978-93-80250-06-9
8.	Mathematics-I	Deepak Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-42-4
9.	Mathematics-II	Garima Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-52-3

(b) Online Educational Resources:

1. https://ocw.mit.edu/
2. https://tutorial.math.lamar.edu/
3. https://www.khanacademy.org/
4. https://www.feynmanlectures.caltech.edu/
5. https://www.wolframalpha.com/
6. https://www.dplot.com/
7. https://www.geogebra.org/
8. https://www.easycalculation.com/
9. https://www.scilab.org/
10. https://www.desmos.com/
11. https://nptel.ac.in/

12. https://swayam.gov.in/
13. https://ndl.iitkgp.ac.in/
14. https://parakh.aicte-india.org/
15. https://ekumbh.aicte-india.org/
16. https://learnengg.com/LE/Index
17. https://ncert.nic.in/textbook.php
18. https://nios.ac.in/online-course-material/sr-secondary-courses/mathematics-(311).aspx

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

(c) Others:

1. Online Mathematics Courses.
2. Mathematics Communities and Forums.
3. Mathematics Journals.
4. Mathematics Podcast.
5. Mathematics Tutorials.
6. Mathematics Quizzes.
7. Mathematics Animations.
8. Mathematics Simulations.
9. Mathematics Games.
10. Mathematics Puzzles.
11. Mathematics Brain Teasers.
12. Mathematics Apps.
13. Mathematics Blog.
14. Mathematics Challenges.

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A) Course Code : **2400006(T2400006/P2400006/S2400006)**

B) Course Title : **Environmental Education and Sustainable Development**
(Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Every creature depends on nature for their survival. It is therefore, not only essential but also moral responsibility of all of us to keep our environment clean & in a good condition. The global environmental issues such as clean water and sanitation, affordable & clean energy, sustainable cities & communities, etc. are best addresses through sustainable development goals. Environmental education is one of the primary activities to spread the concept of sustainability on a broader scope. In India, environmental education is considered as mandatory for all segment of education including technical education. Every creature depends on nature for their survival. It is therefore, not only essential but also moral responsibility of all of us to keep our environment clean & in a good condition. The concept of sustainable development is closely associated with environmental education to promote developments. Considering importance of environmental education and sustainable development, it became necessary to provide basics of these areas to the engineering graduates. The knowledge gained through this course will help the diploma students to take engineering decisions aligned to ensure sustainability of environment for next generations through proper protection of environment.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- **CO-1** Explain the importance of ecosystem for the protection of environment
- **CO-2** Use relevant air & water pollution control methods to solve pollution related issues
- **CO-3** Recognize relevant energy sources required for domestic & industrial application
- **CO-4** Analyze the issues of climate change and its impact on sustainability
- **CO-5** Apply engineering solutions/methods/legislations to reduce the activities that are harming the environment.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof 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**
CO-1	3	-	-	-	2	-	2		
CO-2	3	2	2	2	2	-	2		
CO-3	3	-	-	-	3	-	2		
CO-4	3	3	-	2	2	-	2		
CO-5	3	-	3	3	2	2	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400006	Environmental Education and Sustainable Development	01	-	01	01	03	02

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment(TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400006	Environmental Education and Sustainable Development	15	-	10	-	10	15	50

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400006

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate aquatic & terrestrial ecosystem *TSO 1b.* Explain structure of ecosystem *TSO 1c.* Compare food chain & web chain *TSO 1d.* Describe carbon, nitrogen, Sulphur & phosphorus cycle *TSO 1e.* Explain causes & effect of global warming	**Unit-1.0 Ecosystem** 1.1 Aquatic & Terrestrial ecosystem 1.2 Structure of ecosystem 1.3 Food chain & Food web 1.4 Carbon, Nitrogen, Sulphur & Phosphorous Cycle 1.5 Global warming – Causes & Effects	**CO1**
TSO 2a. Explain environmental pollution & its sources. *TSO 2b.* Assess the causes of water & air pollution in a given area *TSO 2c.* Explain the effects of water & air pollution on human, plant & animal *TSO 2d.* Take appropriate measures to prevent the pollution problems at city /municipal areas *TSO 2e.* Determine the pollution level in the environment at different seasons.	**Unit-2.0 Air & Water Pollution** 2.1 Traditional pollution issues- Air, Water, Noise 2.2 Water pollution 2.2.1 Sources of water pollution 2.2.2 Effects of water pollution 2.2.3 Control of water pollution 2.2.4 Physical & chemical standard of domestic water as per Indian Standard 2.3 Air pollution 2.3.1 Sources of air pollution 2.3.2 Air pollutants 2.3.3 Effects of air pollution on human, plant & animal 2.3.4 Air monitoring system 2.3.5 Air pollution control	**CO2**
TSO 3a. Describe various types renewable sources of energy *TSO 3b.* Explain solar energy & methods of harnessing *TSO 3c.* Explain wind energy and its impact on environment *TSO 3d.* Explain characteristics of biomass & its digestion process *TSO 3e.* Describe new energy sources & their application	**Unit-3.0 Sustainability & Renewable Sources of Energy** 3.1 Concept of sustainable development 3.2 Renewable sources of energy for sustainable development 3.3 Solar Energy 3.3.1 Features of solar thermal & PV system 3.3.2 Solar pond, Solar water heater, Solar dryer and Solar stills 3.4 Wind Energy 3.4.1 Current status & future prospects of wind energy 3.4.2 Wind energy in India- Advantages and challenges of harnessing wind energy 3.4.3 Environmental benefits & limitations 3.5 Biomass 3.5.1 Types of Biomass energy sources	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.5.2 Energy content in Biomass of different types 3.5.3 Biogas production 3.6 Concept and advantages of hydroponics or aquaponics system to demonstrate soil less cultivation and integration of fish and plant cultivation. 3.7 Water conservation and sustainable development 3.8 New Energy Sources: Hydrogen energy, Ocean energy & Tidal energy	
TSO 4a. Describe impact of climate change on human life *TSO 4b.* Identify the factors contributing to climate change *TSO 4c.* Explain sustainable development goals to transform the world *TSO 4d.* Develop implementation strategies for action plan on climate change	**Unit-4.0 Climate Change and Sustainable Development** 4.1 Impact of Climate change 4.2 Factor contributing to climate change 4.3 Sustainable development Goals (SDGs) 4.4 Action Plan on Climate Change- India	**CO4**
TSO 5a. Identify the elements of a successful management system *TSO 5b.* Explain green building concept & its benefits *TSO 5c.* Apply 5R concept in a given building construction project *TSO 5d.* Explain various environment protection laws *TSO 5e.* Explain carbon foot-print & carbon credit	**Unit-5.0 Environmental legislation and Sustainable Building Practices** 5.1 Environment management system and Planning 5.2 Green Building concept 5.3 Green and sustainable building materials -5R concept 5.4 Environment protection acts, legislation and Laws 5.5 Zero carbon foot-print building for sustainable constriction.	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400006

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use of Air pollutant analyzer to determine the air pollution level *LSO 1.2.* Collect air samples for pollution level detection	1.	Determination of air pollutants harming local environment	CO2
LSO 2.1 Use of Water pollutant analyzer to determine the water pollution LSO 2.2 Collect water samples for pollution level detection	2	Determine the water pollutants harming local environment	CO2
LSO 3.1 Prepare report on EIA of a given context and area. LSO 3.2 Collection of stakeholders view on effect on environment about a particular project/activity.	3.	Carry out the Environmental Impact Assessment (EIA) for a given project /activity of development	CO1 CO3
LSO 4.1 Predict of possible factors causing effects of climate change LSO 4.2 Effect of Ice melting on sea water	4.	Assessment of the impact of climate change on local environment	CO1 CO4
LSO 5.1 Elaborate the uses of sustainable building materials, the considering 3R LSO 5.2 Trace of Carbon foot print due to construction of a small building	5.	Demonstration of sustainable building materials in lab/workshop	CO2 CO5
LSO 6.1 Set up sample recycling bins in the laboratory LSO 6.2 Appreciate the importance of recycling and environmental benefits LSO 6.3 Explain the importance of 3 R	6.	Demonstration of the recycling process for the different materials such as paper, plastic etc. for waste management	CO3
LSO 7.1 Explain the process of composting LSO 7.2 disseminate the use of composting process to near and dear for soil health and fertility for generating organic food	7	Setting up composting bins in the laboratory to demonstrate the process of composting organic waste	CO3
LSO 8.1 Calculate own water footprint for daily activities LSO 8.2 Explain the importance of reducing water consumption and conserve water resources.	8	Calculation of personal water footprint for daily water usage for activities like bathing, cooking and laundry.	CO3
LSO 9.1 Explore the alternative / renewable sources of energy in day to day life	9.	Develop bio mass energy in the laboratory	CO3 CO4
LSO 10.1 Explore the alternative / renewable sources of energy in day to day life	10.	Develop solar model in the laboratory	CO3
LSO 11.1 Explore the alternative / renewable sources of energy in day to day life	11.	Develop wind turbine model in the laboratory	CO4

L) Suggested Term Work and Self Learning: S2400006 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems- Real life problem /Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Conduct a waste audit in your polytechnic. Categorize waste into different types such as plastic, paper, organic. Quantify the amount of each waste.

b. Micro Projects:

- Conduct of EIA of a project/activity such as construction of roads in the local area. Prepare a report on:

  (a) Environmental issues in your city
  (b) SDGs and environment related acts/laws applicable in your state and in India.
  (c) Current-status & future-prospects of Wind Energy
  (d) New energy sources

- Prepare a model of rain water harvesting system to demonstrate how rainwater can be collected and stored for various purposes such as irrigation and toilet flushing.

- Students may be asked in group to set up a small solar panel to compare the energy output under different lighting condition and angles to understand the concept of solar energy and its potential applications.

c. Other Activities:

1. Seminar Topics:
   - Climate change issue and problems
   - Sustainable development- Global practices
   - Factor affecting sustainability in India

2. Visits:
   Visit Pollution control Board of your city. Prepare report of visit with special comments of initiatives taken for protecting environment and ensuring sustainable development of the city.

   Organize a field trip to a nearby park for the students. Students can be observed different species of the plants, animals and insects. They may be asked to prepare report on importance of biodiversity conservation.

3. Self-Learning Topics:

   - Sustainable Development Goals
   - Climate change.
   - Pollution issues
   - Laws and legislation of environmental protection

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	-	-	15%	-	-	20%	20%
CO-2	-	-	10%	25%	-	10%	20%
CO-3	-	-	15%	25%	50%	15%	20%
CO-4	-	-	30%	50%	50%	15%	20%
CO-5	-	-	30%	-	-	40%	20%
Total Marks	**-**	**-**	**10**	**10**	**05**	**10**	**15**
			25				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine the Air and water pollutants harming local environment	CO1	30	60	10
2.	Determine the water pollutants harming local environment	CO1	40	50	10
3.	Carry out the Assessment of Environmental Impact (EIA) for a given project /activity of development	CO1 CO3	30	60	10
4.	Assess the impact of climate change on local environment	CO1 CO4	30	60	10
5.	Demonstrate sustainable building materials in lab/workshop	CO2 CO5	30	60	10
6.	Demonstrate the recycling process for the different materials such as paper, plastic etc. for waste management	CO3	50	40	10
7.	Setting up composting bins in the laboratory to demonstrate the process of composting organic waste	CO3	50	40	10
8.	Calculation of personal water footprint for daily water usage for activities like bathing, cooking and laundry.	CO3	50	40	10
9.	Develop bio mass energy in the laboratory	CO3 CO4	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
10.	Develop solar model in the laboratory	CO3	30	60	10
11.	Develop Wind turbine model in the laboratory	CO4	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Air analyzer	Air Quality Meter Product Type: Measuring Instrument Analysis Time: 2 sec to 8-hour 59 min. 59 sec Automation Grade: Automatic	1
2.	Water Analyzer	Multi-Parameter Water Testing Meter Digital LCD Multi-Function Water Quality Monitor PH/EC/TDS/Salt/S. G/CF/ORP	2
3.	Sustainable Building Materials	As per availability in the market	2,5
4.	Solar energy Panel – KT	Solar Panel Kit 5 LEDs, 2 ON/Off Switch, Wire, 2 Crocodile Clip	7
5.	Bio mass/energy installation -kit	The Bio-energy Science Kit is a great way to find out how a direct ethanol fuel cell works.	6
6.	Wind power energy -Kit	4M wind turbine kit, to demonstrate power of wind and convert it into electricity by building your own turbine.	8
7.	Ice melting demo kit	Simple bowls of different sizes	--

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Ecology and Control of the Natural Environment	Izrael, Y.A.	Kluwer Academic Publisher eBook ISBN: 978-94-011-3390-6
2.	Renewable Energy Sources and Emerging Technologies	Kothari, D.P. Singal, K.C., Ranjan, Rakesh	PHI Learning, New Delhi, 2009 ISBN-13 - 978-8120344709
3.	Green Technologies and Environmental Sustainability	Singh, Ritu, Kumar, Sanjeev	Springer International Publishing, 2017 eBook ISBN 978-3-319-50654-8

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
4.	Coping with Natural Hazards: Indian Context	K. S. Valadia	Orient Longman, ISBN-10: 8125027351 ISBN-13: 978-8125027355
5.	Introduction to Engineering and Environment	Edward S. Rubin	Mc Graw Hill Publications ISBN-10: 0071181857, ISBN-13: 978-0071181853
6.	Environmental Science	Subrat Roy	Khanna Book Publishing Co. (P) Ltd. ISBN-978: 93-91505-65-3

(b) Online Educational Resources:

1. http://www1.eere.energy.gov/wind/wind_animation.html
2. http://www.nrel.gov/learning/re_solar.html
3. http://www.nrel.gov/learning/re_biomass.html
4. http://www.mnre.gov.in/schemes/grid-connected/biomass-powercogen/
5. http://www.epa.gov/climatestudents/
6. http://www.climatecentral.org
7. http://www.envis.nic.in/
8. https://www.overshootday.org/
9. http://www.footprintcalculator.org/
10. https://www.carbonfootprint.com/calculator.aspx

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1) www.nptel.iitm.ac.in
2) www.khanacademy

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