Curriculum of Diploma Programme

in

Electrical Engineering

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	Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment(LA)		Total Marks (TA+TWA+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.

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) = $\sum$ (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 + $\overline{A}$C + B$\overline{C}$ 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.

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.

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 निर्धारक 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 3a पठित 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

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.

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

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.