Curriculum of Diploma Programme

in

Mechanical Engineering

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

State Board of Technical Education
(SBTE), Bihar

Semester – I

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				
2400101	**ASC**	**Basic Engg. Mathematics** (ME, ME (Auto), CE, MIE, CSE, AIML, EE, CRE, CHE, ELX, ELX (R))	02	01	-	02	05	04
2400103A	**ASC**	**Applied Chemistry -A** (CE, ME, ME (Auto), MIE, AE, FTS, CRE, CHE)	03	-	04	02	09	06
2418103	**BCC**	**Python Programming** (CE, CSE, AIML, EE, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	03	-	04	02	09	06
2400104	**HSC**	**Communication Skills (English)** (Common for all Programmes)	03	-	04	02	09	06
2425105	**BEC**	**Engineering Drawing** (ME, ME (Auto))	03	-	04	02	09	06
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 Paper, 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. todeliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, work shop, 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= (1x 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 - I
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)	
2400101	**ASC**	**Basic Engg. Mathematics** (ME, ME (Auto), CE, MIE, CSE, AIML, EE, CRE, CHE, ELX, ELX (R))	30	70	20	30	-	-	150
2400103A	**ASC**	**Applied Chemistry -A** (CE, ME, ME (Auto), MIE, AE, FTS, CRE, CHE)	30	70	20	30	20	30	200
2418103	**BCC**	**Python Programming** (CE, CSE, AIML, EE, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	30	70	20	30	20	30	200
2400104	**HSC**	**Communication Skills (English)** (Common for all Programmes)	30	70	20	30	20	30	200
2425105	**BEC**	**Engineering Drawing** (ME, ME (Auto))	30	70	20	30	20	30	200
2400006	**ASC**	**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 Paper, 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 becarried 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 : **2400101(T2400101/S2400101)**

B) Course Title : Basic Engg. Mathematics
(CE, ME, ME (Auto), CSE, EE, ELX, ELX (R), AIML, MIE, CRE, CHE)

C) Pre-requisite Course(s) :

D) Rationale :

This course is an extension of the course based on Mathematics of the first semester namely Basic Engineering Mathematics. The course is designed to inculcate its application in relevant branches of engineering and technology. With calculus, we can find how the changing conditions of a system affect us, and we can control a system. Definite integral is a powerful tool that helps us realize and model the world around us. Differential equations are widely applied to modern natural phenomena, engineering systems, and many other situations. Numerical methods offer approximate but credible accurate solutions to problems that are not readily or possibly solved by closed-form solution methods. On the other hand, Numerical integration is a computational (approximate) approach to evaluating definite integrals. It has a lot of applications in engineering such as in the computation of areas, volumes, and surfaces. It also has the advantage of being easily programmable in computer software. Probability distributions are useful for modeling, simulation, analysis, and inference on varieties of natural processes and physical phenomena. A situation in which an experiment is repeated a fixed number of times can be modeled, engineers need to apply existing knowledge of success and failure to a specific analytical scenario.

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 algebra.
- **CO-2** Use the concept of derivative as a tool to solve engineering-related problems.
- **CO-3** Apply differential calculus to solve branch-specific problems.
- **CO-4** Use the concept of Coordinate geometry to solve branch-specific engineering-related problems.
- **CO-5** Apply techniques and methods of probability and statistics to crack branch-specific 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	-	-	-	-	-	-		
CO-2	3	1	-	-	-	-	-		
CO-3	3	1	1	-	-	-	1		
CO-4	3	1	-	-	-	-	-		
CO-5	3	2	1	1	-	-	1		

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

***** PSOs will be developed by the respective program coordinators 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				
2400101	Basic Engineering Mathematics	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= (1xCI hours) + (0.5xLI hours) + (0.5xNotional 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)	
2400101	Basic Engineering Mathematics	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: T2400101

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Find the solution of a system of equations in three unknowns by applying Cramer's rule. *TSO 1b.* Solve simple given problems based on the Algebra of matrices. *TSO 1c.* Find the inverse of the matrix by applying the concept of Adjoint of the matrix. *TSO 1d.* Find a solution of simultaneous equations in three variables using the concept of the Matrix Inversion method. *TSO 1e.* Solve problems based on the sum, and subtraction of Vectors. *TSO 1f.* Solve simple problems related to Scalar and Vector product of vectors. *TSO 1g.* Solve simultaneous equations by using concepts given in Ancient Indian Mathematics. (IKS)	**Unit-1.0 Algebra Determinant** 1.1 Concept and properties of determinant. 1.2 Solutions of simultaneous equations in three Unknowns by Cramer's rule. **Matrices** 1.3 Algebra of matrices (Addition, Subtraction, Multiplication by Scalar, and Multiplication of Two matrices). 1.4 Transpose, Adjoint and Inverse of Matrix. 1.5 Solutions of simultaneous equations of a Matrix of order 3 x3 by Inversion method. **Vectors** 1.6 Position vector. 1.7 Algebra of Vectors (Addition, Subtraction, Scalar Multiplication with vector). 1.8 Scalar product. 1.9 Vector product. 1.10 Algebra in Indian Knowledge System: Solution of simultaneous equations (Indian Mathematics). (IKS)	**CO1**
TSO 2a. Define the concept of a function and its types. *TSO 2b.* Solve simple problems based on Domain and range of function. *TSO 2c.* Evaluate problems of limit function based on Indeterminate form. *TSO 2d.* Check the continuity of a function at a point. *TSO 2e.* Find the differentiation of some simple functions (sinx, cosx, tanks, and e^x) by the first principle. *TSO 2f.* Calculate the derivative of given Algebraic, trigonometric, and exponential functions. *TSO 2g.* Find the derivative of the given two functions' sum, product, and quotient. *TSO 2h.* Find the differentiation of given composite functions by applying the concept of the Chain rule. *TSO 2i.* Find the derivative of Logarithmic, Implicit, and Parametric functions. *TSO 2j.* Familiar with the concept of calculus given in Indian Mathematics. (IKS)	**Unit-2.0 Differential Calculus** **Function and Limit** 2.1 Concept of function. 2.2 Different type of functions. 2.3 Domain and Range of Function. 2.4 Concept of Limits and its evaluation. **Continuity** 2.5 Concept of continuity with simple problems. **Differentiation** 2.6 Differentiation by First Principle. 2.7 Differentiation of Algebraic, trigonometric, Exponential, and Logarithmic functions. 2.8 Differentiation of sum, product, and quotient of two functions. 2.9 Differentiation of composite functions by Chain Rule. 2.10 Logarithmic differentiation. 2.11 Implicit differentiation. 2.12 Differentiation of Parametric Functions. 2.13 Calculus in Indian Knowledge System: The Discovery of Calculus by Indian Astronomers. (Indian Mathematics). (IKS)	**CO2**
TSO 3a. Find the second-order derivative of given simple functions.	**Unit-3.0 Application of Differential Calculus** 3.1 Successive differentiation up to second order.	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3b. Solve simple problems based on Rolle's Theorem and Mean Value Theorem. *TSO 3c.* Apply the concept of Rate of change to solve simple problems related to velocity, and acceleration. *TSO 3d.* Apply rules of derivative to solve given applied problems related to tangent and normal. *TSO 3e.* Apply rules of derivative to solve applied problems based on Maxima-Minima and Radius of curvature.	3.2 Rolle's Theorem and Mean Value Theorem (without proof) with examples. 3.3 Rate of change of quantities. 3.4 Equation of Tangent and Normal. 3.5 Maxima and Minima. 3.6 Radius of curvature.	
TSO 4a. Calculate the angle between the given two lines and also find the slope. *TSO 4b.* Formulate an equation of straight lines of different forms. *TSO 4c.* Find the perpendicular distance of a straight line from a given point and the perpendicular distance between two parallel lines. *TSO 4d.* Use the geometry given in Sulabasutras to solve the given problems. *TSO 4e.* Solve simple problems related to Circles and Parabola for engineering applications. *TSO 4f.* Solve given simple problems related to Ellipse for engineering applications.	**Unit-4.0 Co-ordinate Geometry** **Co-ordinate systems** 4.1 Introduction of Co-ordinate Systems. **Straight lines** 4.2 Slope of a line, the angle between two lines. **Various forms of Straight Lines** 4.3 Point-slope form, Two-point form, Slope intercept form, Intercept form, Normal form, General form. 4.4 Perpendicular distance of a line from a point, perpendicular distance between two parallel lines. 4.5 Geometry in Sulabasutras in Indian Knowledge System (construction of the square, circling the square). (Indian Mathematics). **Conic Section** 4.6 Introduction of Conic-Section. 4.7 Equation of Circle in standard form. 4.8 Standard equation of parabola, ellipse, and hyperbola.	**CO4**
TSO 5a. Compute the probability of given simple problems based on the Addition and Multiplication theorem. *TSO 5b.* Evaluate the Mean, Median, and Mode of the given data for engineering applications. *TSO 5c.* Calculate the Range, Variance, and standard deviation of given data for engineering applications. *TSO 5d.* Calculate the Coefficient of variance of given data for engineering applications.	**Unit-5.0 Probability and Statistics** **Probability** 5.1 Concept of Probability. 5.2 Addition and multiplication theorems of Probability. **The measure of Central Tendency** 5.3 Mean, Median, Mode. **Measure of Dispersion** 5.4 Range, Variance, Standard Deviation. 5.5 Coefficient of Variation.	**CO5**

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 Determine the value of the determinant by using available open-source software. 1.2 Determine the inverse of a non-singular matrix by using open-source software. 1.3 Apply the Matrix Inversion method to determine currents through various branches of given electrical networks. 1.4 Determine the resultant force applied at a particle using properties of vector for a given engineering problem.	1.	• Value of determinant of order 3, 4, and higher using opensource software. • Inverse of the non-singular matrix using open-source software. • Calculation of current in electrical networks by Matrix Inversion method. • Geometrical interpretation of operations of vector algebra.	CO1
2.1 Geometrically represent the domain and range of the given Modulus function, Signum function, and Floor function. 2.2 Verify geometrically the continuity of a given function at a point. 2.3 Determine the concavity and convexity of a given continuous function for a given engineering application. 2.4 Find the acceleration of the given moving body at a time t.	2.	• Geometrical interpretation of domain and range of a function. • Geometrical interpretation of limit and continuity. • Branch-specific engineering application of derivative. • Branch-specific engineering application of derivative of a parametric function.	CO2
3.1 Determine the maximum height of a projectile trajectory using Roll's theorem. 3.2 Use Lagrange's Mean Value theorem to find the point at which the slope of the tangent becomes equal to the slope of the secant through its endpoints. 3.3 Use the concept of derivative to find the slope of a bending curve for a given engineering problem. 3.4 Use the concept of tangent and normal to solve the given problem of Engineering Drawing. 3.5 Use the concepts of Maxima and Minima to obtain optimum value for a given engineering problem. 3.6 Use the concept of the radius of curvature to solve a given branch-specific engineering problem.	3.	• Geometrical Interpretation of Rolle's Theorem. • Geometrical Interpretation of Lagrange's Mean Value theorem. • Branch-specific engineering application of rate of change of quantities. • Branch-specific engineering applications of tangent and normal. • Branch-specific engineering applications of maxima and minima. • Engineering applications of Radius of curvature.	CO3
4.1 Apply the concept of Gradient to draw graphs in engineering drawing. 4.2 Use the given form of a straight line to calculate the speed, distance, and time of a moving object. 4.3 Use the concept of Ellipse to prepare a Model of the path of the Planet and its foci.	4.	• Geometrical interpretation of Gradient. • Geometrical Interpretation of lines in various forms. • Geometrical interpretation of the perpendicular distance of a line. • Geometrical representation of conic-section.	CO4

Outcomes	S. No.	Tutorials Titles	Relevant COs Number(s)
5.1 Use the concept of probability to solve given problems based on Board and playing cards. 5.2 Calculate the Standard Deviation for Concrete with the given data.	5.	• Applications of Probability and related theorems. • Applications of Mean, Median, and Mode for applied problems.	CO5

L) Suggested Term Work and Self-Learning: S2400101 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. Solve the simultaneous system of equations in two variables by Matrix Inversion Method. Write down a Mathematical program using any open-source software to verify the result.
2. A rigid body is subjected to multiple forces acting at different points. Apply vector technique to calculate the net moment or torque acting on the body. Discuss the equilibrium condition and the significance of the moment in terms of structural integrity and mechanical system using open-source software.
3. Represent the Graph of the Trigonometric function and logarithmic function on GeoGebra. Interpret the nature of the graph and make a pdf file.
4. Find the derivative of $y = x^{sinx}$ and visualize the graph of the function and its derivative using any open-source software geometrically.
5. A window in the form of a rectangle surmounted by a semi-circular opening. The total perimeter of the window to admit maximum light through the whole opening. Prepare a model using the concept of Maxima and Minima for the above problem and verify the result.
6. Find the curvature of $x = 4cost$ and $y = 3sint$, at what point on this ellipse does the curvature have the greatest and least values? What are the magnitudes? Visualize the result graphically using any open-source software.
7. When a double-sided right circular cone is intersected by a plane, different types of conic sections are generated. Represent all these conic sections on GeoGebra and write down their equation.
8. Explain how parabolic reflectors are used in engineering applications such as Satellite Dish Antennas or headlights.
9. By Collecting the Data of the Last 5 IPL series, Calculate the probability of winning a match by any two teams.
10. Collect the Data of Marks obtained by your class in 1st class test. Compute the Mean, Median, Mode, and variance of the data and interpret the result.

b. Micro Projects:

1. Prepare charts displaying the properties of determinants and Matrices.
2. Prepare a chart for the use of Vector algebra to solve problems of the rate of change of the mass of a fluid flow.
3. Draw the graph of functions like x^2, $sinx$, $cosx$, $tanx$, and e^x etc analytically on graph paper and verify using suitable open-source software like Sage Math, Math3d, GeoGebra, Wolfram Alpha, and Dplot and prepare a pdf file.
4. Collect at least 10 engineering applications for each Limits, Continuity, and Differentiability and prepare a PDF file.

5. Prepare a chart consisting of 8-10 engineering-related functions whose derivative does not exist.
6. Prepare a model showing the application of Rolle's Theorem to determine the projectile trajectories of maximum height.
7. Prepare a chart consisting of any 10 applications of the Mean value theorem related to real-world problems.
8. Model to maximize the volume of a box made of a rectangular tin sheet by cutting off squares of the same size from each corner and folding them up. Also, design models for at least 5 similar situations and prepare a soft file with animation.
9. Prepare models using the concept of tangent and normal while bending of roads in case of sliding of a vehicle.
10. Prepare models using the concept of the radius of curvature while bending of railway track.
11. Make a short video of duration 5-7 minutes for the use of Derivative to calculate the profit and loss in business using graphs.
12. Download 5-7 videos based on applications of Derivative to check the temperature variation, find the range of magnitudes of the earthquake, etc. Watch them and write a report to detail the mathematical steps involved.
13. Prepare the Charts of formulae showing different forms of straight lines for engineering applications.
14. Draw the graph for the standard equations of Circle, Parabola, Ellipse, and Hyperbola on the Chart paper using any open-source software and make a file.
15. Prepare the Charts consisting tree diagram to find the probability of a given event.
16. Collect the data of World of Work and find the mean, mean deviation, and standard deviation for that data using any open-source software of Statistics and make a soft copy.
17. Download 5-7 videos based on applications of probability for the weather forecast, watch them, and write a report to detail the mathematical steps involved.

c. Other Activities:

1. Seminar Topics:
    - Applications of Integral calculus in control systems, dynamics, and vibrations.
    - Applications of determinants and matrices in graphic design to make digital images.
    - Application of determinants and matrices for calculating the battery power outputs.
    - Application of Vector algebra in engineering mechanics.
    - Application of limit and continuity to measure the strength of the magnetic field and electric field.
    - Applications of Derivatives for engineering & technology.
    - Application of radius of curvature for Engineering and Science.
    - Applications of Derivatives in the economy to compute the level of output at which the total revenue is the highest, the profit is the highest, and (or) the lowest, etc.
    - Applications of Coordinate geometry to design of athletic tracks, recreational parks, building plans, roundabouts, Ferris wheels.
    - Application of ellipses to be used to orbits of planets, satellites, moons comets, etc.
    - Probability and statistics: Civil engineering, estimation of model uncertainties, identification of probability distribution.

2. 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 a mathematics research institute.
    - Visit to a mathematics laboratory.
    - Visit to a Data Science Center.
    - Visit the mathematics department of a college or university.

- Visit a mathematics software company.
- Visit to a Cryptography Company.
- Visit to a Space Agency.
- Visit to a Game Studio.
- Visit to a mathematics library.
- Attend Mathematical conferences on real-world problem-solving.
- Participation in mathematics competitions.

3. Self-Learning Topics:
   - Participate in MOOCs based Course on Matrix offered by Foreign University: Methods and Applications.
   - Participate in an MOOCs-based Course on Differential Calculus: Methods and Applications.
   - Participate in MOOC-based Courses on Probability and its Engineering applications.
   - Participate in MOOC-based Courses on Statistics and its Engineering applications.
   - Watching videos on applications of coordinate geometry to Real-world problems.

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	20%	20%	15%	15%	25%	-	-
CO-2	15%	20%	20%	20%	15%	-	-
CO-3	20%	15%	15%	15%	10%	-	-
CO-4	20%	20%	25%	25%	25%	-	-
CO-5	25%	25%	25%	25%	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 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 the 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 Algebra	8	CO1	12	4	4	4
Unit-2.0 Differential Calculus	10	CO2	14	4	8	2
Unit-3.0 Application of Differential Calculus	8	CO3	12	4	4	4
Unit-4.0 Co-ordinate Geometry	10	CO4	14	4	6	4
Unit-5.0 Probability and Statistics	12	CO5	18	4	6	8
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, Graph Eq^2.13, Microsoft Mathematics, GeoGebra, Math3D	1,2,3,4,5
3.	Printer	High-Speed Duplex Printer	
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.	

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.	Indian Mathematics Engaging with the World from Ancient to Modern Times	George Gheverghese Joseph	World Scientific Publishing Europe Ltd. 57ISBN 978-17-86340-61-0
8.	A Modern Introduction to Ancient Indian Mathematics	T.S. Bhanumurthy	New Age International Private Limited, 1 January 2008 ISBN- 10. 812242600X, ISBN- 13. 978-8122426007
9.	Mathematics-I	Deepak Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-42-4
10.	Mathematics-II	Garima Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-52-3
11.	Consider Dimension and Replace Pi	M.P. Trivedi and P.Y. Trivedi	Notion Press; 1st edition (2018), ISBN: 978-1644291795
12.	Sansar Ke Mahan Ganitagya	Gunakar Muley	First Edition, Rajkamal Prakashan, ISBN-10. 8126703571, ISBN-13. 978-8126703579.

(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 Animation.
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 : 2400103A(T2400103A/P2400103A/S2400103A)

B) Course Title : Applied Chemistry- A (ME, ME (Auto), CE, MIE, AE, CHE, FTS, CRE)

C) Pre- requisite Course(s) :

D) Rationale :

Students pursuing diplomas in engineering fields like mechanical, automobile, civil, mining, chemical, ceramic, agricultural, fire technology and safety need to study applied chemistry as a prerequisite course. After completion of this course student will have a deep understanding of chemical concepts, their uses, and how they relate to engineering field. Diploma engineers deals with various concept of chemistry to be approved in diverse technical and engineering field. Ever increasing use of materials like metals, alloys and fuel and lubricants will compel engineers to acquire essential applied chemistry knowledge to select engineering material, which will be economical and eco-friendly. 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 concepts like **water treatment** and analysis, fuels and combustions and electrochemistry have constantly proved the importance of applied chemistry**.**

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 engineering problems using concepts of engineering materials and properties.
- **CO-4** Use relevant fuels and lubricants for domestic and industrial applications.
- **CO-5** Solve engineering problems using the concepts 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/ 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	-	-	-	1		
CO-2	3	3	2	2	2	1	1		
CO-3	3	2	1	2	1	1	1		
CO-4	3	1	1	1	1	1	1		
CO-5	3	2	1	1	-	1	2		

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

* PSOs will be developed by respective programme coordinator at institute level. As per 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				
2400103A	Applied Chemistry- A	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)	
2400103A	Applied Chemistry- A	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: T2400103A

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO-1a Describe the three subatomic particles in an atom. *TSO-1b* Conclude 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, Hund's Rule of Maximum Multiplicity, Aufbau Principle, Electronic Configuration (till atomic number 30). 1.7 Concept of Chemical bonding - Cause 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 $CaCO_3$ 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 between homopolymer and copolymer. *TSO-3h* Write the monomers of given polymers. *TSO-3i* Explain vulcanization process.	**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 Extraction of Aluminium, Iron and Copper from their important ores along with reactions, Properties and uses. 3.4 Alloys – Definition, Purpose of alloying, Ferrous and Non-Ferrous Alloy with suitable examples, Composition, Properties, and their applications. 3.5 Ancient Indian Metallurgy (IKS) 3.6 Polymers-Homopolymers and Copolymers,	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO-3j Explain cement & its manufacture. *TSO-3k* Differentiate among the different engineering materials based on their chemical composition and composition-based applications.	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. 3.9 Cement, Average composition of Portland cement, Raw material for manufacture of cement, Setting of Cement.	
TSO-4a Classify fuels. *TSO-4b* Describe HCV and LCV. *TSO-4c* Explain knocking, octane number and cetane number. *TSO-4d* Use different gaseous fuels based on their composition, calorific value, and other properties. *TSO-4e* Explain uses of NPK fertilizers. *TSO-4f* Select relevant lubricant based on their composition, calorific value, and other properties. *TSO-4g* Determine viscosity, flash, and fire point of given lubricant for its specific use. *TSO-4h* Explain Flash, Fire, Cloud & Pour point.	**Unit-4.0 Chemistry of Fuel and Lubricants** 4.1 Fuels, Characteristics of an Ideal Fuel. 4.2 Classification of Fuel- Solid, liquid and gas fuel, Calorific Values (HCV and LCV), 4.3 Petroleum and its fractional distillation. 4.4 Cracking, knocking, Fuel Rating (Octane Number, Cetane Number). 4.5 Composition, uses, advantages and disadvantages of LPG, CNG and Biogas. 4.6 Manures, NPK fertilizers (preparation and uses). 4.7 Fire Extinguishers and their types. 4.8 Lubricants- Classification of Lubricants with examples, Functions and Properties of Good Lubricant. 4.9 Viscosity & Viscosity Index. Flash point. Fire point, Cloud & Pour point	**CO4**
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: P2400103A

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. Calculate % of moisture	5.	Estimation of moisture content in given coal sample gravimetrically.	**CO4**
LSO-6.1. Perform double displacement reaction. *LSO-6.2.* Test the presence of sulphate.	6.	Preparation of Barium Sulphate from Barium Chloride.	**CO2**
LSO-7.1. Use viscometer. *LSO-7.2.* Calculate viscosity using the drop number method.	7.	Determination of viscosity of liquid Using Ostwald Viscometer.	**CO4**
LSO-8.1. Construct Daniel cell. *LSO-8.2.* Compare the effect of dilution of electrolytes on the emf of a Daniel cell.	8.	Comparison of the effect of dilution of electrolytes on the emf of a Daniel cell.	**CO5**
LSO 9.1. Perform acid base titration using pH meter.	9.	Determination of pH of given solution by pH meter.	**CO2**
LSO-10.1. Carry out Polymerization. *LSO-10.2.* Set the environment for carrying out polymerization.	10.	Preparation of Phenol Formaldehyde Resin (Bakelite).	**CO3**
LSO-11.1. Perform iodometry titration. *LSO-11.2.* Use of starch as indicator.	11.	Determination of dissolved Oxygen in given sample of Water.	**CO2**
LSO-12.1. Calculate pH.	12.	Determination of pH of soil using baking soda and vinegar.	**CO2**

L) Suggested Term Work and Self Learning: S2400103A 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. Explain the working principle of TEL as antiknock.
6. Prepare chart showing different types of liquid fuels with their calorific values and uses.
7. Prepare a comparative chart of commercially available lubricants based on mechanism of lubrication.
8. Compare the EMF of Zinc - Copper cell with different cathodic concentration and predict out of low and high cathodic concentration, which increases EMF?
9. 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. Prepare a model of electronic configurations for different atoms (Z=30)
3. Prepare a model to demonstrate the application of electrolytic 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. Compare the hardness of different sample water by measuring the time required for forming lather.
10. Determine the flash point and fire point of a lubricant.
11. Collect petrol from different petrol pumps and compare the extent of knocking by comparing their mileage.

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. Prepare report of visit.
   Visit a nearby battery shop. Prepare a report of visit.
3. Self-Learning Topics: -

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	8	CO1	14	4	4	6
Unit-2.0 Water	8	CO2	14	4	4	6
Unit-3.0 Engineering Material	8	CO3	14	4	6	4
Unit-4.0 Chemistry of fuels and Lubricants	12	CO4	10	4	2	4
Unit-5.0 Electrochemistry	12	CO5	18	4	6	8
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	30	60	10
2.	Preparation of 250ml of N/10 Sodium Carbonate Solution.	CO1	40	50	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.	Estimation of moisture content in given coal sample gravimetrically.	CO3	30	60	10
6.	Preparation of Barium Sulphate from Barium Chloride.	CO2	30	60	10
7.	Determination of viscosity of lubricating oil using Ostwald Viscometer	CO4	30	60	10
8.	Comparison of the effect of dilution of electrolytes on the emf of a Daniel cell.	CO5	40	50	10
9.	Determination of pH of given solution by pH meter.	CO2	40	50	10
10.	Preparation of Phenol Formaldehyde Resin (Bakelite).	CO3	40	50	10
11.	Determination of dissolved Oxygen in given sample of Water.	CO2	30	60	10
12.	Determination of pH of soil using baking soda and vinegar.	CO2	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.	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
4.	Digital pH Meter	Type: Microcontroller Based, Display: LED / LCD / Touch Screen, 3 digits, Calibration: up to 3 points with auto buffer, pH Range (pH): 0.00 to 14.00, +/- 0.05, Power Requirements: 230 V +/- 10, 50 Hz AC, Modes: pH mV- C, Temperature Compensation Type: Automatic, Temperature Compensation Range (Degree C): 0 to 100, Temperature Accuracy (Degree C): +/- 0.3, Resolution (pH): 0.01	9,12

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.wastewaterelearning.com/elearning/ (Water Treatment)
5. www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
6. https://iksindia.org
7. www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel & Combustion)
8. www.chemcollective.org (Metals, Alloys)
9. www.wqa.org(Water Treatment)
10. PhET: Free online physics, chemistry, biology, earth science and math simulations (colorado.edu)
11. https://www.ancient-origins.net/history-famous-people/indian-sage-acharya-kanad-001399
12. Courses: NPTEL
13. Virtual Labs (vlab.co.in)
14. olabs.edu.in
15. 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. Learning Packages.
2. Lab Manuals.
3. Manufacturers' Manual
4. Users' Guide

******

A) Course Code **: 2418103(T2418103/P2418103/S2418103)**

B) Course Title **:** Python Programming

(CE, CSE, AIML, EE, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)

C) Pre- requisite Course(s) **:**

D) Rationale **:**

Python programming has emerged as a popular programming language across wide range of application segments from Scientific to Machine Learning to mobile app development, and so on. Python is a high-level general-purpose programming language.

Because code is automatically compiled to byte code and executed, Python is suitableuse as a scripting language, Web application implementation language, etc.
In Python there are multiple levels of organizational structure: functions, classes, modules, and packages. These assist in organizing code. An excellentand large example is the Python standard library.

The Object-oriented Python provides a consistent way to use objects: in Python it is easy to implement new object types (called classesin object-oriented programming).
This introductory course to learn basic Python programming features which can be used as building blocks to develop different kind of applications using Python 3.

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 various data types and operators in formation of expressions.
- **CO-2** Write and execute programs using control statements.
- **CO-3** Perform relevant operations on Sequence data types.
- **CO-4** Create functions in modules.
- **CO-5** Use object-oriented approach and features in writing python programs.
- **CO-6** Handle data files and exceptions.

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	1	-	1	-	-	-	-		
CO-2	1	2	2	1	-	1	-		
CO-3	1	2	2	1	-	1	-		

CO-4	1	2	2	1	-	1	2		
CO-5	1	2	2	1	-	1	-		
CO-6	1	2	2	1	-	1	1		

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

* PSOs will be developed by respective programme coordinator at institute level. As per 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				
2418103	Python Programming	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)	
2418103	Python Programming	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:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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: T2418103

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate between Procedure Oriented P and Object-Oriented Programming approach with example. *TSO 1b.* Use the concept of Lvalue and Rvalue. *TSO 1c.* Write python program using various data types and operators.	**Unit-1.0 Basics of Python Programming syntax** 1.1 Python character set, Python tokens, variables, concept of Lvalue and Rvalue, use of comments 1.2 Data types: number (integer, floating point, complex), Boolean, sequence (string, list, tuple), none, mapping (dictionary), mutable and immutable data types 1.3 Operators: arithmetic operators, relational operators, logical operators, assignment operator, augmented assignment operators. Expressions, statement, type conversion & input/output: precedence of operators, expression, evaluation of expression.	**CO-1**
TSO 2a. Write Python program using decision making statements. *TSO 2b.* Write Python program using loop structure to solve iterative problems.	**Unit-2.0 Conditional and Iterative statements** 2.1 Conditional statements: simple if statement, if- else statement, if-elif-else statement	**CO-2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	2.2 Iterative statements: while loop, for loop, range function, break and continue statements, nested loops	
TSO 3a. Perform various operations on string using string operators and methods. *TSO 3b.* Perform various operations on List using list operators and methods. *TSO 3c.* Perform various operations on tuples using tuples operators and methods. *TSO 3d.* Perform various operations on set using set methods. *TSO 3e.* Perform various operations on dictionary using dictionary methods.	**Unit-3.0 String, List, Tuples, set and Dictionary** 3.1 String: indexing, string operations (concatenation, repetition, membership & slicing), traversing a string using loops, built-in functions 3.2 Lists: introduction, indexing, list operations: concatenation, repetition, membership & slicing, traversing a list, built- in list functions, linear search on list of numbers and counting the frequency of elements in a list 3.3 Tuples: Creating, initializing, accessing elements, tuple assignment, performing operations on tuples, tuple methods and built-in functions, nested tuples 3.4 Set: Creating set, traversing, adding, removing data in set, performing set operations like join, Union intersection, difference 3.5 Dictionary: accessing items in a dictionary using keys, mutability of dictionary: adding a new item, modifying an existing item, built-in dictionary functions.	**CO-3**
TSO 4a. Create and use user defined functions to implement modular programming approach. *TSO 4b.* Differentiate variable scope with example. *TSO 4c.* Import and use Python modules, libraries.	**Unit-4.0 Python Functions, Modules and packages** 4.1 Functions: types of function (built- in functions, functions defined in module, user defined functions), creating user defined function, arguments and parameters, default parameters, positional parameters, Lambda functions, returning value, scope of a variable: global scope, local scope 4.2 Modules and Packages: Importing module using 'import' Regular Expressions, Exception Handling, PyPI Python Package Index, Pip Python package manager, Importing Libraries and Functions	**CO-4**
TSO 5a. Write simple Python programs with object-oriented approach. *TSO 5b.* Use constructors and destructors appropriately in python program.	**Unit-5.0 Object Oriented Programming (OOP)** 5.1 OOPs Object oriented programming concepts and approach, Abstraction, encapsulation, class, object, class	**CO-5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5c. Explain different type of inheritance based on its characteristic. *TSO 5d.* Implement given type of inheritance in Python. *TSO 5e.* Implement the concept of Polymorphism in Python.	method vs static method in Python, class and static variable, constructor and destructors in python 5.2 Inheritance: types of inheritance: single, multiple, multilevel, hierarchical 5.3 Polymorphism: Polymorphism with class method, polymorphism with inheritance, method overriding, overloading	
TSO 6a. Explain different types of Exceptions in python. *TSO 6b.* Write Python programs for exception handling in Python. *TSO 6c.* Differentiate different modes of file opening. *TSO 6d.* Perform read, Write, Append operations in files.	**Unit 6.0: Exception and File Handling in Python** 6.1 Exception Handling: syntax errors, exceptions, need of exception handling, user-defined exceptions, raising exceptions, handling exceptions, catching exceptions, Try - except - else clause, Try - finally clause, recovering and continuing with finally, built-in exception classes. 6.2 File Handling: text file and binary file, file types, open and close files, reading and writing text files, reading and writing binary files, file access modes	**CO-6**

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

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

P2418103

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Write, execute and debug simple Python program using Integrated Development and Learning Environment (IDLE) *LSO 1.2.* Write and execute simple 'C' program using variables, arithmetic expressions.	1.	a) Download and Install IDLE. Write and execute Python program to- b) Calculate the Area of a Triangle where its three sides a, b, c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) c) Swap Two Variables d) Solve quadratic equation for real numbers.	CO-1
LSO 2.1. Write and execute python programs using conditional statements. *LSO 2.2.* Write and execute python programs using various types of Loop statements	2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input.	CO-2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	
LSO 3.1. Write and execute Python program to perform various operations on string using string operators and methods	3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a string the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	CO-2, CO-3
LSO 4.1. Write and execute Python program to perform various operations on List using List operators and methods	4.	Write and execute Python program to- a) find largest number in a given list without using max (). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	CO-2, CO-3
LSO 5.1. Write and execute Python program to perform various operations on Tuple using Tuple operators and methods.	5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuples by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	CO-2, CO-3
LSO 6.1. Write and execute Python program to perform various operations on sets using set methods.	6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	CO-2, CO-3
LSO 7.1. Write and execute Python program to perform various operations on Dictionary using Dictionary methods	7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400}	CO-2, CO-3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	
LSO 8.1. Write and execute Python program to create user defined functions and call them.	8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate n! / (r!)*(n-r)!) where symbol "**!**" stands for factorial.	CO-2, CO-4
LSO 9.1. Write and execute Object Oriented Python program to define a class and its instances. *LSO 9.2.* Develop and execute Python program Using various types of inheritances. *LSO 9.3.* Develop and execute Python program Using various types of inheritances. *LSO 9.4.* Develop and execute Python program Using various types of Polymorphism.	9.	Write program using OOP approach to – a) create an instance of a specified class and display the namespace of the said instance b) create a Python class named Student with two attributes: student_id, student_name. Add a new attribute: student_class. Create a function to display all attributes and their values in the student class. c) Create a Python class named Student with two instances student1, student2 and assign values to the instances' attributes. Print all the attributes of the student1, student2 instances d) Write programs to demonstrate use of following types of inheritance: i. Single inheritance ii. Multiple inheritance iii. Multilevel inheritance e) Demonstrate use of polymorphism with following situations: i. Polymorphism in operator ii. Polymorphism in user defined method iii. Polymorphism in built-in function iv. Polymorphism with class method v. Polymorphism with method overriding	CO-2, CO-5
LSO 10.1. Develop and execute Python program to handle various type of exceptions. *LSO 10.2.* Develop and execute Python program to perform file operations.	10.	a) Using exception handling feature such as try…except, try finally- write minimum three programs to handle following types of exceptions. i. Type Error ii. Name Error iii. Index Error iv. Key Error	CO-6, CO-1, CO-2,

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		v. Value Error vi. IO Error vii. Zero Division Error b) Write Python program to demonstrate file operations.	

Note: in addition to above listed practical, students are suggested to practice all the examples covered by the teacher during theory sessions.

L) Suggested Term Work and Self Learning: S2418103 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:

1. Crete a shop billing system
2. Create income tax calculation system.
3. Develop number guessing game (random integer will be selected by the system and the user has to guess that integer in the minimum number of guesses. Maximum 5 guess allowed.)
4. Assign numbers to alphabet a-z as (1-26). User will input a word. System will convert in to a number by adding all the individual alphabet of that word.
5. Design a basic calculator program that performs arithmetic operations like addition, subtraction, multiplication, and division based on user input.
6. Any other micro-projects suggested by subject faculty on similar line.

(Students may use file and sequence data types to develop above listed applications)

c. Other Activities:

1. Seminar Topics:

- Tkinter widgets in python
- Python date/time module and its applications
- wxPython and its applications

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	End Theory	Term Work & Self Learning Assessment	Progressive Lab Assessment	End Laboratory

	Assessment (PTA) Class/Mid Sem Test	Assessment (ETA)	Assignments	Micro Projects	Other Activities*	(PLA)	Assessment (ELA)
CO-1	10%	10%	15%	16%	16%	10%	16%
CO-2	15%	15%	15%	16%	16%	15%	16%
CO-3	25%	25%	20%	18%	18%	25%	18%
CO-4	15%	15%	15%	16%	16%	15%	16%
CO-5	25%	25%	25%	18%	18%	25%	18%
CO-6	10%	10%	10%	16%	16%	10%	16%
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 is 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 Basics of Python Programming syntax	4	CO-1	7	3	2	2
Unit-2.0 Conditional and Iterative statements	6	CO-2	10	3	3	4
Unit-3.0 3.0 String, List, Tuples, set and Dictionary	12	CO-3	18	5	3	10
Unit-4.0 Python Functions, Modules and packages	7	CO-4	10	3	3	4
Unit-5.0 Object Oriented Programming (OOP)	12	CO-5	18	4	5	9
Unit-6.0 Exception and File Handling in Python	7	CO-6	7	2	2	3
Total	**48**	**-**	**70**	**20**	**18**	**32**

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.	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	CO-1	40	50	10
2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	CO-2	40	50	10
3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a string the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	CO-2, CO3	40	50	10
4.	Write and execute Python program to- a) find largest number in a given list without using max (). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	CO-2, CO-3	40	50	10
5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuples by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	CO-2, CO-3	40	50	10
6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets.	CO-2, CO-3	40	50	10

	c) create set difference. d) check if two given sets have no elements in common.				
7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	CO-2, CO-3	40	50	10
8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate n!/(r!)*(n-r)!) where symbol "**!**" stands for factorial.	CO-2, CO-4	40	50	10
9.	Write program using OOP approach to – a) create an instance of a specified class and display the namespace of the said instance b) create a Python class named Student with two attributes: student_id, student_name. Add a new attribute: student_class. Create a function to display all attributes and their values in the student class. c) Create a Python class named Student with two instances student1, student2 and assign values to the instances' attributes. Print all the attributes of the student1, student2 instances d) Demonstrate use of polymorphism with following situations: i. Polymorphism in operator ii. Polymorphism in user defined method iii. Polymorphism in built-in function iv. Polymorphism with class method v. Polymorphism with method overriding	CO-2, CO-5	40	50	10
10.	Using exception handling feature such as try…except, try finally- write minimum three programs to handle following types of exceptions. i. TypeError ii. NameError iii. IndexError iv. KeyError v. ValueError vi. IOError vii. ZeroDivisionError	CO-2, CO-6	40	50	10

11.	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	CO-1	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 beprepared 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.	Computer system	Processor Intel Core i5, 4 GB RAM, 15 GB free disk space	All
2.	Integrated Development and Learning Environment (IDLE)	S/w to be downloaded for python 3.11.3 or higher	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Computing and Problem-Solving using Python	E. Balagurusamy	McGraw Hill Education (India)Pvt. Ltd.1st Edition /2016
2.	Learning Python Programming	Jeffrey Elkner, Allan B.Downey, Chris Meyers	Samurai Media Limited. 2016
3.	Python Programming	Ashok Namdev Kamthane and Amit Ashok Kamthane	McGraw Hill Education (India) Pvt.Ltd.2020, 2nd Edition
4.	Programming in Python	Dr. Pooja Sharma	BPB Publications 2017

(b) Online Educational Resources:

1. https://docs.python.org/3/tutorial/

2. https://www.w3schools.com/python/
3. https://www.tutorialspoint.com/python/index.htm

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 **: 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 respective programme coordinator at institute level. As per 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)						
		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)	
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.* 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 (ह5ि◌ंदी) TSO 1a सम्प्रेषण कौशल का अर्थ स्पष्ट कर सकें गे. TSO 1b भाव एवं सम्प्रेषण में अंतर बता पाएँ गे. TSO 1c सम्प्रेषण की प्रहिया का उल्लेख कर सकें गे. TSO 1d श्रवण अहवव्यक्ति, वाचन और लेखन की अवधारणा को स्पष्ट कर सकें गे. TSO 1e सम्प्रेषण कौशल केहनधाथरक तत्◌ोि◌ं का हववेचन कर सकें गे. TSO 1f प्रभावशाली सम्प्रेषण केहसद्◌ाि◌ंतोि◌ं का समावेश	Units-1.0: सम्प्रेषण हसद्◌ान्त एवं व्यव5◌ार 1.1 सम्प्रेषण : पररचय , अर्थ एवं पररभाषा 1.2 सम्प्रेषण की प्रहिया एवं तत्त्व 1.3 सम्प्रेषण केप्रकार : औपचाररक एवं अनौपचाररक, शाक्तिक एवं अशाक्तिक 1.4 प्रभावशाली सम्प्रेषण के हसद्◌ाि◌ंत एवं सम्प्रेषण व्यवधान	**CO1, CO2, CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
अपने वाताथलाप में कर सकें गे.	ुकरुक्षेत्र में श्रीकृ ष्ण- अरु ुथन सिंवाद म5ाभारत युद् प्रारम्भ 5ोने से प5ले ुक रुक्षेत्र में श्री ृक ष्ण ने अरु ुथन ेके प्रश्ोिं ेके उत्तर देते हुए र्ीवन ेके सूत्र समझाए र्े।ये उपदेश श्रीमद्भागव गीता में हमलते	
TSO 2a तकनीकी कौशल एविं व्यव5ार कौशल में अन्तर बता पाएँ गे . TSO 2b व्यव5ार कौशल का म म5त् स्पष्ट कर पाएँ गे . TSO 2c आत्म र्ागरूकता एविं आत्म हवश्लेषण का हववेचन सोदा5रण कर पाएँ गे . TSO 2d भावनात्मक बुक्तद्मत्ता एविं करुणा, अनुकू लनशीलता एविं लचीलापन का हवकास कर पाएँ गे. TSO 2e दैहनक र्ीवन में अनुकू लनशीलता एविं लचीलापन को आत्मसात कर पाएँ गे .	Unit-2.0: व्यावसाहयक उ्कृ ष्टता 5ेतु व्यव5ार कौशल 2.1 पररचय : तकनीकी कौशल एविं व्यव5ार कौशल 2.2 व्यव5ार कौशल का म5त्त्व 2.3 र्ीवन कौशल : आत्म र्ागरूकता एविं आत्म हवश्लेषण 2.4 वनात्मक बुक्तद्मत्ता एविं करुणा, अनुकू लनशीलता एविं लचीलापन, व्यव5ार कौशल का उपयोग श्रीराम ेकवट सिंवाद श्रीराम र्ब लक्ष्मण और सीता ेकसार् वन गमन ेकहलए प्रस्थान करते 5ैं तब सरयू नदी ेकपार उतारने हलए ेक वट से अनुरोध करते 5ैं।	**CO1**
TSO 3aपहित गद्ाि ंश एविं पद्ाि ंश से प्राप्त नयी शिावली हवकहसत कर पाएँ गे TSO 3b हदए गये क5ाहनयोिं, कहवताओिं एविं हनबिधोिं का साराि ंश अपने शिोि ं में हलख पाएँ गे. TSO 3c हदए गये क5ाहनयोिं, कहवताओिं एविं हनबिंधोिं में प्रयुि मु5ावरोिं एविं अलिंकारोिं को बता पाएँ गे . TSO 3d कहवताओिं का भावार्थ स्पष्ट कर पाएँ गे .	Unit-3.0: पाि-बोध : शिावली पररवधथन एविं व्याकरण अभ्यास 3.1 नमक का दरोगा, ईदगा5 – मुि ंशी प्रेमचिंद 3.2 बात (हनबिंध)- प्रताप नारायण हमश्र 3.3 व5 प्रदीप र्ो हदख र5ा 5ै हझलहमल दू र न5ीि5ै – रामधारी हसिं5 हदनकर 3.4 नर 5ो न हनराश करो मन को – मैहर्लीशरण गुप्त 3.5 कबीर ेकदो5े -काल्ह करे सो आर् कर , र्ाहत न पूछो साधू की , ऐसी वाणी बोहलए	**CO4**
TSO 4a अपनी शाखा से सम्बक्तित तकनीकी शिावली का चयन कर पाएँ गे . TSO 4b पयाथयवाची एविं हवलोम शिोि ं से सम्बिंहधत शिावली तैयार कर सकें गे . TSO 4c हदये गये गद्ाि ंशोि ं में हवराम हचह्ोिं का स5ी प्रयोग कर पाएँ गे .	Unit-4.0: शिावली एविं व्याकरण 4.1 सामान्य शिावली 4.2 प्रशासहनक शिावली 4.3 **शि** भेद, अनेक **शिोि ं** ेकहलए एक **शि** 4.4 हवराम हचन्ह 4.5 मु5ावरें एविं क5ावतें	**CO4** **CO5**
TSO 5a हदए गये हदए गये गद्ाि ंशोि ं का सिंक्षेपण कर पाएँ गे . TSO 5b हवहभन्न प्रकार ेकपत्रोिं, आवेदनोिं ,सूचनाओिं, हवज्ञक्तप्तयोिं को हलख पाएँ गे . TSO 5c अपनी शाखा से सम्बिंहधत प्रहतवेदन लेखन कर पाएँ गे . TSO 5d अपने सिंस्थान में हुए आयोर्नोिं का प्रहतवेदन हलख पाएँ गे.	Unit-5.0: लेखन कौशल 5.1 सार- लेखन 5.2 औपचाररक एविं व्यवसाहयक पत्र लेखन 5.3 प्रारूप लेखन – सूचना, हनहवदा लेखन, प्रहतवेदन 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 Class room 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 ससद्धान्त एवं व्यवहार**	2	CO1, CO2	3	1	1	1
Unit-2.0: व्यावसासिक उत्कृ ष्टता हेतु D व5 ार **कौशल**	2	CO3	3	1	1	1

Unit Title and Number	Total Class room Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Unders tanding (U)	Application & above (A)
Unit-3.0: पाठ-बोध :शब्दावली पररवधधन, एवं व्याकरण अभ्यास	5	CO4, CO5	5	1	1	3
Unit-4.0: शब्दावली एवं व्याकरण	4	CO5	5	1	1	3
Unit-5.0: लेखन कौशल	3	CO5	4	2	1	1
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

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
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
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
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 कु मार अग्रवाल , डॉ अवनीश कु मार ममश्रा	साहित्य भवन पब्ललके शन : आगरा
16	आधुमनक हिंदी व्याकरण और रचना	डॉ वासुदेवनंदन प्रसाद	भारती भवन पब्ललके शन

(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 : **2425105 (T2425105/P2425105/S2425105)**

B) Course Title : Engineering Drawing (ME, ME (Auto))

C) Pre- requisite Course(s) : Knowledge of standard geometries

D) Rationale :

Engineering drawing is a way of communication for engineers. It is a graphical language that essential for communicating design ideas and technical information to engineers in industry and other professionals throughout the design and manufacturing processes. The purpose of an engineering drawing is to clearly and accurately capture all geometric features of a product or component so that it can be manufactured with desired accuracy. This course aims at development of fundamental understanding and application of engineering drawing concepts so as to develop the ability to visualize, prepare, read and interpret drawings correctly and make aware of drafting practices, symbols, codes, norms and standards generally used in industries. The course covers the knowledge & application of drawing instruments, familiarizes the learner about Bureau of Indian standards related to engineering drawing, developing the ability to draw and read various geometric figures, engineering curves, Scales, dimensioning styles, projections, section of solids and development of surfaces. This course will help the Mechanical and allied discipline students to take up higher level industry-oriented courses like 'Production and Assembly Drawing' and 'Computer Aided Drafting and Modeling'.

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 drawing instruments, drawing codes, dimensioning, conventions and symbols as per IS SP-46(2003) in engineering drawing.
- **CO-2** Draw geometrical figures, engineering curves and scales.
- **CO-3** Draw the orthographic projection of points, lines and planes under different conditions.
- **CO-4** Draw orthographic views of sectioned and un-sectioned regular solids.
- **CO-5** Draw isometric views of components directly or from orthographic projections.
- **CO-6** Draw development of lateral surfaces of primitive solids.
- **CO-7** Draw free hand sketches of engineering elements, their orthographic and isometric views.

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	-	-	3	2	1	-		
CO-2	3	-	-	3	-	1	-		
CO-3	3	1	1	3	-	1	2		
CO-4	3	1	1	3	-	1	2		
CO-5	3	1	1	3	-	1	2		
CO-6	3	1	1	3	-	1	2		
CO-7	3	-	-	-	-	1	2		

F) Suggested Course Articulation Matrix (CAM):

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

***** PSOs will be developed by respective programme coordinator at institute level. As per 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**				
2425105	Engineering Drawing	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)	
2425105	Engineering Drawing	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:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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, and 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: T2425105

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Use Drawing Instruments to prepare 2D drawings manually. *TSO 1b.* Use different lines and annotations for the given situation. *TSO 1c.* Draw engineering scale for the given situation. *TSO 1d.* Choose appropriate scale factor for the drawing as per given situation. *TSO 1e.* Dimension the given geometric figure using IS SP-46 standard. *TSO 1f.* Draw the given regular geometric figure with tangents and normal. *TSO 1g.* Draw the given engineering curve.	**Unit-1.0 Basic Elements of Drawing** 1.1 Methods to use different Drawing Instruments and supporting materials. 1.2 Different lines and conventions in engineering drawing. 1.3 Engineering scales and applications: Reduced, enlarged & full size (Plain and Diagonal scale) 1.4 Dimensioning techniques: Types and applications of chain, parallel and coordinate dimensioning as per SP-46. 1.5 Geometric construction related with line. 1.6 Geometric construction related with angle. 1.7 Geometric construction related with circle & arc. 1.8 Construct polygons: • Hexagon: Using drawing tools. • Polygon (Triangle, square, pentagon, hexagon and heptagon) by general method. • Polygon (Pentagon, hexagon and heptagon) by special method. 1.9 Engineering Curves: Ellipse, Parabola, Cycloids, Involutes (Circle and Polygon) and Spiral (Archimedean).	**CO1, CO2**
TSO 2a. Explain the different types of projections & their uses. *TSO 2b.* Explain the terminology related to orthographic projection. *TSO 2c.* Explain the method of drawing different views in orthographic projection. *TSO 2d.* Draw the orthographic projections of the given point, line and regular plane with different orientations in first angle. *TSO 2e.* Find out true size and shape of the given inclined line and plane respectively.	**Unit-2.0 Elements of Orthographic Projections** 2.1 Concept and applications of Orthographic, Perspective, Isometric and Oblique Projections. 2.2 Projection Planes 2.3 Orthographic Projection: First and Third angle 2.4 Projection of point: • Lies in any one of the quadrants. • Lies any one of the planes. • Lies on XY line. 2.5 Projection of lines: • Parallel to both the planes, • Perpendicular to any one of the planes.	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	• Inclined to any one of the planes. 2.6 Projection of Planes: i.e. Triangle, Square, Rectangle, Pentagon, Hexagon, Circle. • Perpendicular to both the projection planes. • Parallel to one and perpendicular to another projection plane. • Projection of plane inclined to one and perpendicular to another projection plane.	
TSO 3a. Explain the orientation of a solid with respect to HP and VP. *TSO 3b.* Explain the difference between cutting plane and projection planes. *TSO 3c.* Draw the orthographic projections of the given sectioned and/or un-sectioned solid placed with the given orientation. *TSO 3d.* Find out true shape and size of the given sectioned surface. *TSO 3e.* Convert pictorial views into orthographic views. *TSO 3f.* Interpret the given orthographic views to imagine the shape of the component.	**Unit-3.0 Orthographic Projection of Un-Sectioned and Sectioned Solids** 3.1 Orthographic Projection of regular solids with their base resting on H.P. • Prism: Triangular, Square (Cube/Cuboid), Rectangular (Cuboid) and Pentagonal. • Pyramid: Triangular, Square, Rectangular and Pentagonal. • Cylinder, Cone, Sphere 3.2 Orthographic Projection of Cuboid, Pentagonal Prism and Cylinder with their base inclined to any one projection plane and parallel to another. 3.3 Orthographic Projection of Cube & Cone with their axis inclined to both the projection planes. 3.4 Section of Regular solids (i.e. Cube, Cuboid, Cylinder, Cone.) with their base resting on H.P. by a Section plane: • Parallel to one reference plane and Perpendicular to another. • Inclined to one reference plane and Perpendicular to other. 3.5 Conversion of simple pictorial views into orthographic views.	**CO3, CO4**
TSO 4a. Explain the Isometric Projection, Isometric view and Isometric Scale. *TSO 4b.* Draw isometric dimensioning on the given isometric view. *TSO 4c.* Explain the Methods of constructing isometric drawing	**Unit-4.0 Isometric Projection** 4.1 Introduction to isometric projection. 4.2 Isometric scale and Natural Scale. 4.3 Isometric view and isometric projection. 4.4 Illustrative problems limited to Isometric projection of objects	**CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4d. Draw Isometric View of the given object containing elements like rectangular, circular, cylindrical shapes and slots on sloping and plane surfaces. *TSO 4e.* Convert the given orthographic views into isometric View/Projection.	containing rectangular, circular, cylindrical shapes and slots on sloping and plane surfaces. 4.5 Conversion of orthographic views into isometric View/projection.	
TSO 5a. Identify parts where the concept of development of surfaces is required. *TSO 5b.* Develop the lateral surfaces of the given Prism. *TSO 5c.* Develop the lateral surfaces of the given Pyramids. *TSO 5d.* Develop the lateral surfaces of the given Cylinder and Cone.	**Unit-5.0 Development of Surfaces** 5.1 Development of lateral surfaces of Triangular Prisms and Square Prisms (Cube and Cuboid) 5.2 Development of lateral surfaces of Triangular Pyramids (Tetrahedron) and rectangular pyramids. 5.3 Development of lateral surfaces of Cylinders and Cones.	**CO6**
TSO 6a. Sketch the given straight line, square, rectangle, circle and arc. *TSO 6b.* Sketch the given simple orthographic and isometric views of the given part. *TSO 6c.* Sketch the given engineering element/component.	**Unit-6.0 Free Hand Sketches of Engineering Elements** 6.1 Materials for Sketching. 6.2 General Guidelines for Freehand Sketching. 6.3 Freehand sketching of straight lines, square, rectangle, circles and arcs. 6.4 Free hand sketches of orthographic views. 6.5 Free hand sketches of isometric views. 6.6 Freehand sketching of engineering elements/components (e.g. Bolt, Nut, Washer, Stud, Screw, Simple machine parts, etc.)	**CO7**

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

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

P2425105

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use manual drawing instruments *LSO 1.2.* Draw simple 2D entities using manual drawing instruments.	1.	Geometric Construction: • Draw set of lines with different conditions (two problems). • Draw circle and arcs with different geometric conditions and constraints (two problems). • Draw polygons by general methods (Triangle, square, pentagon, hexagon, heptagon) (Three problems). • Draw polygons by special methods (Pentagon, hexagon and heptagon) (Three problems). • Draw various problems related to tangency of circle and point (two problems). • Draw a typical Title block.	CO1, CO2
LSO 2.1. Draw conic sections using manual drawing instruments. *LSO 2.2.* Use different methods of construction of engineering curves.	2.	Conic Sections and Engineering curves: • Construct ellipse using concentric circle method, four center method, arc of circle method, rectangle method, oblong method and eccentricity method. • Construct parabola using rectangular method, parallelogram method, tangent method and eccentricity method. • Construct hyperbola using rectangular method, oblique method and eccentricity method. • Construct hypocycloid & epicycloid. • Construct involute of circle. • Construct involute of polygons. • Construct Archimedean spiral	CO2
LSO 3.1. Project the given points, lines and regular planes with different orientations on reference planes using the method of orthographic projection. *LSO 3.2.* Find out true length and shape of the given inclined line and plane respectively.	3.	Orthographic Projection of Points, Lines and Planes: • Exercise on projection of points. (Three problems) • Exercise on projection of lines. (Six problems) • Exercise on projection of planes. (Six problems)	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 4.1. Apply the concepts of orthographic projection in drawing the various views of the given simple object on drawing sheet. *LSO 4.2.* Visualize the three views related to the given object based on its shape and orientation. *LSO 4.3.* Draw the three views of an un sectioned solid using method of orthographic projection.	4.	Draw Orthographic projections of following using first angle method: • A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P • A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P • Cuboid, Pentagonal Prism and Cylinder with their base inclined to any one projection plane and parallel to another. • Cube with their axis inclined to both the projection planes. • Cone with their axis inclined to both the projection planes. • Different objects having cylindrical surfaces, ribs. • Conversion of simple pictorial views into orthographic views.	CO3, CO4
LSO 5.1. Apply concepts of orthographic projection to draw different views of the given sectioned solid object on drawing sheet. *LSO 5.2.* Draw true shape and size of the given sectioned surface.	5.	Section of Regular solids (i.e. Cube, Cuboid, Cylinder, Cone.) with their base resting on H.P. by a Section plane: • Parallel to one reference plane and Perpendicular to another. • Inclined to one reference plane and Perpendicular to other.	CO4
LSO 6.1. Use concepts of Isometric projection to draw the given simple object with plain and slant surfaces.	6.	Draw Isometric view of simple objects having plain and slanting surface by using natural scale. (Three problems)	CO5
LSO 7.1. Convert the given 2D figures/views into 3D object using isometric projection. *LSO 7.2.* Visualize the 3D shape of the given object by identifying the missing elements.	7.	• Convert the orthographic views of an object to isometric view (Two problems) • Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book.	CO4, CO5
LSO 8.1. Correlate the concept of development of surfaces with sheet metal work. *LSO 8.2.* Develop the lateral surfaces of primitive solids.	8.	Development of lateral surfaces of: • Triangular Prisms and Square Prisms (one problem each) • Triangular Pyramids (Tetrahedron) and rectangular pyramids. (one problem each) • Cylinders and Cones. (one problem each)	CO6

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		• Funnel, chimney and pipe bend. (one problem each)	
LSO 9.1. Draw free hand sketches of the given domain specific object/component. *LSO 9.2.* Draw 3D free hand sketches from the given isometric shape. *LSO 9.3.* Draw 3D free hand sketches of the given real object/component.	9.	Draw free hand sketches/conventional representation of • Domain specific components (Three problems) • All above isometric drawings (prepared in Sr. No. 06) without using any instruments. Given the 3D model of an object, student will try to imagine the three views and draw them with free hand in the sketch book.	CO7

L) Suggested Term Work and Self Learning S2425105: Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

1. Prepare a list of industrial and household components in which conic curves are used and justify the utility of these curves.
2. Write the equations for parabola in different quadrants and observe the effect of changing eccentricity in case of parabola.
3. Exercises on drawing orthographic views of engineering domain specific simple parts.
4. Exercise on drawing isometric views of different objects.
5. Exercises on converting the orthographic views of an object to isometric view.
6. Exercise on missing views.
7. Each student should explain at least one problem for construction and method of drawing in sheet to all batch colleagues. Teacher will assign the problem of particular sheet to be explained to each student batch.
8. Each student will assess at least one sheet of other students (May be a group of 5-6 students identified by teacher can be taken) and will note down the mistakes committed by them. Student will also guide the students for correcting the mistakes, if any.

b. Micro Projects:

1. Through experimentation, justify that the eccentricity of an ellipse is 1.
2. Cut a Cardboard/Thermocole cone with various section planes to get circle, ellipse, parabola and hyperbola.
3. Explore the applications of engineering curves in different fields of engineering and prepare a short report.
4. List the shapes and curves you are observing around you in real life with name of place and item. (For Ex. ellipse, parabola, hyperbola, cycloid, epicycloids, hypocycloid, involute, spiral helix).
5. Cut triangular, square, rectangular and circular shaped Cardboard/Thermocole pieces and observe them by placing in different positions with respect to the protection planes.
6. Take a medium sized hexagonal nut and draw its isometric projection.

7. The teacher will assign one set of orthographic projections and ask the student to develop 3D Thermocol models of the same.
8. Prepare a drawing sheet of Top view of your Institute with details.
9. Show the development of surfaces of different types of solid model made by cardboard.
10. Prepare an A4 digital drawing template of your institute with title block and institute logo.
11. Each batch will collect 2 assembly/production/detailed drawings from the nearby industry interpret it and prepare a report on the lines used, annotations used, view used, bill of material, dimensioning style used, conventions used.

c. Other Activities:

1. Seminar Topics:
   - Standard symbol and conventions used in engineering drawings related to your branch/domain.
   - Use of different types of scales.
   - Difference between Orthographic, Isometric, Perspective and Oblique projections.
   - Effect of eccentricity on shape of conic sections.
   - Difference between Natural and Isometric scales.
   - Use of development of surfaces for sheet metal and other work.
   - Difference between First and Third angle orthographic projections.

2. Visits:
   - Collect production/construction/circuit drawings from nearby industries/shop/builders and observe the type of orthographic projection, symbol of projection and various views used.
   - Visit Tool room training center, Patna. Prepare report of visit with special comments on 2D and 3D view of Components. Also prepare report on drawings prepared by drafter and AutoCAD software.

3. Self-Learning Topics:
   - Types of lines and dimensioning in engineering drawing.
   - Use of Epicycloid and Hypocycloid engineering curves in Gears and Cams.
   - Projection of a circle/circular plane.
   - Radius of a sphere in isometric view/isometric projection.
   - Development of all the surfaces of a cube.

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	05%	05%	05%	-	-	05%	14%
CO-2	10%	10%	10%	20%	20%	10%	14%

CO-3	10%	10%	10%	20%	20%	10%	14%
CO-4	25%	25%	25%	20%	20%	25%	15%
CO-5	20%	20%	20%	20%	20%	20%	15%
CO-6	20%	20%	20%	20%	20%	20%	14%
CO-7	10%	10%	10%	-	-	10%	14%
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 is 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 Basic Elements of Drawing	8	CO1, CO2	10	4	2	4
Unit-2.0 Elements of Orthographic Projections	6	CO3	7	2	2	3
Unit-3.0 Orthographic Projection of Un-Sectioned and Sectioned Solids	12	CO3, CO4	20	4	4	12
Unit-4.0 Isometric Projection	8	CO5	12	4	2	6
Unit-5.0 Development of Surfaces	8	CO6	14	4	2	8
Unit-6.0 Free Hand Sketches of Engineering Elements	6	CO7	7	2	1	4
Total	**48**	**-**	**70**	**20**	**13**	**37**

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.	Geometric Construction	CO1, CO2	30	60	10
2.	Conic Sections and Engineering curves	CO2	30	60	10
3.	Orthographic Projection of Points, Lines and Planes	CO3	30	60	10
4.	Orthographic projections of un-sectioned solids	CO3, CO4	30	60	10
5.	Orthographic projections of sectioned solids	CO4	30	60	10
6.	Isometric view of simple objects having plain and slanting surface by using natural scale.	CO5	30	60	10
7.	• Convert the orthographic views of an object to isometric view • Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book.	CO4, CO5	30	60	10
8.	Development of lateral surfaces	CO6	30	60	10
9.	• Draw free hand sketches/conventional representation • Given the 3D model of an object, student will try to imagine the three views and draw them with free hand in the sketch book.	CO7	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.	Drawing Table with Drawing Board	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2.	Models and Charts	Normal and cut sectioned Models and Charts of objects for orthographic / isometric projections	All
3.	Smart Class Room	Interactive board (165 x 130 cm) with LCD overhead projector	All
4.	Sample production/construction drawings	• Set of various industrial drawings/production drawings/construction drawings/assembly drawings being used by industries. • Set of drawings sheets developed by experienced teachers and made used available on the SBTE portal to be used as reference/standards.	All
5.	Drawing equipments and instruments	Drawing equipments and instruments for class room teaching-large size: • T-square or drafter (Drafting Machine). • Set squires (450 and 300-600) • Protector. • Drawing instrument box (containing set of compasses and dividers). • Drawing sheets, Drawing pencils, Eraser. • Drawing pins / clips	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Engineering Drawing	N.D. Bhatt	Charotar Publishing House, Anand, Gujrat 2010; ISBN: 978-93- 80358-17-8.
2.	Engineering Drawing	R.K. Dhawan	S. Chand and Company, New Delhi; ISBN: 81-219-1431-0.
3.	Engineering Drawing	P.J. Shah	S. Chand & Company, New Delhi, 2008, ISBN:81-219-2964-4.
4.	Engineering Drawing	M.B. Shah, B.C. Rana	Pearsons. 2009 ISBN: 9788131759714
5.	Engineering Graphics	S. K. Pradhan K.K. Jain	Khanna Book Publishing Company Pvt. Ltd., New Delhi ASIN : B0BM5BMMXT ISBN-10 : 9355381891 ISBN-13 : 978-9355381897

(b) Online Educational Resources:

1. Scales: https://youtu.be/YSEZu3Ch26k
2. Dimensioning: https://youtu.be/_OSY04TnlEM
3. Simple Orthographic Projections: https://youtu.be/DW7dpKdxVrA
4. Orthographic Projections of objects with slant and curved surfaces: https://youtu.be/dCWjBvZBpjM
5. Illustrative Example: https://youtu.be/MR5de9EC940
6. Illustrative Example: https://youtu.be/mahh-WONNHA
7. Isometric Projection of 3D objects: https://youtu.be/0K-5URiyi50
8. Isometric Projection-Object with slant surfaces: https://youtu.be/qSPJOiXKv98
9. Isometric Projection-Object with curved surfaces: https://youtu.be/qSPJOiXKv98
10. Missing lines and missing views: https://nptel.ac.in/courses/105/104/105104148/
11. https://nptel.ac.in/courses/112/103/112103019
12. https://nptel.ac.in/courses/112/105/112105294

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. Bureau of Indian Standards, Engineering Drawing Practice for Schools and Colleges IS: SP- 46, BIS, Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2.
2. Set of various industrial drawings/production drawings/construction drawings/assembly drawings being used by industries.
3. Set of drawings sheets developed by experienced teachers and made used available on the SBTE portal to be used as reference/standards.

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/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		
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 respective programme coordinator at institute level. As per 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	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	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 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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