Curriculum
of
Diploma Programme
in
Mechanical Engineering

State Board of Technical Education (SBTE)

Bihar

Semester – I

Teaching & Learning Scheme

Board of Study	Course Codes	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	**Basic Engg. Mathematics** (ME, ME (Auto), CE, MIE, CSE, AIML, EE, CRE, CHE, ELX, ELX (R), RE)	2	1	-	2	5	4
	2400102A	**Applied Physics -A** (CE, ME, ME (Auto), MIE, AE, FTS, CRE, CHE, RE)	3	-	4	2	9	6
	2418103	**Python Programming** (CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT, RE)	3	-	4	2	9	6
	2400104	**Communication Skills (English)** (Common for all Programmes)	3	-	4	2	9	6
	2425105	**Engineering Drawing** (ME, ME (Auto), RE)	3	-	4	2	9	6
	2400006	**Environmental Education and Sustainable Development** (Common for All Programmes)	1	-	1	1	3	2
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.

For Non exam course institute have option to choose any one course (Cisco/KYP/ST)

Semester - I

Assessment Scheme

Board of Study	Course Codes	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	**Basic Engg. Mathematics** (ME, ME (Auto), CE, MIE, CSE, AIML, EE, CRE, CHE, ELX, ELX (R), RE)	30	70	20	30	-	-	150
	2400102A	**Applied Physics -A** (CE, ME, ME (Auto), MIE, AE, FTS, CRE, CHE, RE)	30	70	20	30	20	30	200
	2418103	**Python Programming** CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT, RE) (	30	70	20	30	20	30	200
	2400104	**Communication Skills (English)** (Common for all Programmes)	30	70	20	30	20	30	200
	2425105	**Engineering Drawing** (ME, ME (Auto), RE)	30	70	20	30	20	30	200
	2400006	**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:

- 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 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 Engineering Mathematics

C) Pre- requisite Course(s) : Algebra, Geometry, Trigonometry

D) Rationale :

This course provides strong foundation in mathematical concepts and techniques that can be applied in a variety of settings and can help them develop important problem-solving and logical thinking skills that are valuable. This basic course of Mathematics is being introduced as a foundation which will help in developing the competency and the requisite course outcomes. Calculus is a branch of Mathematics that calculates how matter, particles and heavenly bodies actually move. Derivatives are useful to find maxima and minima of the function, velocity and acceleration and also useful for many engineering optimization problems. Statistics can be defined as a type of mathematical analysis which involves the method of collecting and analyzing data and then summing up the data into a numerical form for a given set of factual data or real-world observations. This course is an attempt to initiate the multi-dimensional logical thinking and reasoning capabilities. It will help to apply the principles of basic mathematics to solve related technology problems. The course provides the insight to analyze engineering problems scientifically using, determinants, matrices, trigonometry, coordinate geometry, and statistics. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used for modeling and analysis in a wide range of applications in engineering.

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 Demonstrate the ability to solve engineering related problems based on applications of algebra.

CO-2 Use concept of derivative as a tool to solve engineering related problems.

CO-3 Apply differential calculus to solve branch specific problems.

CO-4 Use 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)	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	-	-	-	-	-	-		
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 respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	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

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

Legend:

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

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

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

SL: Self Learning, MOOCs, Spoken Tutorials, online educational resources etc.

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

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

H) Assessment Scheme:

Board of Study	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

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)

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

J) Theory Session Outcomes (TSOs) and Units: T2400101

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Find solution of system of equations in three unknown applying Cramer's rule. *TSO 1b.* Solve simple given problems based on Algebra of matrices. *TSO 1c.* Find inverse of matrix applying the concept of Adjoint of matrix. *TSO 1d.* Find solution of simultaneous equations in three variables using the concept of Matrix Inversion method. *TSO 1e.* Solve problems based on sum, subtraction of Vectors. *TSO 1f.* Solve simple problems related to Scalar and Vector product of vectors.	**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.	**CO1**
TSO 2a. Define concept of 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 continuity of function at a point. *TSO 2e.* Find differentiation of some simple function (sinx, cosx, tanx and e^x) by first principle. *TSO 2f.* Calculate derivative of given Algebraic, trigonometric and exponential functions. *TSO 2g.* Find derivative of sum, product and quotient of given two functions. *TSO 2h.* Find the differentiation of given composite functions applying the concept of Chain rule. *TSO 2i.* Find derivative of Logarithmic, Implicit and Parametric functions.	**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.	**CO2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Find second order derivative of given simple functions. *TSO 3b.* Solve simple problems based on Rolle 's Theorem and Mean Value Theorem. *TSO 3c.* Apply concept of Rate of change to solve give simple problems related to velocity, 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.	**Unit-3.0 Application of Differential Calculus** 3.1 Successive differentiation up to second order. 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.	**CO3**
TSO 4a. Calculate angle between given two lines also find slope. *TSO 4b.* Formulate equation of straight lines of different forms. *TSO 4c.* Find perpendicular distance of a straight line from a given point and perpendicular distance between two parallel lines. *TSO 4d.* Solve given simple problems related to Circle and Parabola for engineering applications. *TSO 4e.* 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, 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. **Conic Section** 4.5 Introduction of Conic-Section. 4.6 Equation of Circle in standard form. 4.7 Standard equation of parabola, ellipse and hyperbola.	**CO4**
TSO 5a. Compute probability of given simple problems based on Addition and Multiplication theorem. *TSO 5b.* Evaluate Mean, Median and Mode of the given data for engineering applications. *TSO 5c.* Calculate Range, Variance and standard deviation of given data for engineering applications. *TSO 5d.* Calculate 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. **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 Laboratory (Practical) Session Outcomes (LSOs) and List of Practical:

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Determine the value of determinant by using available open source software. *LSO 1.2.* Determine inverse of a non-singular matrix by using open source software. *LSO 1.3.* Apply Matrix Inversion method to determine currents through various branches of given electrical networks. *LSO 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 open source 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**
LSO 2.1. Geometrically represent the domain and range of given Modulus function, Signum function and Floor function. *LSO 2.2.* Verify geometrically the continuity of given function at a point. *LSO 2.3.* Determine the concavity and convexity of a given continuous function for given engineering application. *LSO 2.4.* Find 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. • Vibrations of a mass-spring system. • Branch specific engineering application of derivative of parametric function.	**CO2**
LSO 3.1. Determine the maximum height of a projectile trajectory using Roll's theorem. *LSO 3.2.* Use Lagrange's Mean Value theorem to find point at which the slope of the tangent becomes equal to the slope of the secant through its endpoints. *LSO 3.3.* Use the concept of derivative to find the slope of a bending curve for given engineering problem. *LSO 3.4.* Use the concept of tangent and normal to solve the given problem of Engineering Drawing. *LSO 3.5.* Use the concept of Maxima and Minima to obtain optimum value for given engineering problem. *LSO 3.6.* Use the concept of radius of curvature to solve 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**
LSO 4.1. Apply the concept of Gradient to draw graphs in engineering drawing. *LSO 4.2.* Use given form of straight line to calculate the speed, distance and time of moving object. *LSO 4.3.* Use concept of Ellipse to prepare a Model of the path of Planet and its foci.	4.	• Geometrical interpretation of Gradient. • Geometrical Interpretation of line in various forms. • Geometrical interpretation of perpendicular distance of a line. • Geometrical representation of conic-section.	**CO4**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 5.1. Use concept of probability to solve given problems based on Board, Playing card. *LSO 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 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.

1. Solve the simultaneous system of equation in two variables by Matrix Inversion Method. Write down a Mathematical programming 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 moment in term of structural integrity and mechanical system using open source software.
3. Represent the Graph of Trigonometric function, Logarithmic function on Geogebra and interpret the nature of 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 semicircular opening. The total perimeter of the window to admit maximum light through the whole opening. Prepare a model using concept of Maxima and Minima for the above problem and verify the result.
6. Find the curvature of x=4cos t and y= 3 sin t, 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 section on Geogebra and write down their equation.
8. Explain how parabolic reflectors are used in engineering applications such as Satellite Dish Antennas or Head Lights.
9. By Collecting the Data of 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 properties of Determinant and Matrices.
2. Prepare a chart for the use of Vector algebra to solve problems of rate of change of the mass of a fluid flow.
3. Draw 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 SageMaths, MATHS3D, GeoGebra, Graph 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 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 Mean value theorem related to real world problems.
8. Model to maximize the volume of a box made of a rectangle tin sheet by cutting off squares of same size from each corner and folding up. Also design models for at least 5 similar situation and prepare a soft file with animation.

9. Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
10. Prepare models using the concept of radius of curvature to 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, to find the range of magnitudes of the earthquake etc. watch them and write a report to detail out the mathematical steps involved.
13. Prepare the Charts of formulae showing different forms of straight line 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 probability of given event.
16. Collect the data of world of work and find 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 out the mathematical steps involved.

c. Other Activities:

1. Seminar Topics:
    - Applications of Integral calculus in control systems, dynamics and vibrations.
    - Applications of Determinant and matrices in graphic design to make digital images.
    - Application of Determinant 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, electric field.
    - Applications of Derivative for engineering & technology.
    - Application of radius of curvature for engineering and Science.
    - Applications of Derivative in 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 Co-ordinate 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 and comets etc.
    - Probability and statistics: Civil engineering, estimation of model uncertainties, identification of probability distribution.

2. Visits: Visiting 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 Science museum.
    - Visit to a mathematics research institute.
    - Visit to a Data Science Center.
    - Visit to a mathematics department of a college or university.
    - Visit to a software company.
    - Visit to a Space Agency.
    - Visit to a Gamming Studio.
    - Visit to a Science library.
    - Visit to planetarium.
    - Participation in mathematics competition.

3. Self-learning topics:
    - Participate in MOOCs based Course on Matrix offered from Foreign University: Methods and Applications.
    - Participate in MOOCs based Course on Differential calculus: Methods and Applications.
    - Participate in MOOCs based Course on Probability and its Engineering applications.
    - Participate in MOOCs based Course 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 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%	10%		
CO-2	15%	20%	20%	20%	15%		
CO-3	20%	15%	15%	20%	25%		
CO-4	20%	20%	25%	20%	25%		
CO-5	25%	25%	25%	20%	25%		
Total Marks	**30**	**70**	**20**	**20**	**10**		
			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 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: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested AssessmentTable for Laboratory (Practical):

SN	Laboratory Practical Titles	Relevant Cos Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.					

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	Processor Intel Core i7 with Compilers and Programming Languages; RAM 32 GB, DDR3/DDR4, HDD 500 GB, OS Windows 10.	All
2.	Software	Scientific Calculators, Graphing Calculator, SCILAB, GraphEq^2.13, Micro soft Mathematics, GeoGebra, Math3D	1,2,3,4,5
3.	Printer	High Speed Duplex Printer	
4.	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.	Mathematics-I	Deepak Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-42-4
8.	Mathematics-II	Garima Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-52-3
9.	Consider Dimension and Replace Pi	M.P. Trivedi and P.Y. Trivedi	Notion Press; 1st edition (2018), ISBN: 978-1644291795

(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 : **2400102A(T2400102A/P2400102A/S2400102A)**

B) Course Title : Applied Physics – A (ME, ME (Auto), CE, MIE, CRE, CHE, AE, FTS, RE)

C) Pre- requisite Course(s) :

D) Rationale :

As a subject Physics includes large numbers of diverse topics, related to materials, energy and their interactions that exists in the world around us, it empowers us to explain the different physical phenomena by observation and prediction. Engineering Diploma graduates are required to use of principles of physics in various fields of engineering and technology and same has been given prominence in the course content. This course will help the diploma engineers to apply the basic concepts and principles of physics for solving various broad-based engineering problems and comprehend different state of art technology-based applications.

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

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

CO-1 Estimate the errors in measurements of physical quantity with precision.

CO-2 Apply the concepts and principles of rotational motion in various civil and mechanical engineering problems.

CO-3 Select relevant materials for industrial applications based on its physical and thermal properties.

CO-4 Apply the concept of waves for various engineering applications involving wave dynamics

CO-5 Apply the basic concepts of modern physics for solving engineering problems.

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	1	-	-	-	1	2		
CO-2	3	2	2	1	1	1	1		
CO-3	3	1	2	1	1	1	1		
CO-4	3	2	2	1	-	1	1		
CO-5	3	2	1	2	-	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:

Board of Study	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				
	2400102A	Applied Physics- A	03	-	04	02	09	06

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. 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:

Board of Study	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)	
	2400102A	Applied Physics- A	30	70	20	30	20	30	200

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:

- 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: T2400102A

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Distinguish between fundamental and derived physical quantity. *TSO 1b.* Estimate the errors in the measurement of given physical quantity. *TSO 1c.* Derive dimensional formula of a given physical quantity. *TSO 1d.* Apply dimensional analysis for inter conversion of units. *TSO 1e.* Establish relation between physical quantities using dimensional analysis. *TSO 1f.* Use dimensional analysis to check the correctness of a given equation.	**Unit-1.0 Unit and Measurements** 1.1 Physical quantities, fundamentals and derived units and system of units 1.2 Accuracy, precision and errors (systematic and random) in measurements, Method of estimation of errors (absolute and relative) in measurement, propagation of errors, significant figures 1.3 Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimension in an equation 1.4 Applications of dimensions: conversion from one system of units to other, corrections of equations and derivation of simple equations	**CO1**
TSO 2a. Explain circular motion and various terms related to circular motion. *TSO 2b.* Apply the concept of centripetal and centrifugal forces in a given situation. *TSO 2c.* Distinguish between translational and rotational motion. *TSO 2d.* Explain the terms torque and angular momentum. *TSO 2e.* Apply the principle of conservation of angular momentum in a given situation. *TSO 2f.* Find the moment of inertia of a given regular shape body.	**Unit-2.0 Circular and Rotational Motion** 2.1 Circular motion, angular displacement, angular velocity, frequency, time period, angular acceleration, relation between angular & linear velocity, linear acceleration & angular acceleration 2.2 Centripetal and centrifugal forces: banking of roads and bending of cyclist 2.3 Translational and rotational motion, torque and angular momentum, conservation of angular momentum and its applications 2.4 Moment of inertia and its physical significances, radius of gyration of rigid body, theorem of parallel and perpendicular axes (statements only), moment of inertia of rod, ring, disc and sphere (hollow and solid)	**CO2**
TSO 3a. Explain the stress-strain curve of a given elastic or plastic body. *TSO 3b.* Interrelate different coefficient of elasticity. *TSO 3c.* Apply the concepts of surface tension and	**Unit-3.0 Physical Properties of Matter and Heat** 3.1 Elasticity: Hooke's law, Coefficient of elasticity; Young's modulus, Bulk Modulus and modulus of rigidity and their inter-relation (No derivation),	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
viscosity to solve a given engineering problem. *TSO 3d.* Explain the behavior of given fluids on the basis of their viscosity. *TSO 3e.* Determine the various modes heat transfer in a given engineering problem. *TSO 3f.* Establish relation between coefficients of thermal expansion.	Poisson's ratio, stress-strain curve, elastic potential energy 3.2 Surface tension: Intermolecular Force, cohesive and adhesive forces, Surface Tension, Surface Energy, angle of contact, Ascent formula (No derivation), applications of surface tension, capillary action, effect of temperature and impurity on surface tension 3.3 Viscosity: Fluid, Viscosity and coefficient of viscosity, Critical Velocity, Reynold's number, streamline and turbulent flow, Terminal velocity, Stokes law and effect of temperature on viscosity. 3.4 Heat: Concept of Heat and Temperature and it's difference, modes of heat transfer: conduction, convection, radiation, coefficient of thermal conductivity, thermal expansion of solid, liquid and gas, coefficient of linear, surface and cubical expansions and relation amongst them.	
TSO 4a. Differentiate among periodic, oscillatory and simple harmonic motion. *TSO 4b.* Explain the various terms related to SHM. *TSO 4c.* Derive the expression for time period of given Bar pendulum. *TSO 4d.* Distinguish between mechanical and electromagnetic waves with examples *TSO 4e.* Differentiate between longitudinal and transverse waves with examples *TSO 4f.* Find the relation between the terms used to describe wave motion. *TSO 4g.* Explain the principle of Superposition of waves and beat formation with examples.	**Unit-4.0 Simple Harmonic Motion and Wave Motion** 4.1 Periodic and Oscillatory Motion 4.2 Simple Harmonic Motion (SHM): Displacement, Amplitude, phase, velocity, acceleration, time period, frequency and their interrelation, Conservation of energy in SHM, Compound pendulum: Bar pendulum 4.3 Types of waves: Mechanical and Electromagnetic waves, Transverse and longitudinal waves, wave velocity, frequency and wave length and their relationship, wave equation, amplitude, phase, phase difference, superposition of waves, Beats formation	**CO4**
TSO 5a. Apply the concept of photoelectric effect to explain the of photonic devices. *TSO 5b.* Explain Laser, components of laser and its various engineering applications. *TSO 5c.* Explain propagation of light in optical fiber and its engineering applications. *TSO 5d.* Describe the properties of nanomaterials and its various applications.	**Unit-5.0 Modern Physics** 5.1 Photoelectric effect; Photon, threshold frequency, work function, Stopping Potential, Einstein's photoelectric equation. 5.2 Lasers: Properties, Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, types of lasers: Ruby laser, He-Ne Laser, engineering and medical applications of lasers. 5.3 Optical fibers: Total internal reflection, acceptance angle and numerical aperture, Optical fiber types, applications of optical fibers 5.4 Nanotechnology: Properties (optical, magnetic and dielectric properties) of Nanomaterials and its application	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400102A

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use Vernier caliper to measure the known and unknown dimensions of a given small object. *LSO 1.2.* Estimate the mean absolute error up to two significant figures.	1.	Vernier caliper	**CO1**
LSO 2.1. Use screw gauge to measure the diameter/ thickness of a given object. *LSO 2.2.* Estimate the mean absolute, relative and percentage errors up to three significant figures.	2.	Screw gauge	**CO1**
LSO 3.1. Use Spherometer to measure radius of curvature of given convex and concave mirror/surface. *LSO 3.2.* Estimate errors in the measurement.	3.	Spherometer	**CO1**
LSO 4.1. Determine the spring constant of a given spring.	4.	Spring Oscillator	**CO4**
LSO 5.1. Determine the time period of oscillation of given bar pendulum. *LSO 5.2.* Determine the radius of gyration and moment of inertia about an axis perpendicular to the plane of oscillation and passing through its center of mass of given bar pendulum.	5.	Bar Pendulum	**CO2, CO4**
LSO 6.1. Determine the coefficient of linear expansion of material of a given rod.	6.	Pullingger's apparatus	**CO3**
LSO 7.1. Use Searle's apparatus to determine the Young's modulus of a given wire.	7.	Searle's apparatus	**CO3**
LSO 8.1. Apply Stokes law to determine the coefficient of viscosity of a given viscous liquid.	8.	Stokes law	**CO3**
LSO 9.1. Determine the inverse square law relation between the distance of photocell and light source v/s intensity of light source.	9.	Photo-electric cell experiment	**CO5**
LSO 10.1. Determine the Numerical Aperture (NA) of a given step index optical fiber.	10.	Numerical Aperture of an optical fiber	**CO5**
LSO 11.1. Measure wavelength of a He-Ne/diode laser by using a plane diffraction grating.	11.	He-Ne/diode laser	**CO5**
LSO 11.2. Find the moment of inertia of a given flywheel	12	Fly wheel	**CO2**
LSO 11.3. Plot the graph between KE of Photo electron v/s frequency of incident light *LSO 11.4.* Determine the value of Plank's Constant (*h*) from the graph between KE v/s frequency of incident light. *LSO 11.5.* Determine the variation of stopping potential w.r.t frequency of incident photon	13	Photo electric effect (virtual lab experiment)	**CO5**
LSO 11.6. Determine the wave length of different spectral lines of Hydrogen spectra	14	Emission Spectra of Hydrogen (virtual lab experiment)	**CO5**

L) Suggested Term Work and Self Learning: **S2400102A** 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. Convert the units of given physical quantity from one system of units to another.
2. Find the different terms related to SHM/ wave from given equation of SHM/ wave.
3. Determine the change in the parameters related to rotational motion, when a regular shaped body rolls down on an inclined plane and give comparison for different bodies/ parameters.
4. Measure room temperature of hot bath/ bodies by using mercury thermometer and convert it into different temperature scales (lab- based).
5. Use online tool to determine S/V ratio of a given shape and size. (online assignment)

b. Micro Projects:

1. Make prototype Vernier calipers and screw gauge of desired Least Count,
2. Collect wires of different materials and find the fracture point for required applications
3. Design prototype model to find thermal conductivity of different metals.
4. Prepare model for determining moment of inertia of bodies with different shapes
5. Fiber optics: Demonstrate the phenomenon of total internal reflection.
6. LASER: Prepare model to demonstrate the properties and applications of LASER.
7. Viscosity: Collect 3 to 5 liquids and prepare a working model to differentiate liquids based on viscosity and demonstrate their applications.
8. Motion: Prepare model of ball rolling down on inclined plane to demonstrate the conservation of energy and motion of an object in inclined plane.
9. Waves in string: standing waves in string using woofer loudspeaker
10. Use smartphone to measure the different physical quantity with the sensor applications

c. Other Activities:

1. Seminar Topics:
    - Needs of measurements in engineering and science.
    - Applications of circular motions in daily life.
    - LASER: Production & applications in science, industry, medical and defense, holography.
    - Optical fibers: Construction and application in communication systems.
    - Synthesis and applications of nanomaterials.
    - CNT, Graphene and fullerene(C_{60})
    - Application of modes of different heat transmission in daily life.

2. Visits:
    - Visit nearby industry with Instrumentation, production and Laser/optical fibers facilities. Prepare report of visit with special comments Instrumentation technique and material used.
    - Visit planetarium, Science city and research institutions for exploring the experimental and research facilities available.

3. Self-learning topics:
    - Vectors and its properties with applications
    - Types of fundamental units, system of units
    - Newton's Laws of motion, momentum, inertia, impulse
    - Inertial and non-inertial frame of reference
    - Derivation of formula for moment of inertia
    - Force, work, energy, power, work-energy theorem, law of conservation of energy
    - Frictions and its types
    - Pressure, density, Pascal's law, atmospheric and gauge pressure
    - Work done in various Processes, Adiabatic constant ($C_p/C_v = \Upsilon$), Mayer's formula ($C_p - C_v = R$)
    - CO_2 Laser, Semiconductor LASER.
    - Interference and Diffraction of light

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	12%	12%	20%	20%	10%	30%	20%
CO-2	18%	18%	20%	20%	10%	10%	20%
CO-3	30%	30%	30%	20%	30%	30%	20%
CO-4	15%	15%	15%	20%	20%	10%	20%
CO-5	25%	25%	15%	20%	30%	20%	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 Unit and Measurements	6	CO1	8	4	2	2
Unit-2.0 Circular and Rotational motion	10	CO2	12	4	4	4
Unit-3.0 Physical Properties of Matter and Heat	12	CO3	20	4	8	8
Unit-4.0 Simple Harmonic motion and Wave Motion	8	CO4	12	2	4	6
Unit-5.0 Modern Physics	12	CO5	18	6	6	6
Total	**48**	**-**	**70**	**20**	**24**	**26**

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Vernier caliper	CO1	60	30	10
2.	Screw gauge	CO1	60	30	10
3.	Spherometer	CO1	60	30	10
4.	Spring Oscillator	CO3	50	40	10
5.	Bar Pendulum	CO2	50	40	10
6.	Pullingger's apparatus	CO3	60	30	10
7.	Searle's apparatus	CO3	50	40	10
8.	Stokes law	CO3	60	30	10
9.	Photo-electric cell experiment	CO5	40	50	10
10.	Numerical Aperture of an optical fiber	CO5	50	40	10
11.	He-Ne/diode laser	CO5	60	30	10
12.	Fly wheel	CO2	60	30	10
13.	Photo electric effect (virtual lab experiment)	CO5	70	20	10
14.	Emission spectra of Hydrogen (virtual lab experiment)	CO5	70	20	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.	Vernier-Caliper	Range: 0-15 cm, Resolution 0.01 cm.	1,8
2.	Micrometer screw gauge	Range 0-25 mm, Resolution 0.01 mm	2,7,8
3.	Spherometer	Vertical scale range -10mm to 10 mm, Graduation resolution 0.01 mm	3
4.	Spring oscillator	A spring, a measuring ruler, mass hanger and variable masses (50 gram, 100 gram) .	4
5.	Bar pendulum	Bar pendulum, meter scale a knife–edge with a platform, sprit level, precision stop watch	5
6.	Pullingger's apparatus	Linear-expansion apparatus with steam generator, thermometer 0-100^{o}C range, rubber tubes, metal rods of aluminum, iron, copper, brass and steel	6
7.	Searle's apparatus	Two long steel wires of the same length and diameter, Brass rods, stopwatch, meter scale, 0.5 kg slotted masses, hanger	7
8.	Stokes's law apparatus	A long cylindrical glass jar, Transparent viscous fluid, stop watch, bob, glycerin, tube clamp stand, Meter scale, Spherical ball, Thread	8
9.	Photo-electric cell experiment	Photo cell mounted in the metal box, Lamp holder with 60W bulb, analog meters (500µA & 1000mV), wooden bench fitted with scale and connecting wires	9
10.	Numerical aperture of an optical fiber	Laser Diode (2- 3 mW, 632mm) Objective (10X), Optical fiber (1-meter-long), detector with BNC connector, Auto arranging Multimeter, Screen with circular graduations, one circular base with linear and circular motion, optical bench	10
11.	He-Ne/diode laser	He-Ne Laser (output 0.5 –5.0mW, wavelength 632.8 nm power supply 240V, 50Hz) Or diode laser (2- 3 mW, 632mm), Transmission grating 15000 lines/inch, photo detector with BNC connector and holder, screen with clamp type holder, knife edge with micrometer movement, digital multimeter, scale with mount	11
12.	Fly wheel	Fly wheel setup, (Fly wheel 200 mm diameter with axial support on bearing, hanger 100g+9x100g slotted weight	12
13.	Photo electric effect (virtual lab experiment)	https://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1	13
14.	Emission Spectra of Hydrogen (virtual lab experiment)	https://vlab.amrita.edu/?sub=1&brch=195&sim=359&cnt=1	14

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Concept of physics-1	H.C. Verma	Bharti Bhawan Publications, 2021 ISBN: 8177091875, 978-8177091878
2.	Concept of physics-2	H.C. Verma	Bharti Bhawan Publications, 2021 ISBN: 8177092324, 978-8177092325
3.	Text Book of Physics for Class XI (Part-I, Part-II)	N.C.E.R.T., Delhi	N.C.E.R.T., Delhi, 2019 ISBN: 81-7450-508-3(Part-I) & ISBN: 81-7450-566-0 (Part-II)
4.	Text Book of Physics for Class XII (Part-I, Part-II)	N.C.E.R.T., Delhi	N.C.E.R.T., Delhi, 2019 ISBN: 81-7450-631-4 (Part-I) & ISBN: 81-7450-671-3 (Part II)
5.	Engineering Physics	P. V. Naik	Pearson Education Ltd., 1993 ISBN: 817758362X,978-8177583625
6.	Applied Physics-I	Dr. Mina Talati & Vinod Kumar Yadav	Khanna Book Publishing (2021) ISBN : 978-93-91505-43-1
7.	Applied Physics-II	Dr. Hussain Jeevakhan	Khanna Book Publishing (2021) ISBN: 978-93-91505-57-8
8.	Engineering Physics	D. K. Bhattacharya & Poonam Tandon	Oxford University Press, ISBN: 0199452814, 978-0199452811

(b) Online Educational Resources:

1. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype
2. www.nanowerk.com
3. https://www.open2study.com/courses/basic-physics-150315/
4. https://nptel.ac.in/courses/122107035
5. https://nptel.ac.in/courses/122104016
6. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
7. https://www.physicsclassroom.com/
8. https://phys.org/
9. https://vlab.amrita.edu/?sub=1
10. https://www.olabs.edu.in/?pg=topMenu&id=40
11. https://www.khanacademy.org/science/physics

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. Fundamentals of Physics, David Halliday, Robert Resnick and Jearl Walker
2. Engineering Physics, R.K. Gaur and S. L. Gupta
3. University Physics with Modern Physics, Sears and Zemansky
4. Physics for Scientists and Engineers with Modern Physics by Raymond A. Serway andJohn W. Jewett
5. Physics Laboratory Manual, David H Loyd.

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

B) Course Title : Python Programming

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

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/ Developmen tof 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:

Board of Study	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

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. 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:

Board of Study	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

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:

- 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 statemen, if-elif-else statement 2.2 Iterative statements: while loop, for loop, range function, break and continue statements, nested loops	**CO-2**
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**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
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 *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	**Unit-5.0 Object Oriented Programming (OOP)** 5.1 OOPs Object oriented programming concepts and approach, Abstraction, encapsulation, class, object, class 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	**CO-5**
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: 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. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	**CO-2**
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 strings 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 tuple 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**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
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} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	**CO-2, CO-3**
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	**CO-2, CO-5**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		iv. Polymorphism with class method v. Polymorphism with method overriding	
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 v. Value Error vi. IO Error vii. Zero Division Error b) Write Python program to demonstrate file operations.	**CO-6, CO-1, CO-2,**

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 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	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 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 (CI) 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 strings 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 tuple 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. c) create set difference. d) check if two given sets have no elements in common.	**CO-2, CO-3**	40	50	10
7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to	**CO-2, CO-3**	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	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})				
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: vi. Polymorphism in operator vii. Polymorphism in user defined method viii. Polymorphism in built-in function ix. Polymorphism with class method x. 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. viii. TypeError ix. NameError x. IndexError xi. KeyError xii. ValueError xiii. IOError xiv. 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 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.	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.

******

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 success of any organization or industry in the globalized economy. The global village gives due weightage to English language and it enjoys a privileged status. Engineering students with English as a communicative language open for 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 researches in the form of presentations, reports, research papers, memos, circular etc. Additionally, it will help students of diploma in engineering to present concepts and designs in effective manner along with writing CVs, Group Discussions, Mock Interview sessions in placements and job recruitments. Though communication skills in SBTE, Bihar largely emphasizes to communicate effectively in english but communication in hindi is also focused to some extend at diploma level.

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 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:

Board of Study	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

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. 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:

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

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:

- 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: 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) *TSO 1a* Define communication and its different forms. *TSO 1b.* Explain the elements of communication with examples. *TSO 1c.* Explain the linkages between different stages of communication with the help of a diagram. *TSO 1d.* Apply the principles of effective communication and state two examples of communication. *TSO 1e.* State eight examples for explaining different types of barriers to communication. *TSO 1f.* Identify the barriers of communication. *TSO1g.* Suggest the ways to overcome/minimise barriers to communication.	**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	**CO1** **CO2**
TSO 2a. Distinguish formal and informal communication. *TSO 2b.* Illustrate the types of Formal Communication with examples. *TSO 2c.* Define verbal & non-verbal communication. *TSO 2d.* Explain advantage of oral and written Communication. *TSO 2e.* Interpret non-verbal codes. *TSO 2f.* Explain the role of tables, charts & graphs in communication. *TSO 2g.* Differentiate Intrapersonal and Interpersonal Communication with examples. TSO 2h. List the advantages and disadvantages of Group Communication.	**Unit- 2.0 Types of Communication** **2.1** On the basis of organizational structure: Formal (Vertical, Horizontal, Diagonal), Informal (Grapevine) 2.2 On the basis of 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 On the basis of number of people involved: Intrapersonal Communication, Interpersonal Communication, Group Communication	**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. *TSO 3d.* Find out idioms and phrases used in the	**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)
given texts. *TSO 3e*. Write a short biography of the given writers. *TSO 3f.* Identify the figures of speech used in the given texts. *TSO 3g.* Classify the forms of poetry. *TSO 3h.* Elaborate the central idea / theme of the given poems in your own words.	3.1 An Astrologer's Day by R K Narayan 3.2 Indian Civilization and Culture by M K Gandhi 3.3 The Secret of Work by Swami Vivekanand 3.4 My Struggle for an Education by Brooker T Washington **Section-2 (Poetry)** 3.5 Where the Mind is without Fear by R N Tagore 3.6 Ode on Solitude by Alexander Pope 3.7 Stopping by Woods on a Snowy Evening by Robert Frost 3.8 A Psalm of Life by H W Longfellow	
TSO 4a. Form new words adding prefix and suffix to the given root words. *TSO 4b.* Write synonyms and antonyms of the given words. *TSO 4c.* Use the given idioms and phrases in your own sentences. *TSO 4d.* Distinguish between acronym and abbreviation. *TSO 4e.* Prepare a list of technical jargons of your respective branch. *TSO 4f.* Identify the parts of speech of the specific words in the given sentences. *TSO 4g.* Fill in the blanks with suitable verb forms in the given sentences. *TSO 4h.* Transform the given sentences as directed. *TSO 4i.* Punctuate the given paragraphs.	**Unit-4.0 Vocabulary and Grammar** 4.1 Word Formation: Prefix, Suffix, Acronym 4.2 Synonyms, Antonyms, Homonyms, One Word Substitution, Idioms and Phrases 4.3 Technical Jargons -Related to the respective program 4.4 Parts of speech 4.5 Time and Tense 4.6 Transformation: Voice, Narration, Removal of 'Too', Question Tag 4.7 Punctuation	**CO4, CO5**
TSO 5a. Write the precis of the given passage with suitable title. *TSO 5b.* Draft letters and applications for the given purpose. *TSO 5c.* Compose E-mails, Notices, Memos, and Circulars. *TSO 5d.* Prepare reports of the projects of your respective branch. *TSO 5e.* Write a report on the events organized in your institute.	**Unit-5.0 Professional Writing** 5.1 Precis Writing 5.2 Business Letters / Applications 5.3 Drafting E-mails, Notices, Memos, Circulars 5.4 Report Writing: Project and Event/ Incident Report Writing	**CO5**
Part -B (हिंदी) *TSO 1a* सम्प्रेषण कौशल का अर्थ स्पष्ट कर सकेंगे. *TSO 1b* भाव एवं सम्प्रेषण में अंतर बता पाएँगे. *TSO 1c* सम्प्रेषण की प्रक्रिया का उल्लेख कर सकेंगे. *TSO 1d* श्रवण अविव्यक्ति, वाचन और लेखन की अवधारणा को स्पष्ट कर सकेंगे. *TSO 1e* सम्प्रेषण कौशल के निर्धारक तत्वों का विवेचन कर सकेंगे. *TSO 1f* प्रभावशाली सम्प्रेषण के सिद्धांतों का समावेश	**Units-1: सम्प्रेषण सिद्धान्त एवं व्यवहार** 1.1 सम्प्रेषण : परिचय , अर्थ एवं परिभाषा 1.2 सम्प्रेषण की प्रक्रिया एवं तत्त्व 1.3 सम्प्रेषण के प्रकार : औपचारिक एवं अनौपचारिक, शाब्दिक एवं अशब्दिक 1.4 प्रभावशाली सम्प्रेषण के सिद्धांत एवं सम्प्रेषण व्यवधान	**CO1** **CO2** **CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
अपने वार्तालाप में कर सकेंगे.		
TSO 2a तकनीकी कौशल एवं व्यव्हार कौशल में अन्तर बता पाएँगे . *TSO 2b* व्यव्हार कौशल का महत्व स्पष्ट कर पाएँगे . *TSO 2c* आत्मा जागरूकता एवं आत्मा विश्लेषण का विवेचन सोदाहरण कर पाएँगे . *TSO 2d* भावनात्मक बुद्धिमत्ता एवं करुणा, अनुकूलनशीलता एवं लचीलापन का विकास कर पाएँगे. *TSO 2e* दैनिक जीवन में अनुकूलनशीलता एवं लचीलापन को आत्मसात कर पाएँगे .	**Unit-2 : व्यावसायिकउत्कृष्टता हेतु व्यव्हार कौशल** 2.1 परिचय : तकनीकी कौशल एवं व्यवहार कौशल 2.2 व्यवहार कौशल का महत्त्व 2.3 जीवन कौशल : आत्म जागरूकता एवं आत्म विश्लेषण 2.4 भावनात्मक बुद्धिमत्ता एवं करुणा, अनुकूलनशीलता एवं लचीलापन व्यवहार कौशल का उपयोग	**CO1**
*TSO 3a*पठित गद्यांश एवं पद्यांश से प्राप्त नयी शब्दावली विकसित कर पाएँगे *TSO 3b* दिए गये कहानियों, कविताओं एवं निबंधों का सारांश अपने शब्दों में लिख पाएँगे. *TSO 3c* दिए गये कहानियों, कविताओं एवं निबंधों में प्रयुक्त मुहावरों एवं अलंकारों को बता पाएँगे . *TSO 3d* कविताओं का भावार्थ स्पष्ट कर पाएँगे .	**Unit-3 : पाठ-बोध : शब्दावली परिवर्धन एवं व्याकरण अभ्यास** 3.1 नमक का दरोगा , ईदगाह - मुंशी प्रेमचंद 3.2 बात (निबंध)- प्रताप नारायण मिश्र 3.3 वह प्रदीप जो दिख रहा है झिलमिल दूर नहीं है - रामधारी सिंह दिनकर 3.5 नर हो न निराश करो मन को - मैथिलीशरण गुप्त 3.6 कबीर के दोहे -काल्ह करे सो आज कर , जाति न पूछो साधू की , ऐसी वाणी बोलिए	**CO4**
TSO 4a अपनी शाखा से सम्बन्धित तकनीकी शब्दावली का चयन कर पाएँगे . *TSO 4b* पर्यायवाची एवं विलोम शब्दों से सम्बंधित शब्दावली तैयार कर सकेंगे . *TSO 4c* दिये गये गद्यांशों में विराम चिह्नों का सही प्रयोग कर पाएँगे .	**Unit-4 : शब्दावली एवं व्याकरण** 2 Hrs 4.1 सामान्य शब्दावली 4.2 प्रशासनिक शब्दावली 4.3 शब्द भेद, अनेक शब्दों के लिए एक शब्द 4.4 विराम चिन्ह 4.5 मुहावरें एवं कहावतें	**CO4** **CO5**
TSO 5a दिए गये दिए गये गद्यांशों का संक्षेपण कर पाएँगे . *TSO 5b* विभिन्न प्रकार के पत्रों, आवेदनों ,सूचनाओं, विज्ञप्तियों को लिख पाएँगे . *TSO 5c* अपनी शाखा से सम्बंधित प्रतिवेदन लेखन कर पाएँगे . *TSO 5d* अपने संस्थान में हुए आयोजनों का प्रतिवेदन लिख पाएँगे.	**Unit-5 : लेखन कौशल** 5.1 सार- लेखन 5.2 औपचारिक एवं व्यवसायिक पत्र लेखन 5.3 प्रारूप लेखन - सूचना, निविदा लेखन, प्रतिवेदन लेखन, बायोडाटा	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400104 These practical 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 and words etc.	7	Sounds of minimal pairs, syllables and 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 on the basis of stress and intonation marks put.	9	Stress and intonation.	CO2
LSO10.a Apply the paralanguage codes in verbal dialogues to show the 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 and 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 the texts aloud with proper pause 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 jargons 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 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.

1. Visit your institute's library/ web search and enlist the books, journals and magazines related to your respective branches to prepare bibliography consisting name of the authors, title of the books, publication and place of publication.

2. SWOT Analysis: Analyze yourself with respect to your strength and weaknesses, opportunities and threats with respect to your communication.

3. Conduct interview of 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 individual time-table for a week and prioritize your activities.

6. Visit any historical places/ offices / farms/ industries / development sites etc. nearby your city and prepare a report on it.

b. Micro Projects:

a) Book review – students should read a book and then write his reviews about the book and present it in the class.

b) Interview of any successful person in your locality in context with his life journey, inspiration social contribution, role model and keys to success.

c) Prepare register of technical jargons of the industry related to their specific branch.

d) Prepare a presentation on environmental issues of their locality with their solution.

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 prepare hoardings, boards, collages, posters for the same.

3. Organize a campaign on educational awareness in the nearby places prepare advertising campaign for the same.

d. Self- learning topics:

- 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 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, 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)
(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: सम्प्रेषण सिद्धान्त एवं व्यवहार**	2	CO1, CO2	3	1	1	1
Unit-2: व्यावसायिक उत्कृष्टता हेतु व्यव्हार कौशल	2	CO3	3	1	1	1

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-3: पाठ-बोध :शब्दावली परिवर्धन, एवं व्याकरण अभ्यास	5	CO4, CO5	5	1	1	3
Unit-4: शब्दावली एवं व्याकरण	4	CO5	5	1	1	3
Unit-5: 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
15	Jumbled Sentences.	CO3	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
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 कुमार अग्रवाल , डॉ अवनीश कुमार मिश्रा	साहित्य भवन पब्लिकेशन : आगरा
16	आधुनिक हिंदी व्याकरण और रचना	डॉ वासुदेवनंदन प्रसाद	भारती भवन पब्लिकेशन

(b) Online Educational Resources:

1. https://www.academia.edu/37871134/COMMUNICATION_SKILLS_1ST_YR_2_pdf
2. https://socialsci.libretexts.org/Courses/Butte_College/Exploring_Intercultural_Communication_(Grothe)/05%3A_Nonverbal_Processes_in_Intercultural_Communication/5.02%3A_Types_of_Nonverbal_Communication
3. http://muhamadjaelani35.blogspot.com/2014/11/inquiry-letter-order-letter-complaint.html?m=1
4. https://www.slideshare.net/sundaredu/barriers-of-communication-53545680
5. https://allpoetry.com/where-the-mind-is-without-fear
6. https://www.poetryfoundation.org/poems/46561/ode-on-solitude
7. https://www.poetryfoundation.org/poems/44644/a-psalm-of-life
8. https://www.poetryfoundation.org/poems/42891/stopping-by-woods-on-a-snowy-evening
9. https://www.hindisamay.com/content/
10. http://kavitakosh.org/
11. https://bundelkhand.in/maithilisharan-gupt/nar-ho-na-nirash-karo-man-ko

12. https://etc.usf.edu/lit2go/92/up-from-slavery/1575/chapter-3-the-struggle-for-an-education/
13. https://oursmartstudy.com/english-chapter-1-class-12-pdf-download/
14. https://ve-iitg.vlabs.ac.in/Listening%20Skills(Procedure).html
15. https://nptel.ac.in/courses/109104031

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

(b) 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), RE)

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.

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	-	-	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		

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:

Board of Study	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

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. 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:

Board of Study	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

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:

- 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.	**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:	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 2e. Find out true size and shape of the given inclined line and plane respectively.	• Lies in any one of the quadrant. • 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 plane. • Inclined to any one of the plane. 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**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
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 *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.	**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 containing rectangular, circular, cylindrical shapes and slots on sloping and plane surfaces. 4.5 Conversion of orthographic views into isometric View/projection.	**CO5**
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) • Funnel, chimney and pipe bend. (one problem each)	**CO6**
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 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 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):

SN	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.

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

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

C) Pre- requisite Course(s) :

D) Rationale :

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

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

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

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

F) Suggested Course Articulation Matrix (CAM):

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

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

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:

Board of Study	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

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. 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:

Board of Study	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:

- 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: 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**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
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.* Discuss characteristics of biomass & its digestion process *TSO 3e.* Describe new energy sources & their application	**Unit-3.0 Sustainability & Renewable Sources of Energy** 3.1 Concept of sustainable development 3.2 Renewable sources of energy for sustainable development 3.3 Solar Energy 3.3.1 Features of solar thermal & PV system 3.3.2 Solar pond, Solar water heater, Solar dryer and Solar stills 3.4 Wind Energy 3.4.1 Current status & future prospects of wind energy 3.4.2 Wind energy in India-Advantages and challenges of harnessing wind energy 3.4.3 Environmental benefits & limitations 3.5 Biomass 3.5.1 Types of Biomass energy sources 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	**CO3**
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**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
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	8	Calculation of personal water footprint for daily water usage for activities like bathing, cooking and laundry.	**CO3**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
consumption and conserve water resources.			
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: **P2400006** 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%	33%	15%	20%
CO-4	-	-	30%	25%	33%	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

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
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
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
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:

a) www.nptel.iitm.ac.in
b) www.khanacademy

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