Curriculum of Diploma Programme

in

Electronics & Communication Engineering

Department of Science,

Technology and Technical Education (DSTTE),

Govt. of Bihar

State Board of Technical Education

(SBTE), Bihar

Semester – I
Teaching & Learning Scheme

Course Codes	Category of course	CourseTitles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
2400101	**ASC**	**Basic Engg. Mathematics** (ME, ME (Auto), CE, MIE, CSE, AIML, EE, CRE, CHE, ELX, ELX (R))	02	01	-	02	05	04
2400102B	**ASC**	**Applied Physics -B** (CSE, AIML, EE, ELX, ELX (R))	03	-	04	02	09	06
2400103B	**ASC**	**Applied Chemistry -B** (CSE, AIML, EE, ELX, ELX (R))	03	-	04	02	09	06
2425104	**BEC**	**Engg. Mechanics** (CE, EE, ME, ME (Auto), MIE, FTS, AE, CRE, CHE, ELX, ELX (R), TE)	03	-	04	02	09	06
2415105	**BEC**	**Engg. Drawing & Graphics** (MIE, AE, CRE, CE, CHE, FTS, TE, EE, ELX, ELX (R))	-	-	04	02	06	03
2420105	**PCC**	**Electrical and Electronics Workshop**	-	-	04	02	06	03
2400006	**NRC**	**Environmental Education and Sustainable Development** (Common for All Programmes)	01	-	01	01	03	02
Total			**12**	**1**	**21**	**13**	**47**	**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. to deliver theoretical concepts)

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

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

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

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

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

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

Semester - I
Assessment Scheme

Course Codes	Category of course	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment(LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400101	**ASC**	**Basic Engg. Mathematics** (ME, ME (Auto), CE, MIE, CSE, AIML, EE, CRE, CHE, ELX, ELX (R))	30	70	20	30	-	-	150
2400102B	**ASC**	**Applied Physics -B** (CSE, AIML, EE, ELX, ELX (R))	30	70	20	30	20	30	200
2400103B	**ASC**	**Applied Chemistry -B** (CSE, AIML, EE, ELX, ELX (R))	30	70	20	30	20	30	200
2425104	**BEC**	**Engg. Mechanics** (CE, EE, ME, ME (Auto), MIE, FTS, AE, CRE, CHE, ELX, ELX (R), TE)	30	70	20	30	20	30	200
2415105	**BEC**	**Engg. Drawing & Graphics** (MIE, AE, CRE, CE, CHE, FTS, TE, EE, ELX, ELX (R))	-	-	20	30	20	30	100
2420105	**PCC**	**Electrical and Electronics Workshop**	-	-	20	30	20	30	100
2400006	**NRC**	**Environmental Education and Sustainable Development** (Common for All Programmes)	15	-	10	-	10	15	50
Total			**135**	**280**	**130**	**180**	**110**	**165**	**1000**

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

Legend:

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

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

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

Note:

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

A) Course Code : **2400101(T2400101/S2400101)**

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

C) Pre-requisite Course(s) :

D) Rationale :

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

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

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

Demonstrate the ability to solve engineering-related problems based on applications of algebra.
Use the concept of derivative as a tool to solve engineering-related problems.
Apply differential calculus to solve branch-specific problems.
Use the concept of Coordinate geometry to solve branch-specific engineering-related problems.
Apply techniques and methods of probability and statistics to crack branch-specific problems.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Program Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	-	-	-	-		
CO-2	3	1	-	-	-	-	-		
CO-3	3	1	1	-	-	-	1		
CO-4	3	1	-	-	-	-	-		
CO-5	3	2	1	1	-	-	1		

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400101	Basic Engineering Mathematics	02	01	-	02	05	04

Legend:

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

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

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

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

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

C: Credits= (1xCI hours) + (0.5xLI hours) + (0.5xNotional hours)

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

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400101	Basic Engineering Mathematics	30	70	20	30	-	-	150

Legend:

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

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

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

Note:

ETA & ELA are to be carried out at the end of the term/ semester.

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

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

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

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

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

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

K) Suggested Tutorials and Outcomes:

Outcomes	S. No.	Tutorials Titles	Relevant COs Number(s)
Determine the value of the determinant by using available open-source software. Determine the inverse of a non-singular matrix by using open-source software. Apply the Matrix Inversion method to determine currents through various branches of given electrical networks. Determine the resultant force applied at a particle using properties of vector for a given engineering problem.	1.	Value of determinant of order 3, 4, and higher using opensource software. Inverse of the non-singular matrix using open-source software. Calculation of current in electrical networks by Matrix Inversion method. Geometrical interpretation of operations of vector algebra.	CO1
Geometrically represent the domain and range of the given Modulus function, Signum function, and Floor function. Verify geometrically the continuity of a given function at a point. Determine the concavity and convexity of a given continuous function for a given engineering application. Find the acceleration of the given moving body at a time t.	2.	Geometrical interpretation of domain and range of a function. Geometrical interpretation of limit and continuity. Branch-specific engineering application of derivative. Branch-specific engineering application of derivative of a parametric function.	CO2
Determine the maximum height of a projectile trajectory using Roll's theorem. Use Lagrange's Mean Value theorem to find the point at which the slope of the tangent becomes equal to the slope of the secant through its endpoints. Use the concept of derivative to find the slope of a bending curve for a given engineering problem. Use the concept of tangent and normal to solve the given problem of Engineering Drawing. Use the concepts of Maxima and Minima to obtain optimum value for a given engineering problem. Use the concept of the radius of curvature to solve a given branch-specific engineering problem.	3.	Geometrical Interpretation of Rolle's Theorem. Geometrical Interpretation of Lagrange's Mean Value theorem. Branch-specific engineering application of rate of change of quantities. Branch-specific engineering applications of tangent and normal. Branch-specific engineering applications of maxima and minima. Engineering applications of Radius of curvature.	CO3
Apply the concept of Gradient to draw graphs in engineering drawing. Use the given form of a straight line to calculate the speed, distance, and time of a moving object. Use the concept of Ellipse to prepare a Model of the path of the Planet and its foci.	4.	Geometrical interpretation of Gradient. Geometrical Interpretation of lines in various forms. Geometrical interpretation of the perpendicular distance of a line. Geometrical representation of conic-section.	CO4
Use the concept of probability to solve given problems based on Board and playing cards.	5.	Applications of Probability and related theorems.	CO5

Outcomes	S. No.	Tutorials Titles	Relevant COs Number(s)
Calculate the Standard Deviation for Concrete with the given data.		Applications of Mean, Median, and Mode for applied problems.	

L) Suggested Term Work and Self-Learning: S2400101 Some sample suggested assignments, micro-projects, and other activities are mentioned here for reference.

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

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

b. Micro Projects:

1. Prepare charts displaying the properties of determinants and Matrices.
2. Prepare a chart for the use of Vector algebra to solve problems of the rate of change of the mass of a fluid flow.
3. Draw the graph of functions like x^2, $sinx$, $cosx$, $tanx$, and e^x etc analytically on graph paper and verify using suitable open-source software like Sage Math, Math3d, GeoGebra, Wolfram Alpha, and Dplot and prepare a pdf file.
4. Collect at least 10 engineering applications for each Limits, Continuity, and Differentiability and prepare a PDF file.
5. Prepare a chart consisting of 8-10 engineering-related functions whose derivative does not exist.
6. Prepare a model showing the application of Rolle's Theorem to determine the projectile trajectories of maximum height.

7. Prepare a chart consisting of any 10 applications of the Mean value theorem related to real-world problems.
8. Model to maximize the volume of a box made of a rectangular tin sheet by cutting off squares of the same size from each corner and folding them up. Also, design models for at least 5 similar situations and prepare a soft file with animation.
9. Prepare models using the concept of tangent and normal while bending of roads in case of sliding of a vehicle.
10. Prepare models using the concept of the radius of curvature while bending of railway track.
11. Make a short video of duration 5-7 minutes for the use of Derivative to calculate the profit and loss in business using graphs.
12. Download 5-7 videos based on applications of Derivative to check the temperature variation, find the range of magnitudes of the earthquake, etc. Watch them and write a report to detail the mathematical steps involved.
13. Prepare the Charts of formulae showing different forms of straight lines for engineering applications.
14. Draw the graph for the standard equations of Circle, Parabola, Ellipse, and Hyperbola on the Chart paper using any open-source software and make a file.
15. Prepare the Charts consisting tree diagram to find the probability of a given event.
16. Collect the data of World of Work and find the mean, mean deviation, and standard deviation for that data using any open-source software of Statistics and make a soft copy.
17. Download 5-7 videos based on applications of probability for the weather forecast, watch them, and write a report to detail the mathematical steps involved.

c. Other Activities:

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

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

- Visit to a Game Studio.
- Visit to a mathematics library.
- Attend Mathematical conferences on real-world problem-solving.
- Participation in mathematics competitions.

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

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

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

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

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

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

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Algebra	8	CO1	12	4	4	4
Unit-2.0 Differential Calculus	10	CO2	14	4	8	2
Unit-3.0 Application of Differential Calculus	8	CO3	12	4	4	4
Unit-4.0 Co-ordinate Geometry	10	CO4	14	4	6	4
Unit-5.0 Probability and Statistics	12	CO5	18	4	6	8
Total	**48**	**-**	**70**	**20**	**28**	**22**

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

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

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

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

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

R) Suggested Learning Resources:

Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Elementary Engineering Mathematics	B. S. Grewal	Khanna Publishers,15th Edition. ISBN: 978-81-7409-257-1
2.	Engineering Mathematics (Third edition)	Croft, Anthony	Pearson Education, New Delhi, 2014. ISBN 978-81-317-2605-1
3.	Calculus and Its Applications	Marvin L. Bittinger David J. Ellenbogen Scott A. Surgent	Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1
4.	Calculus and Analytic Geometry	G. B. Thomas, R. L. Finney	Addison Wesley, 9th Edition, 1995. ISBN 978-8174906168
5.	Understanding Engineering Mathematics	John Bird	Routledge; First Edition ISBN 978-0415662840
6.	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publ., New Delhi,2014, ISBN: 978-0-470-45836-5
7.	Indian Mathematics Engaging with the World from Ancient to Modern Times	George Gheverghese Joseph	World Scientific Publishing Europe Ltd. 57ISBN 978-17-86340-61-0
8.	A Modern Introduction to Ancient Indian Mathematics	T.S. Bhanumurthy	New Age International Private Limited, 1 January 2008 ISBN- 10. 812242600X, ISBN- 13. 978-8122426007
9.	Mathematics-I	Deepak Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-42-4
10.	Mathematics-II	Garima Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-52-3
11.	Consider Dimension and Replace Pi	M.P. Trivedi and P.Y. Trivedi	Notion Press; 1st edition (2018), ISBN: 978-1644291795
12.	Sansar Ke Mahan Ganitagya	Gunakar Muley	First Edition, Rajkamal Prakashan, ISBN-10. 8126703571, ISBN-13. 978-8126703579.

(b) Online Educational Resources:

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 :2400102B(T2400102B/P2400102B/S2400102B)

B) Course Title : Applied Physics – B (CSE, AIML, EE, ELX, ELX (R))

C) Pre- requisite Course(s) :

D) Rationale :

Physics is the natural science that studies the fundamental principles governing matter, energy, space, and time. Engineering physics is a branch of applied physics that focuses on the application of physics principles to engineering problems. Graduates of diploma engineering programs are expected to have a solid foundation in physics that they can apply to real-world problems, including in industrial settings. This curriculum aims to prepare students to be successful in the workforce by providing them with a deep understanding of physics concepts and their practical applications, including in industrial settings. This curriculum also includes examples of industrial applications of physics principles in areas such as robotics, electrical power generation and transmission, digital electronics and communication, and semiconductor technology. 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 concept of waves for various engineering applications involving wave dynamics.

CO-3 Apply the concepts of electromagnetics in engineering applications.

CO-4 Use semiconductor devices for various electronics related applications.

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

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400102B	Applied Physics- B	03	-	04	02	09	06

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400102B	Applied Physics- B	30	70	20	30	20	30	200

Legend:

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

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

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

Note:

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

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

J) Theory Session Outcomes (TSOs) and Units: T2400102B

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 given physical quantity. *TSO 1d.* Apply dimensional analysis for inter conversion of units. *TSO 1e.* Establish relation among 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. 1.5 Ancient astronomical instruments: Chakra, Dhanuryatra , Yasti and Phalaka yantra . (IKS)	**CO1**
TSO 2a. Explain the various terms related to SHM. *TSO 2b.* Distinguish between mechanical and electromagnetic waves with examples. *TSO 2c.* Differentiate between longitudinal and transverse waves with examples. *TSO 2d.* Find the relation between the terms used to describe wave motion. *TSO 2e.* Explain the principle of Superposition of waves	**Unit-2.0 Simple Harmonic and Wave Motion** 2.1 Periodic and Oscillatory Motion 2.2 Simple Harmonic Motion (SHM): Displacement, velocity, acceleration, time period, frequency and their interrelation 2.3 Types of waves: Mechanical and Electromagnetic, Transverse and longitudinal waves, wave velocity, frequency and wave length and their relationship, wave equation, amplitude, phase, phase difference, Superposition of waves	**CO2**
TSO 3a. Derive an expression for electric field experienced by electric charge in the vicinity of another electric charge(s). *TSO 3b.* Differentiate between electric potential and potential difference. *TSO 3c.* Apply Gauss' law to find the electric field intensity due to charge bodies. *TSO 3d.* Describe factors affecting the capacitance of a given capacitor. *TSO 3e.* Find the expression for magnetic field caused by current carrying circular wire at the center.	**Unit-3.0 Electrostatics, Electromagnetism and Electric Current** 3.1 Electric Charge, Coulomb's law, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Electric dipole 3.2 Gauss' law, electric field intensity due to straight charged conductor, charged plane sheet and charged sphere 3.3 Dielectric, Capacitance of capacitor (parallel plate), Factor affecting capacitance of capacitors	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3f. Explain Faraday's law of electromagnetic induction and Lenz's with applications. *TSO 3g.* Explain the terms required to describe the AC current	3.4 Magnetic field and its units, Biot Savart Law Magnetic field due to current caring wire: straight and circular wire, Lorentz force (force on moving charge in magnetic field) 3.5 Magnetic flux, Faraday's law of electromagnetic induction, Lenz's law, Self and Mutual induction, eddy current, motional emf 3.6 DC and AC currents, Average, rms and Peak value of AC current	
TSO 4a. Distinguish material on the basis of band gap. *TSO 4b.* Explain the various terms related to movement of charge carrier inside the semiconductors. *TSO 4c.* Explain the formation of depletion layer in a given pin junction. *TSO 4d.* Use V-I characteristic of explain the working of given p-n junction device.	**Unit-4.0 Semiconductor Physics** 4.1 Energy band and band gap, insulator, semi-conductor, conductor 4.2 Intrinsic and Extrinsic semiconductors, Drift velocity, drift and diffusion current, Mobility, current density, law of mass action. 4.3 Depletion layer and barrier Potential, p-n junction and V-I characteristics, Half wave and full wave rectifier 4.4 Photocells, Solar cells; working principle and engineering applications.	**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 applications of optical fiber. *TSO 5d.* Describe the properties of nanomaterials and its various applications.	**Unit-5.0 Modern Physics** 5.1 Photoelectric effect; threshold frequency, work function, Stopping Potential, Einstein's photoelectric equation. 5.2 Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, types of lasers): He Ne Laser, p-n junction diode laser, engineering and medical applications of lasers. 5.3 Optical fibers: Total internal reflection, acceptance angle and numerical aperture, Optical fiber types, applications in telecommunication, medical and sensors. 5.4 Nanotechnology: Properties (optical, magnetic and dielectric properties) of Nanomaterials and its application, Bhasma (Ancient Ayurveda, IKS)	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400102B

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

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
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. Measure the variation of Time period with Mass of a given spring Oscillator. *LSO 4.2.* Determine the spring constant of a given spring.	4.	Spring Oscillator	CO2
LSO 5.1. Determine the time period of oscillation of given bar pendulum.	5.	Bar Pendulum	CO2
LSO 6.1. Determine the V-I characteristics of a given p-n junction device.	6.	p-n junction diode	CO4
LSO 7.1. Determine the capacitance of a given parallel plate capacitor.	7.	Parallel Plate capacitor	CO3
LSO 8.1. Determine the inverse square law relation between the distance of photocell and light source v/s intensity of light source.	8.	Photo-electric cell	CO5
LSO 9.1. Determine the Numerical Aperture (NA) of a given step index optical fiber.	9.	Numerical Aperture of an optical fiber.	CO5
LSO 10.1. Measure wavelength of a He-Ne/diode laser by using a plane diffraction grating.	10.	He-Ne/diode laser	CO5
LSO 11.1. Determine the V-I characteristics of given solar cell under various illumination condition	11.	Solar cell (virtual experiment)	CO4
LSO 12.1. Determine the V-I characteristics of a given p-n junction device under various temperature conditions.	12.	p-n junction diode (virtual experiment)	CO4
LSO 13.1. Plot the graph between KE of Photo electron v/s frequency of incident light *LSO 13.2.* Determine the value of Plank's Constant (*h*) from the graph between KE v/s frequency of incident light. *LSO 13.3.* Determine the variation of stopping potential w.r.t frequency of incident photon	13.	Photo electric effect (virtual lab experiment)	CO5
LSO 14.1. Determine the wavelength of different spectral lines of Hydrogen spectra	14.	Emission Spectra of Hydrogen (virtual lab experiment)	CO5
LSO 15.1. Find the variation in magnitude and direction of emf induced in a coil due to change in magnetic flux.	15.	Electromagnetic induction (virtual lab experiment)	CO4

L) Suggested Term Work and Self Learning: S2400102B 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. Check the correctness of given equations, using dimensional analysis.
2. Find phase difference between particles executing SHM with different initial conditions.
3. Determine the magnitude and direction of the net electrostatics force acting on any one charge, when 'n' point charges of charge q are placed at the vertices of given polygon with sides 'a' cm.
4. Find the electric field intensity at point due to different type of distribution of charges.
5. Two concentric conducting spheres have radii of r1 and r2 (r1<r2). The inner sphere has charge q1 and the outer sphere has charge q2. Calculate electric field between the two spheres.

6. Explain the significance of determining the forward and reverse bias V-I characteristics of any p-n junction diode with example.
7. For a given V-I characteristic graph p-n junction diode, determine the dynamic and static resistance.
8. Apply the concept of work function in various device and instruments, such as photodiodes, solar cells and electron microscope.

b. Micro Projects:

1. Make prototype Vernier calipers and screw gauge of desired LC,
2. Fiber optics: Demonstrate the phenomenon of total internal reflection.
3. LASER: Prepare model to demonstrate the properties and applications of LASER.
4. Use physics lab mobile application for demonstration of various concepts of physics.
5. Use Arduino board and with embedded sensors to measure the physical quantities.
6. Make prototype parallel plate capacitor and measure capacitance.
7. Make working model to demonstrate Lenz Law.
8. Prepare model to demonstrate DC and AC current.
9. Demonstrate the conversion of light energy into electric energy by using LED(s).
10. Waves in string: standing waves in string using woofer loudspeaker.
11. Use smartphone to measure the different physical quantity with the sensor applications.
12. Use open source simulation software such as SCILAB and PheT to demonstrate SHM/wave, Phase difference between two waves and superposition of waves.

c. Other Activities:

1. Seminar Topics:
    - Needs of measurements in engineering and science.
    - Optical fibers: Construction and application in communication systems.
    - Synthesis and applications of nanomaterials
    - Applications of SHM/wave in daily life.
    - Ohm's Law and its applications in series and parallel circuits.
    - Kirchhoff's Laws and applications
    - Power and Energy in Electrical Circuits
    - Resistivity and Conductivity:
    - Electrical Safety and Hazard Prevention
    - Laser applications in Computer peripherals/ communications/ robotics
    - Holography.

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.

3. Self-Learning Topics:
    - Vectors and its properties with applications
    - Diffraction of light
    - Newton’s Laws of motion, momentum, inertia, impulse
    - Continuous and discrete charge distribution
    - Force, work, energy, power, work-energy theorem, law of **conservation of energy**
    - Frictions and its types
    - Relation between Electric field (E)and potential (V)
    - Work done in various Processes, Adiabatic constant (Cp/Cv = ϒ), Mayer’s formula (Cp - Cv = R)
    - Ultrasonic
    - Microwave and electromagnetic wave.
    - Ruby Laser

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%	10%	20%	-	20%	20%
CO-2	15%	20%	10%	20%	25%	20%	20%
CO-3	25%	25%	30%	20%	25%	15%	20%
CO-4	25%	25%	30%	20%	25%	15%	20%
CO-5	20%	20%	20%	20%	25%	30%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

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

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

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Unit and Measurements	6	CO1	8	2	2	4
Unit-2.0 Simple Harmonic and Wave motion	8	CO2	12	4	4	4
Unit-3.0 Electrostatics, Electromagnetism and Electric current	12	CO3	20	6	6	8
Unit-4.0 Semiconductor Physics	12	CO4	18	4	6	8
Unit-5.0 Modern Physics	8	CO5	12	4	4	4
Total	**48**	**-**	**70**	**20**	**22**	**28**

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	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.	p-n junction diode	CO3	40	50	10
7.	Parallel Plate capacitor	CO3	50	40	10
8.	Photo-electric cell	CO5	40	50	10
9.	Numerical Aperture of an optical fiber.	CO5	50	40	10
10.	He-Ne/diode laser	CO5	60	30	10
11.	Solar cell (virtual experiment)	CO4	60	30	10
12.	p-n junction diode (virtual experiment)	CO5	60	30	10
13.	Photo electric effect (virtual lab experiment)	CO5	60	30	10
14.	Emission Spectra of Hydrogen (virtual lab experiment)	CO5	60	30	10
15.	Electromagnetic induction (virtual lab experiment)	CO5	60	30	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
2.	Micrometer screw gauge	Range 0-25 mm, Resolution 0.01 mm	2,9
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 gms, 100 gms) .	4
5.	Bar Pendulum	Bar pendulum, meter scale a knife–edge with a platform, sprit level, precision stop watches	5
6.	p-n junction diode	A diode, batteries, connecting wires, multimeter/ ammeter voltmeter	6
7.	Parallel Plate capacitor	Parallel plate capacitor arrangement, ruler scale, DC voltmeter	7
8.	Photo-electric cell	Photo cell mounted in the metal box, Lamp holder with 60W bulb, analog meters (500μA & 1000mV), wooden bench fitted with scale and connecting wires	8
9.	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 and optical bench	9
10.	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	10
11.	Solar cell (virtual experiment)	https://vlab.amrita.edu/?sub=1&brch=195&sim=360&cnt=1	11
12.	p-n junction diode (virtual experiment)	https://amrita.olabs.edu.in/?sub=1&brch=6&sim=233&cnt=2	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
15.	Electromagnetic induction (virtual lab experiment)	https://cdac.olabs.edu.in/?sub=74&brch=9&sim=242&cnt=1	15

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
			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
9.	The Surya Siddhanta	Aryabhatta	Baptist Mission press , Calcutta

(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 :2400103B(T2400103B/P2400103B/S2400103B)
B) Course Title : Applied Chemistry- B (CSE, AIML, EE, ELX, ELX (R))
C) Pre- requisite Course(s) :
D) Rationale :

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

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

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

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

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	2	1	-	-	-	1		
CO-2	3	3	2	2	2	1	1		
CO-3	3	2	1	2	-	1	1		
CO-4	3	1	1	-	2	-	1		
CO-5	3	2	1	1	-	1	2		

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

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

G) Teaching & Learning Scheme:

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

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

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

Legend:

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

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

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

Note:

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

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

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

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

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
uses of ferrous and non-ferrous alloys. *TSO 3g.* Distinguish homopolymer, copolymer. *TSO 3h.* Write the monomers of given polymers. *TSO 3i.* Explain vulcanization process.	their important ores along with reactions, Properties and uses. 3.5 Alloys – Definition, Purpose of alloying, Ferrous and Non-Ferrous Alloy with suitable examples, Composition, Properties, and their applications. 3.6 Polymers-Homopolymers and Copolymers, Natural polymers and synthetic polymers, Addition and Condensation polymerization, Thermoplastic and Thermosetting plastic. 3.7 Monomers, applications, and synthesis of Polythene, PVC, Orlon, Terylene, Nylon 66, Nylon 6, Bakelite. 3.8 Natural Rubber and its vulcanization, advantages of vulcanized rubber.	
TSO 4a. Differentiate between crystalline and amorphous solid. *TSO 4b.* Classify crystalline solid based on binding forces. *TSO 4c.* Classify unit cells based on structure. *TSO 4d.* Describe imperfections in solid. *TSO 4e.* Differentiate between metals and semiconductors using band theory. *TSO 4f.* Explain ferromagnetism and diamagnetism. *TSO 4g.* Describe Bragg's law. *TSO 4h.* Describe kjeldahl method to determine melting point of crystalline solid.	**Unit-4.0 Solid State** 4.1 General characteristics of solid state, crystalline and amorphous solid. 4.2 Classification of crystalline solid- Molecular, ionic, metallic, covalent solids. 4.3 Crystal lattice and unit cells- Primitive, BCC, FCC 4.4 Imperfections of solid, Types of point defects- stoichiometric defects, impurity defects, non-stoichiometric defects. 4.5 Electrical properties, conduction of electricity in metals and semiconductors- Band theory. 4.6 Magnetic properties- Ferromagnetism, Para magnetism, diamagnetism, anti-ferro magnetism and ferrimagnetism. 4.7 General introduction to X ray diffraction method- *Bragg's* law. 4.8 Melting point determination of crystalline solid by Kjeldahl method.	
TSO-5a. Describe Electrolyte and Nonelectrolyte. *TSO-5b.* Describe Metallic and electrolytic conduction. *TSO-5c.* Explain the faraday law of electrolysis. *TSO-5d.* Calculate the mass of metal deposited after passing a certain amount of current. *TSO-5e.* Calculate the emf at different temperature, pressure, and molar concentration. *TSO-5f.* Predict the feasibility of a cell. *TSO-5g.* Explain the working of a cell. *TSO-5h.* Describe corrosion. *TSO-5i.* Explain the different methods to prevent corrosion.	**Unit-5.0 Electrochemistry** 5.1. Introduction, Electrolyte and Nonelectrolyte, Electrolytic and Metallic Conduction, Factors affecting Electrolytic Conductance. 5.2. Molar Conductivity and Equivalent Conductivity. Variation of Molar Conductivity, Kohlrausch's law. 5.3. Faraday's Laws of Electrolysis. 5.4. Galvanic Cell, Electrode Potential, Measurement of Electrode Potential SHE (Standard Hydrogen electrode), EMF, Electrochemical Series, Nernst Equation for Electrode Potential. 5.5. Batteries, Primary Cells-Dry cell, Secondary cell -Lead storage battery, Fuel cells.	**CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	5.6. Corrosion, their types (Dry & Wet corrosion) and prevention.	

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

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

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

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO-12.1. Construct Daniel cell. *LSO-12.2.* Compare the effect of dilution of electrolytes on the emf of a Daniel cell.	12.	Comparison of the effect of dilution of electrolytes on the emf of a Daniel cell.	CO5

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

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

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

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

b. Micro Projects:

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

c. Other Activities:

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

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

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

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

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

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

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

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

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Atomic Structure and Chemical Bonding	11	CO1	14	4	4	6

Unit-2.0 Water	9	CO2	14	4	4	6
Unit-3.0 Engineering Material	8	CO3	14	4	6	4
Unit-4.0 Solid state	8	CO4	10	4	3	3
Unit-5.0 Electrochemistry	12	CO5	18	4	5	9
Total	**48**		**70**	**20**	**22**	**28**

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

O) Suggested Assessment Table for Laboratory (Practical):

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

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

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

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications

Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

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

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

R) Suggested Learning Resources:

(a) Books:

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

(b) Online Educational Resources:

1. www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2. www.visionlearning.com (Atomic structure and chemical bonding)
3. www.chem1.com (Atomic structure and chemical bonding)
4. https://www.ancient-origins.net/history-famous-people/indian-sage-acharya-kanad-001399
5. https://www.wastewaterelearning.com/elearning/ (Water Treatment)
6. www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)

7. www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel & Combustion)
8. PhET: Free online physics, chemistry, biology, earth science and math simulations (colorado.edu)
9. Courses: NPTEL
10. Virtual Labs (vlab.co.in)
11. https://iksindia.org
12. olabs.edu.in
13. Khan Academy | Free Online Courses, Lessons & Practice

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

(c) Others:

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

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

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

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

D) Rationale **:**

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

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

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

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

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	2	1	-	-		
CO-2	2	3	3	3	2	-	-		
CO-3	3	3	3	2	2	1	1		
CO-4	3	3	3	2	2	1	1		
CO-5	3	2	2	3	3	1	2		

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

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

G) Teaching & Learning Scheme:

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

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

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

Legend:

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

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

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

Note:

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

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

J) Theory Session Outcomes (TSOs) and Units:

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

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Calculate force of friction and coefficient of friction for the given condition or situation *TSO 3b.* Describe the conditions for friction for the given situation. *TSO 3c.* Identify the various forces acting on a ladder for the given conditions using free body diagram. *TSO 3d.* Compare the value of coefficient of friction between different surfaces. *TSO 3e.* Interpret the effect of change of masses, change of angle of inclination or both on the coefficient of friction *TSO 3f.* Calculate forces acting on a body that is moving on a horizontal rough surface *TSO 3g.* Determine the forces acting on a body that is moving on an inclined plane	**Unit 3.0 Friction** 3.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 3.2 Equilibrium of bodies on level surface subjected to force parallel and 3.3 inclined to plane. 3.4 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. FBD of ladder in friction	**CO3, CO4**
TSO.4a Distinguish between centroid and center of gravity TSO.4b Calculate the centroid of geometrical plane figures. TSO.4c Calculate centroid of the given composite plane lamina TSO.4d Determine centre of gravity of the given simple solid. TSO.4e Determine centre of gravity of the given composite solid. TSO.4f Calculate Moment of Inertia of different geometric shapes.	**Unit 4.0 Centroid, Centre of Gravity and Moment of Inertia** 4.1 Introduction to Centroid, Centre of Gravity and Areas 4.2 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle). 4.3 Centroid of composite figures composed of not more than three geometrical figures and centroid of perforated section, axis of symmetry 4.4 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere). 4.5 Centre of Gravity of composite solids composed of not more than two simple solids. 4.6 Moment of inertia - Introduction, calculation of moment of inertia by integration method, theorem of perpendicular axis, theorem of parallel axis, moment of inertia of a rectangular section, hollow rectangular section, circular section, hollow circular section, triangular section	**CO4**
TSO.5a Describe the components of the given lifting machine. TSO.5b Differentiate the working principle of the given two types of lifting machines. TSO.5c Determine velocity ratio, efficiency of the given lifting machine. TSO.5d Calculate effort required and load lifted by the given lifting machine. TSO.5e Draw the graph with the given data TSO.5f Interpret the given graphs TSO.5g Select the relevant lifting machine for the given purpose with justification	**Unit-5.0 Simple Lifting Machine** 5.1 Simple lifting machine, load, effort, mechanical advantage, Applications and advantages. Velocity ratio, efficiency of machines, Law of machine. 5.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility 5.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Screw jack, Weston's differential pulley block, geared pulley block.	**CO2, CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	5.4 Graphs of Load verses Effort, Load verses ideal Effort, Load verses Effort lost in friction, Load verses MA, Load verses Efficiency.	

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

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

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

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

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

b. Micro Projects:

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

c. Other Activities:

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

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

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

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

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

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

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

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

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

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

O) Suggested Assessment Table for Laboratory (Practical):

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

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
10.	Find M.A, V.R and efficiency of screw jack.	CO2, CO5	30	60	10
11.	Find M.A, V.R and efficiency of differential wheel and axle	CO2, CO5	30	60	10
12.	Calculate the efficiency of single purchase crab winch and double purchase crab winch	CO2, CO5	30	60	10
13.	Determine forces in jib crane.	CO1, CO2	40	50	10
14.	Determine the efficiency of worm and worm wheel	CO2, CO5	40	50	10

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

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

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

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

S. No.	Name of Equipment and Tools	Broad Specifications	Relevant Experiment/Practical Number
1.	Differential axle and wheel	wall mounted unit with the wheel of 40 cm diameter and axles are insteps of 20 cm and 10 cm reducing diameter	11
2.	Simple screw Jack	Table mounted metallic body, screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	10
3.	Worm and worm wheel	wall mounted unit with threaded spindle. load drum. effort wheel: with necessary slotted weights. hanger and thread.	14
4.	Single Purchase Crab winch	Table mounted heavy cast iron body. The wheel is of C.L material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	12
5.	Double Purchase Crab winch	Having assembly same as above but with double set of gearing arrangement.	11
6.	Weston's Differential pulley block	Consisting of two pulleys; one bigger and other smaller	13
7.	Weston's Differential worm geared pulley block	Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weight.	13
8.	Universal Force Table	Consists of a circular 40 cm dia. Aluminum disc. graduated into 360 degrees. with all accessories.	1, 2
9	Beam Reaction apparatus	The apparatus is with two circular dial type 10 kg.	3,4

S. No.	Name of Equipment and Tools	Broad Specifications	Relevant Experiment/Practical Number
10.	Friction apparatus for motion along horizontal and inclined plane	Base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees_ pan. Two weight boxes (each of 5 gm.10 cm, 2-20 gm. 2-50 gm, 2-100 gm, weight.	5,6
11	Set-up for belt friction apparatus	V and Flat Belt, Cap screw, Spring balance, Belt pulley, Torque cord, Load hanger x2, Weights	7
12	Fly wheel apparatus	flywheel, weight hanger with slotted weights, stop clock, metre scale etc	9
13	Jib crane	Jib Apparatus, Weight, Meter Rod, Set Square	13
14	Models of geometrical figures	Models of geometrical figures	8

R) Suggested Learning Resources:

(a) Books:

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

(b) Online Educational Resources:

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

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

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A) Course Code : **2415105(P2415105/S2415105)**

B) Course Title : Engineering Drawing & Graphics
(CE, EE, ELX, ELX (R), MIE, FTS, AE, CHE, TE, CRE)

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

D) Rationale :

With the emergence of computer-aided drafting and design (CADD) tools the traditional engineering drawing practices has undergone significant change as the emphasis has shifted from drawing board-based engineering practices to Computer aided based drafting and modeling which has the advantages of speed, modification, storage and convenience of drawing complex 2D and 3D entities. Still to develop ability of visualization, understanding of drawing standards and free hand sketching on one side and to take advantage of digital drafting tools on the other, this course addresses both the aspects. 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 engineering curves, projections and dimensioning styles and finally make him able to use computer aided drafting software for developing engineering drawings related to different fields.

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-

Use drawing instruments, drawing codes, dimensioning, conventions and symbols as per IS SP-46(2003) in engineering drawing.
Draw geometrical figures, curves and engineering scales.
Draw the views of objects using principles of orthographic projection.
Draw isometric views of components directly or from orthographic projections.
Draw free hand sketches of engineering elements, their orthographic and isometric views.
Use computer aided drafting software to draw 2D and isometric geometric entities.

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	3	-	-	2		
CO-6	3	-	1	3	2	1	3		

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2415105	Engineering Drawing and Graphics	-	-	04	02	06	03

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2415105	Engineering Drawing and Graphics	-	-	20	30	20	30	100

Legend:

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

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

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

Note:

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

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

J) Theory Session Outcomes (TSOs) and Units:

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
Use Drawing Instruments to prepare 2D drawings manually. Use different lines and annotations for a given situation. Draw engineering scale for the given situation. Choose appropriate scale factor for the drawing as per given situation. Dimension the given geometric figure using IS SP-46 standard. Draw the given regular geometric figure with tangents and normal. Draw selected engineering curve.	**Unit-1.0 Basic Elements of Drawing** Methods to use different Drawing Instruments and supporting materials. Different lines and conventions in engineering drawing. Engineering scales and applications: Reduced, enlarged & full size (only Plain scale) Dimensioning techniques: types and applications of chain, parallel and coordinate dimensioning as per IS SP-46. Regular Geometrical figures, Tangency constructions. Engineering Curves: only Ellipse and Parabola using concentric circle method, rectangular method and Eccentricity method when focus and directrix are given.	**CO1, CO2**
Explain the different types of projections & their uses. Draw the orthographic projections of different objects Convert pictorial views into orthographic views	**Unit-2.0 Orthographic Projections** Concept and applications of Orthographic, Perspective, Isometric and Oblique Projections. Orthographic Projection: First and Third angle Draw orthographic views of simple 3D entities containing lines, circles and arcs with axis/orientation parallel and/or perpendicular to the projection planes only. Problems should be restricted up to three views Front view/Elevation, Top view/Plan and Side views only using First Angle Method only. Conversion of simple pictorial views into orthographic views. (Domain specific illustrative problems to be given by the teacher)	**CO1, CO2, CO3**
Explain the Isometric Projection, Isometric view and Isometric Scale. Draw isometric dimensioning on the given isometric view. Explain the Methods of constructing isometric drawing Draw Isometric View of the given object containing elements like rectangular, circular,	**Unit-3.0 Isometric Projection** Introduction to isometric projection. Isometric scale and Natural Scale. Isometric view and isometric projection. Illustrative problems limited to Isometric projection of objects containing rectangular, circular,	**CO1, CO3, CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
cylindrical shapes and slots on sloping and plane surfaces. Convert the given orthographic views into isometric View/Projection.	cylindrical shapes and slots on sloping and plane surfaces. Conversion of orthographic views into isometric View/projection.	
Sketch the given straight line, square, rectangle, circle and arc. Sketch the given simple orthographic and isometric views of the given part. Sketch the given domain specific engineering element/component.	**Unit-4.0 Free Hand Sketches of Engineering Elements** Materials for Sketching. General Guidelines for Freehand Sketching. Freehand sketching of straight lines, square, rectangle, circles and arcs. Free hand sketches of orthographic views. Free hand sketches of isometric views. Freehand sketching of domain specific engineering elements/components (e.g. Bolt, Nut, Washer, Stud, Screw, simple machine parts, etc. in case of mechanical, production, automobile, electrical engineering).	**CO5**
Use computer aided drafting software for creating the institute Drawing Template. Use computer aided drafting software for creating the given simple 2D entity.	**Unit-5.0 Basic Computer aided Drafting** Basics of AutoCAD or any other drafting software– interface, screen layout, starting commands from menus, command line. Coordinate system, Angular measurements, Point specification. Drawing aids - Grid, Snap, Ortho, Osnap, Units, Limits, Layers, Linetype. Opening and Saving drawing files. Creating User Defined Templates. Methods of Selecting and deleting Objects. Undo and Redo. Creating basic drawings objects - lines, arc, circles, ellipses, polyline and polygons.	**CO1, CO2, CO6**
Use computer aided drafting software for creating orthographic views of the given object. Use computer aided drafting software for creating isometric views of the given object. Print the given drawing (using institute template) on A4/A3 sheet.	**Unit-6.0 Advanced Computer aided Drafting** Modify commands - erase, copy, move, rotate, scale, stretch, Array: concept and applications. Controlling Drawing display Text and Dimensioning Layers: concept and application Drawing orthographic views using drafting software with principles mentioned in Unit 2. Drawing isometric views using drafting software with principles mentioned in Unit 3. Printing and plotting of drawings.	**CO1, CO2, CO3, CO4, CO6**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2415105

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
Use manual drawing instruments Draw simple 2D entities using manually 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).	CO1, CO2
Draw conic sections using manually drawing instruments. Use different methods of construction of ellipse and parabola.	2.	Construct ellipse using four center method, arc of circle method and rectangle method. Construct parabola using rectangular method, and parallelogram method.	CO2
Apply concepts of orthographic projection in drawing the given simple object on drawing sheet. Visualize the three views related to the given object based on its shape and orientation.	3.	Draw Orthographic projections of following using first angle method: A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P Different objects having cylindrical surfaces, ribs. (three views of each object, total six problems)	CO3
Apply concepts of orthographic projection to draw three views of given domain specific object/ component.	4.	Draw Orthographic projections of domain specific objects (three views of each object) (Two problems).	CO3
Use concepts of Isometric projection to draw the given simple object with slant surface.	5.	Draw Isometric view of simple objects having plain and slanting surface by using natural scale. (Three problems)	CO4
Visualize the 3D shape of the given object. Convert the given 2D figures/views into 3D object.	6.	Convert the orthographic views of an object to isometric view. (Two problems)	CO3, CO4
Draw free hand sketches of the given domain specific object/component	7.	Draw free hand sketches/conventional representation of your domain specific components (Six problems)	CO5
Draw 3D free hand sketches from the given isometric shape.	8.	Draw free hand sketch of isometric drawings (prepared in Sr. No. 05) without using any instruments.	CO5
Draw 3D free hand sketches of the given real object/component.	9.	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.	CO5
Use computer aided drafting software to create and modify a template. Insert any picture in the existing AutoCAD drawing Insert text in the existing AutoCAD drawing	10.	Prepare a template for your institute of A-4 size with title block and institute logo.	CO6

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
Use computer aided drafting software to create and modify simple 2D entities. Use computer aided drafting software to create and modify circles and arcs with different geometric conditions and constraints	11.	Computer Aided Drafting: Use the software to draw following simple 2-D entities using Draw commands individually Draw circle and arcs with different geometric conditions and constraints (two problems). Draw polygons (Triangle, square, pentagon, hexagon, heptagon) (Three problems).	CO6
Use computer aided drafting software to calculate Area, Perimeter, and Centroid of the given 2D entity	12.	Use the software to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands.	CO6
Use computer aided drafting software to draw complex 2D entities.	13.	Use the software to draw four domain specific complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands	CO6
Use computer aided drafting software to create and modify 2D entities. Use computer aided drafting software to create and modify the given orthographic views.	14.	Use the software to draw orthographic views of A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P Different objects having cylindrical surfaces, ribs. (three views of each object, total six problems)	CO3, CO6
Use computer aided drafting software to create and modify the given isometric entities.	15.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots	CO4, CO6

L) Suggested Term Work and Self Learning: S2415105 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

1. Sketch progressive and parallel dimensioning.
2. Prepare a list of industrial and household components in which conic curves are used and justify the utility of these curves.
3. Write the equations for parabola in different quadrants and observe the effect of changing eccentricity in case of parabola.
4. Exercises on drawing orthographic views of engineering domain specific simple parts.
5. Exercise on drawing isometric views of different objects.
6. Exercises on converting the orthographic views of an object to isometric view.
7. Exercise on missing views.
8. Exercises on creating simple digital drawings, orthographic views and isometric views.
9. Each student should explain at least one problem for construction and method of drawing in sheet/computer to all batch colleagues. Teacher will assign the problem of particular sheet to be explained to each student batch.
10. 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 an A4 digital drawing template of your institute with title block and institute logo.
9. Each batch will collect 5 components/circuits/items specific to their branch and draw their orthographic views using AutoCAD software.
10. Download 5 videos on shortcuts used in AutoCAD, watch them and write a report to detail out the steps involved, Commands used.

c. Other Activities:

1. Seminar Topics:

    - Standard symbol and conventions used in engineering drawings related to your branch/domain.
    - Commercially available other Computer Aided Drafting Software.
    - Compatibility of AutoCAD drawings compared to Conventional Drawing.

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.

3. Self-Learning Topics:

    - Types of lines and dimensioning in engineering drawing.
    - Different methods of drawing Arcs and Circles in AutoCAD software.

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%	16%
CO-2	-	-	05%	20%	20%	05%	16%
CO-3	-	-	20%	20%	20%	15%	16%
CO-4	-	-	20%	20%	20%	15%	16%
CO-5	-	-	15%	20%	20%	20%	16%
CO-6	-	-	35%	20%	20%	40%	20%
Total Marks	**-**	**-**	**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: (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** (%)	
	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).	CO1, CO2	30	60	10
	Construct ellipse using four center method, arc of circle method and rectangle method Construct parabola using rectangular method, and parallelogram method	CO2	30	60	10
	Draw Orthographic projections of following using first angle method: A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P A frustum of a hexagonal is placed in third quadrant with its axis parallel to H.P. and V.P Different objects having cylindrical surfaces, ribs. (three views of each object, total six problems)	CO3	30	60	10
	Draw Orthographic projections of domain specific objects (three views of each object) (Two problems).	CO3	30	60	10
	Draw Isometric view of simple objects having plain and slanting surface by using natural scale. (Three problems)	CO4	30	60	10
	Convert the orthographic views of an object to isometric view (Two problems)	CO3, CO4	30	60	10
	Draw free hand sketches/conventional representation of your domain specific components (Six problems)	CO5	30	60	10
	Draw free hand sketch of all above isometric drawings (prepared in Sr. No. 06) without using any instruments.	CO5	30	60	10
	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.	CO5	40	50	10
	Prepare a template for your institute of A-4 size with title block and institute logo.	CO6	40	50	10
	Computer Aided Drafting: Use the software to draw following simple 2-D entities using Draw commands individually Draw circle and arcs with different geometric conditions and constraints (two problems). Draw polygons (Triangle, square, pentagon, hexagon, heptagon) (Three problems).	CO6	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	Use the software to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands.	CO6	40	50	10
	Use the software to draw four domain specific complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands	CO6	40	50	10
	Use the software to draw orthographic views of A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P Different objects having cylindrical surfaces, ribs. (three views of each object, total six problems)	CO3, CO6	40	50	10
	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots	CO4, CO6	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.	1 to 9
2.	Models and Charts	Normal and cut sectioned Models and Charts of objects for orthographic / isometric projections	1 to 9
3.	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	1 to 9
4.	Sample production/construction drawings	From nearby industries, construction companies and developed by senior teachers of the state	All

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
5.	Interactive board (165 x 130 cm)	Supports dual touch, dual write and intuitive gestures, such as toss, rotate and zoom with multitouch operating systems, such as Windows®	All
6.	Computer aided drafting software like AutoCAD	Latest educational licensed network version	9 to 15
7.	CAD workstations	latest configuration Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	9 to 15
8.	Printer/plotter	A3 size	9 to 15

R) Suggested Learning Resources:

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 Graphics with AutoCAD	A.K. Sarkar, A.P. Rastogi, D.M. Kulkarni	PHI Learning Private Limited-New Delhi (2010); ISBN: 978-8120337831.
5.	Engineering Drawing and Graphics using AutoCAD	T. Jeyapoovan	Vikas Publishing House Pvt. Ltd, Noida, 2011; ISBN: 978-8125953005.
6.	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. Launching AutoCAD and Opening drawing: https://youtu.be/aoo-t0-gEfw
12. AutoCAD Main Screen: https://youtu.be/D0YyEiCjwpk

13. Draw and Modify Toolbars: https://youtu.be/T_RN_RBFk7o
14. Illustrative Example-1: https://youtu.be/_Bheo9MzeVk
15. Block creation: https://youtu.be/ZguZZVjxaek
16. Rectangular and Polar array : https://youtu.be/YgYZgbrUJ_M
17. Illustrative Example-2: Array: https://youtu.be/yJf_IsWX4gM
18. Dimensioning: https://youtu.be/sEiRsi14u0U
19. Use of layers: https://youtu.be/fdQqNdDtOI8
20. Illustrative Example 3: Flywheel: https://youtu.be/AU-Vsd2T0DA

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. AutoCAD e manual

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A) Course Code **: 2420105(P2420105/S2420105)**

B) Course Title **:** Electrical and Electronics Workshop (EE, ELX, CSE, AIML)

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

D) Rationale:

Electrical and Electronics Workshop is a basic practical engineering course which provides basic knowledge of workshop safety, measuring instruments, hand tools, equipment and machinery used in various shops like wood working shops, welding shop, electrical and electronics materials and components. Students will develop practical skills by performing a variety of operations in various shops using relevant mechanical, electrical and electronic materials as well as appropriate hand tools, equipment, tools and machinery. The knowledge, skills and attitude developed during the course enable the students to undertake industrial and field work related tasks. This course provides industrial environment in educational institutions.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course out comes 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 measuring devices and hand tools effectively.
CO-2 Undertake wood working operations economically and safely.
CO-3 Perform various joining operations using welding, brazing and soldering methods.
CO-4 Identify basic electrical and electronics components.
CO-5 Use firefighting equipment and other safety related accessories.

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** Lifelong Learning	**PSO-1**	**PSO-2**
CO-1	3	2	2	3	1	-	2		
CO-2	3	2	2	3	2	-	2		
CO-3	3	2	2	3	1	-	1		
CO-4	3	1	1	3	1	-	1		
CO-5	3	3	2	1	2	1	2		

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	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				
2420105	Electrical and Electronics Workshop	-	-	04	02	06	03

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, fieldorotherlocationsusingdifferentinstructional/Implementationsstrategies)

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

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

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

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

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

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work& Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2420105	Electrical and Electronics Workshop	-	-	20	30	20	30	100

Legend:

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

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

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

Note:

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

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

J) Theory Session Outcomes (TSOs) and Units: (Not Applicable)

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2420105

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. List various measuring tools and instruments. *LSO 1.2.* Use suitable measuring unit and its conversion. *LSO 1.3.* Select suitable measuring devices in a given situation. *LSO 1.4.* Measure the given job using suitable instruments.	1.	1.1 Identify different types of measuring tools available in workshop. 1.2 Use suitable Marking and hand tools in a given situation. 1.3 Measure the given job using suitable measuring Devices.	CO-1
LSO 2.1 List various wood working tools with major specifications. *LSO 2.2* Select wood working tools as per given job. *LSO 2.3* Perform various wood working operations as per given drawing/sketch. *LSO 2.4* Follow the right procedure to prepare given type of joint.	2.	2.1 Prepare one simple job of wood working comprises of marking, cutting, plaining and finishing as per given drawing/sketch. 2.2 Prepare switch board as per given sample. 2.3 Prepare simple wooden joint as per given sketch / drawing.	CO-2
LSO 3.1 Choose appropriate joining method in a given situation. . *LSO 3.2* Select suitable welding method as per job requirement. *LSO 3.3* Carryout suitable welding procedure as per given sketch / drawing. *LSO 3.4* Perform brazing operation in a given situation.	3.	3.1 Operate gas welding apparatus to generate different types of flames. 3.2 Prepare lap joint using gas welding as per given drawing safely. 3.3 Prepare butt joint using arc welding as per given drawing safely. 3.4 Join the given sheets by using brazing.	CO-3
LSO 4.1 Select various electrical and electronic components. *LSO 4.2* Identify various given electrical tools and measuring instruments. *LSO 4.3* Describe the steps to use the given type of meters. *LSO 4.4* Test the given components using Multimeter. *LSO 4.5* Use the suitable procedure of mounting electrical and electronic components on given PCB. *LSO 4.6* Identify terminals of a given transistor using suitable measuring instrument**.**	4.	4.1 Categorize different active and passive components available in the workshop. 4.2 Identify different types of measuring instruments used for voltage, current and wattmeter. 4.3 Measure resistance of different types of resistors using Multimeter. 4.4 Identify terminals of diodes and transistors. 4.5 Measure voltage and current for single and three phase Supply using multimeter and clip on meter.	CO-4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 4.7 Perform soldering operation in a given situation.		4.6 Perform continuity test of given component using Multimeter. 4.7 Identify three terminals of a transistor using digital Multimeter. 4.8 Solder various resistors, capacitors and inductors and electronic components on Printed Circuit Board (PCB).	
LSO 5.1 Select the fire extinguisher to extinguish the given type of fire. *LSO 5.2* Describe the procedure to use the given firefighting equipment. *LSO 5.3* List the materials used for first Aid. *LSO 5.4* Describe the ways to maintain good housekeeping in the given situation.	5.	5.1 Conduct mock artificial respiration and first Aid exercises to learn about safety procedures of first Aid in case of electrical hazards. 5.2 Use Fire Extinguisher to extinguish the fire in a given situation.	CO-5

L) Suggested Term Work and Self Learning: S2420105 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

i. Select any engineering object / part / drawing and perform the measurement using suitable measuring instrument / device.
ii. Select any (Minimum 3 finished jobs) different wood working / carpentry/welding/metal joining jobs and prepare list of materials and joints used in selected objects.
iii. Select any two joining method and prepare their engineering field of application.
iv. Draw symbols of various electrical components.
v. Draw symbols of various electronic components.
vi. List specifications of various electrical and electronic components

b. Micro Projects:

1. Visit nearby mechanical/electrical workshop and collect information about operation performed by identified workshop and prepare the list of tools and equipment along with specification.
2. Make a wooden job as per given drawing and specifications of material.
3. Prepare any utility job like lab stool structure by using suitable welding process with list of tools and equipment along with specification.
4. Visit any organization /field agency and submit a report on safety practices followed in the identified organization /field agency.

c. Other Activities:

1. **Seminar Topics:**
   - Safety practices and use of personal safety equipment in workshops.
   - Different types of digital instruments and their functions used in workshops.
   - Recent developments in various machines and instruments used in workshop.
2. **Visits:**
   - Visit any wood working shop / welding shops/electrical and electronics workshop and firefighting station and prepare a report.
   - Make a detailed market survey of local dealers for procurement of workshop tools, electrical and electronics equipment /components and raw materials.

3. **Self-learning topic:**
   - Causes and remedies of welding/soldering/ brazing defects.
   - Make various small electrical/electronic equipment for household purpose.
   - Repairing of defective electrical/ electronic appliances/ tools in institutes.

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%	20%	20%	20%
CO-2	-	-	20%	20%	20%	20%	20%
CO-3	-	-	20%	20%	20%	20%	20%
CO-4	-	-	20%	20%	20%	20%	20%
CO-5	-	-	20%	20%	20%	20%	20%
Total Marks			**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

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

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

O) Suggested AssessmentTable for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Identify different types of measuring tools available in workshop.	CO-1	50	40	10
2.	Use suitable Marking and hand tools in a given situation.	CO-1	50	40	10
3.	Measure the given job using suitable measuring Devices.	CO-1	60	30	10
4.	Prepare one simple job of wood working comprises of marking, cutting, plaining and finishing as per given drawing/sketch.	CO-2	60	30	10
5.	Prepare switch board as per given sample.	CO-2	30	60	10
6.	Prepare simple wooden joint as per given sketch / drawing.	CO-2	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
7.	Operate gas welding apparatus to generate different types of flames.	CO-3	60	30	10
8.	Prepare lap joint using gas welding as per given drawing safely.	CO-3	40	50	10
9.	Prepare butt joint using arc welding as per given drawing safely.	CO-3	40	50	10
10.	Join the given sheets by using brazing.	CO-3	50	40	10
11.	Categorize different active and passive components available in the workshop.	CO-4	50	40	10
12.	Identify different type of meters used for voltage, current and wattmeter.	CO-4	60	30	10
13.	Measure resistance of different types of resistors using Multimeter.	CO-4	60	30	10
14.	Identify terminals of diodes and transistors.	CO-4	60	30	10
15.	Measure voltage and current for single and three phase Supply using multimeter and clip on meter.	CO-4	40	50	10
16.	Perform continuity test of given component using Multimeter.	CO-4	60	30	10
17.	Identify three terminals of a transistor using digital Multimeter.	CO-4	50	40	10
18.	Solder various resistors, capacitors and inductors and electronic components on Printed Circuit Board (PCB).	CO-4	30	60	10
19.	Conduct mock artificial respiration and first Aid exercises to learn about safety procedures of first Aid in case of electrical hazards.	CO-5	70	20	10
20.	Use Fire Extinguisher to extinguish the fire in a given situation.	CO-5	50	40	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 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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Measuring tools	Calipers inside and outside, micrometer, protractor, ruler, try square, scriber, laser level, depth gauge, measuring tape, Ammeter, voltmeter, multimeter, tachometer, rheostat	1,2,3
2.	Wood working tools	Marking and measuring tools, saw, claw hammer, mallet, chisels, planers, squares	4,5.
3.	Drilling machine	Up to 15 mm drill cap with 1 HP motor 1000mm height	All
4.	vice	Carpentry vice 200 mm, bench vice 100mm, pipe vice 100 mm	1,2,3,4,5,6,7,8,9
5.	Work benches	Size 2000x1000x750 mm	All
6.	Surface plate	600x900 mm grade I	All
7.	Welding machine	20 KV, 400 A Welding current, welding cable 400 amp, with all accessories	6,7,8,9
8.	Soldering and brazing equipment	Solder. Soldering iron (35 W) soldering wick, magnifying glass, wire cutters, brazing torch, aluminum brazing rod,	9
9.	Gas welding and hand tools	Welding torch, welding tip, pressure regulator, oxygen and acetylene gas cylinder and cutting kit with cylinder and regulator, spark lighter	7,8
10.	Arc welding and hand tools	Electrode holder, cable connector, chipping hammer, earthing clamp, wire brush.	6,7,8,9
11.	Electrical and electronics tools	Wire cutter, screwdriver, insulating tape, wire stripper, pilers, cable cutters, spanner, voltage tester, torch, diode, capacitor, inductor, SCR, transistor, ICs, Led, resistor, switches, plugs, circuit brakers,	10,11,12,13,14, 15,16,17,18
12.	Fire Extinguisher	A, B, C type with capacity of 5 kg and 10 kg of CO_2 type	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Workshop Practice	Bawa,H.S	McGraw Hill Education, Noida ISBN:978-0070671195
2.	Engineering Workshop Practice	A.K. Sarathe	Khanna Book Publishing Co.(P) LTD. New Delhi; 2021 edition ISBN:978-93-91505-51-6
3.	A textbook of workshop Technology.	R.S. Khurmi ,J.K.GUPTA	S.Chand and Co. New Delhi ISBN:9788121908689
4.	Fundamentals of electrical and electronics engineering	J.B. Gupta	S.K. Kataria & sons. New Delhi ISBN:978-81-85749-37-2
5.	Engineering Workshop practice on Electrical &Electronics Engineering	J. Glory Priyadarshini, Dr. K.S.S. Rani , Dr.M.P Maheswari, S. Gomathy	Notion Press Mumbai, ISBN-9781639203819

(b) Online Educational Resources:

1. **Wooden joints**: https://www.youtube.com/watch?v=-f7tTNRH_04
2. **Carpentry tools**: https://www.youtube.com/watch?v=ZyN9Tw9VTSo
3. **Classification of welding joints**: https://www.youtube.com/watch?v=cQEUJnMYf_U
4. **Gas welding**: https://www.youtube.com/watch?v=-SA4D098u-Q
5. **Arc welding**: https://youtu.be/5hRgwnejWPs
6. **Soldering and brazing**: https://www.youtube.com/watch?v=fnEFuzeM8cc
7. **Electrical tools**: https://www.youtube.com/watch?v=0jbFC8dvTVY
8. **Multimeter**: https://www.youtube.com/watch?v=VnL7-TbttGw
9. **Galvanometer**: https://www.youtube.com/watch?v=LdAb3hUDTRY
10. **LED**: https://www.youtube.com/watch?v=0T5ZkOEkrL8
11. **Diodes**: https://www.youtube.com/watch?v=Fwj_d3uO5g8
12. **Capacitors**: https://www.youtube.com/watch?v=X4EUwTwZ110

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. Kents Mechanical Engineering Handbook, John Wiley and Sons, New York.
2. Workshop practice Handbook.
3. Electrical and electronics handbooks
4. Lab Manuals.

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

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

C) Pre- requisite Course(s) :

D) Rationale :

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

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

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

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

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	-	2	-	2		
CO-2	3	2	2	2	2	-	2		
CO-3	3	-	-	-	3	-	2		
CO-4	3	3	-	2	2	-	2		
CO-5	3	-	3	3	2	2	2		

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

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

G) Teaching & Learning Scheme:

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

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

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

Legend:

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

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

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

Note:

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

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

J) Theory Session Outcomes (TSOs) and Units:

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

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.4.2 Wind energy in India- Advantages and challenges of harnessing wind energy 3.4.3 Environmental benefits & limitations 3.5 Biomass 3.5.1 Types of Biomass energy sources 3.5.2 Energy content in Biomass of different types 3.5.3 Biogas production 3.6 Concept and advantages of hydroponics or aquaponics system to demonstrate soil less cultivation and integration of fish and plant cultivation. 3.7 Water conservation and sustainable development 3.8 New Energy Sources: Hydrogen energy, Ocean energy & Tidal energy	
TSO 4a. Describe impact of climate change on human life *TSO 4b.* Identify the factors contributing to climate change *TSO 4c.* Explain sustainable development goals to transform the world *TSO 4d.* Develop implementation strategies for action plan on climate change	**Unit-4.0 Climate Change and Sustainable Development** 4.1 Impact of Climate change 4.2 Factor contributing to climate change 4.3 Sustainable development Goals (SDGs) 4.4 Action Plan on Climate Change- India	**CO4**
TSO 5a. Identify the elements of a successful management system *TSO 5b.* Explain green building concept & its benefits *TSO 5c.* Apply 5R concept in a given building construction project *TSO 5d.* Explain various environment protection laws *TSO 5e.* Explain carbon foot-print & carbon credit	**Unit-5.0 Environmental legislation and Sustainable Building Practices** 5.1 Environment management system and Planning 5.2 Green Building concept 5.3 Green and sustainable building materials - 5R concept 5.4 Environment protection acts, legislation and Laws 5.5 Zero carbon foot-print building for sustainable constriction.	**CO5**

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

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

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

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

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

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

b. Micro Projects:

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

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

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

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

c. Other Activities:

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

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

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

3. Self-Learning Topics:

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

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

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

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

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

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

O) Suggested Assessment Table for Laboratory (Practical):

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

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

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

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

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

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

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

R) Suggested Learning Resources:

(a) Books:

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