

Curriculum of Diploma Programme in Chemical Engineering



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

**State Board of Technical Education
(SBTE), Bihar**

Semester – II

Teaching & Learning Scheme

Course Codes	Category of course	Course Titles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
2414201	PCC	Industrial Chemistry	02	01	-	02	05	04
2420103	BEC	Fundamentals of Electrical and Electronic Engg. (CSE, AIML, ME, ME (Auto), MIE, AE, CRE, CHE, TE)	03	-	04	02	09	06
2425103	BEC	Fundamentals of Mechanical Engg. (CE, CRE, CHE).	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
2400105A	ASC	Applied Mathematics -A (ME, ME (Auto), CE, MIE, AE, CHE, FTS, CRE)	02	01	-	02	05	04
2425106	BEC	Mechanical Workshop (ME, ME (Auto), MIE, AE, CRE, CE, CHE)	-	-	04	02	06	03
2400111	NRC	Principles of Management (CE, AIML, AE, CHE, CSE, ME (Auto), FTS, MIE)	01	-	-	-	01	01
TOTAL			14	2	16	12	44	30

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

Legend:

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

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

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

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

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

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

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

Semester - II Assessment Scheme

Course Codes	Category of course	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment(LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2414201	PCC	Industrial Chemistry	30	70	25	-	-	-	125
2420103	BEC	Fundamentals of Electrical and Electronic Engg. (CSE, AIML, ME, ME (Auto), MIE, AE, CRE, CHE, TE)	30	70	20	30	20	30	200
2425103	BEC	Fundamentals of Mechanical Engg. (CE, CRE, CHE).	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
2400105A	ASC	Applied Mathematics -A (ME, ME (Auto), CE, MIE, AE, CHE, FTS, CRE)	30	70	20	30	-	-	150
2425106	BEC	Mechanical Workshop (ME, ME (Auto), MIE, AE, CRE, CE, CHE)	-	-	20	30	20	30	100
2400111	NRC	Principles of Management (CE, AIML, AE, CHE, CSE, ME (Auto), FTS, MIE)	25	-	-	-	-	-	25
TOTAL			175	350	125	150	80	120	1000

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

Legend:

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

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

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

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

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

- A) **Course Code** : 2414201(T2414201/S2414201)
 B) **Course Title** : Industrial Chemistry
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Industrial chemistry deals with various chemicals in diverse technical and engineering fields. Ever increasing use of materials like aliphatic & aromatic compounds will compel engineers to acquire essential Industrial chemistry knowledge which will be economical and eco-friendly. The concepts like influence of water treatment and its analysis, catalyst and fermentation have constantly proved the importance of industrial chemistry. The aim of this course is to help the student to attain the abilities required in identified industries through various theory & practical experiences. The knowledge gained through this course will help the students to develop the inquisitiveness as per industry oriented tasks.

- 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** Apply the knowledge of synthesis of aliphatic organic compounds and their applications in the industry.
CO-2 Apply the knowledge of synthesis of aromatic organic compounds and their applications in the industry.
CO-3 Use the concepts of gas laws, colligative properties, and phase diagram in many industrial processes.
CO-4 Apply suitable water treatment techniques to solve industrial problems.
CO-5 Use the mechanism of reactions associated with catalysis.

- F) **Suggested Course Articulation Matrix (CAM):**

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

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2414201	Industrial Chemistry	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 = (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)	
2414201	Industrial Chemistry	30	70	25	-	-	-	125

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: T2414201

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the basic rules of nomenclature of organic compounds.</p> <p><i>TSO 1b.</i> Write the IUPAC name of organic compounds.</p> <p><i>TSO 1c.</i> List types of isomerism.</p> <p><i>TSO 1d.</i> Describe different methods of synthesis of alkanes, alkenes, and alkynes.</p> <p><i>TSO 1e.</i> Explain halogenation of alkanes, alkenes, and alkynes.</p> <p><i>TSO 1f.</i> Explain the synthesis of aldehydes and ketones.</p> <p><i>TSO 1g.</i> Differentiate between aldehydes and ketones</p>	<p>Unit-1.0 Aliphatic Hydrocarbons</p> <p>1.1 Nomenclature of organic compound.</p> <p>1.2 Types of structural Isomerism- chain, position, functional and metamerism.</p> <p>1.3 Synthesis of Alkane from unsaturated hydrocarbon and alkyl halides, synthesis of alkene from alkyl halide and Alcohol, synthesis of alkynes from calcium carbide and vicinal dihalides.</p> <p>1.4 Chemical properties-halogenation of alkanes, alkenes and alkynes, hydrohalogenation of alkenes and alkynes.</p> <p>1.5 Synthesis of Aldehydes and Ketones from oxidation of alcohols and dehydrogenation of alcohols.</p> <p>1.6 Nucleophilic addition reaction of aldehyde and ketone with hydroxyl ion and 2,4-Dinitrophenylhydrazine. Oxidation of aldehyde and ketones using Tollens and Fehling's reagent and haloform reaction.</p>	CO1
<p><i>TSO 2a.</i> Explain the basic rules of nomenclature of organic compounds.</p> <p><i>TSO 2b.</i> Write the IUPAC name of given organic compounds.</p> <p><i>TSO 2c.</i> Explain Aromaticity.</p> <p><i>TSO 2d.</i> List methods to synthesize benzene.</p> <p><i>TSO 2e.</i> Explain the chemical properties of benzene.</p> <p><i>TSO 2f.</i> Differentiate between primary, secondary, and tertiary amines</p>	<p>Unit-2.0 Aromatic Compounds</p> <p>2.1 Nomenclature of substituted benzene.</p> <p>2.2 Concept of Aromaticity.</p> <p>2.3 Synthesis of benzene from decarboxylation of aromatic acids, reduction of phenol.</p> <p>2.4 Chemical properties of benzene- Electrophilic substitution reaction - nitration, halogenation. Friedel-Crafts alkylation.</p> <p>2.5 Synthesis of aromatic amines from nitro benzene and amide (Hoffmann bromamide degradation reaction). Reaction of amines with Benzene sulphonyl chloride and Carbylamine reaction.</p>	CO2
<p><i>TSO 3a.</i> Differentiate between Ideal and Real Gases.</p> <p><i>TSO 3b.</i> Explain Van der Waals equation.</p> <p><i>TSO 3c.</i> List postulates of Kinetic theory of gases.</p> <p><i>TSO 3d.</i> Describe Lowering of vapor pressure, Elevation of boiling point, Depression of freezing point.</p> <p><i>TSO 3e.</i> Draw phase diagram for one and two component system.</p>	<p>Unit-3.0 Fundamental Concepts of Gases, Solution & Phase Rule</p> <p>3.1 Ideal & Real gases, Different units of Gas Constant, Boyle's law, Charles's law.</p> <p>3.2 General introduction to Vander Waal Equation.</p> <p>3.3 Equation of state & corresponding states, Liquefaction of gases.</p> <p>3.4 Kinetic theory of gases.</p> <p>3.5 Solutions, molarity, normality, solubility of solid and gas in liquid, Raoult's law, Colligative properties-Lowering of vapor pressure, Elevation of boiling point, Depression of freezing point.</p>	CO3
<p><i>TSO 4a.</i> Explain primary treatment of wastewater.</p> <p><i>TSO 4b.</i> Differentiate between BOD and COD.</p> <p><i>TSO 4c.</i> Describe different steps of secondary treatment of wastewater.</p>	Unit-4.0 Wastewater Treatment	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 4d.</i> Explain different methods to remove the hardness of water.</p> <p><i>TSO 4e.</i> Explain different methods involved in advanced biological treatment.</p>	<p>4.1 Basic processes of water treatment-Primary treatment- pretreatment, sedimentation & flotation.</p> <p>4.2 Secondary treatment-decomposition of organic waste-BOD and COD, aerobic biological treatment, sludge treatment and disposal.</p> <p>4.3 Advanced wastewater treatment- removal of suspended and dissolved solids including removal of hardness, advanced biological systems, chemical oxidation.</p>	
<p><i>TSO 5a.</i> Describe Freundlich adsorption isotherm.</p> <p><i>TSO 5b.</i> Differentiate between Homogenous and Heterogenous catalysis.</p> <p><i>TSO 5c.</i> Explain adsorption theory of catalysis.</p> <p><i>TSO 5d.</i> Describe characteristics of enzyme.</p> <p><i>TSO 5e.</i> Draw mechanism of enzyme catalyzed reaction.</p>	<p>Unit-5.0 Catalysis</p> <p>5.1 Adsorption, adsorption isotherm- Freundlich isotherm and Langmuir adsorption isotherm.</p> <p>5.2 Catalysis-Homogenous and heterogenous catalysis.</p> <p>5.3 Adsorption theory of heterogenous catalysis, activity, and selectivity.</p> <p>5.4 General introduction to Promoters, catalytic poisoning, auto catalysis and negative catalysis.</p> <p>5.5 Some catalysts used in industrial processes like Haber's process, Ostwald's process, Contact process.</p>	CO5

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

K) Suggested Tutorial and Outcomes:

Outcomes	S. No.	Tutorial Titles	Relevant COs Number(s)
<p>1.1. Perform Baeyers test.</p> <p>1.2. Perform Bromine test.</p>	1.	Identification of presence of unsaturation in given organic compound using Baeyer's test and Bromine test.	CO1
<p>2.1. Perform iodoform test.</p> <p>2.2. Perform 2,4-DNP test.</p>	2.	Identification of presence of carbonyl group in given organic compound using iodoform test and 2,4-dinitrophenylhydrazine test(2,4-DNP).	CO1
<p>3.1. Perform Tollen's test.</p> <p>3.2. Perform Fehling's test.</p>	3.	Differentiation between aldehyde and ketone using Tollen's test and Fehling's test.	CO1
<p>4.1. Perform Heisenberg test.</p>	4.	Differentiation between primary, secondary, and tertiary amine using Heisenberg test.	CO2
<p>5.1. Weigh Oxalic acid.</p> <p>5.2. Prepare Oxalic acid solution.</p>	5.	Prepare 250 ml of N/10 Oxalic acid Solution.	CO3
<p>6.1. Determine eutectic temperature.</p> <p>6.2. Plot phase diagram.</p>	6.	Determine the strength of Sodium Hydroxide Solution by Titrating against Oxalic Acid Solution.	CO3
<p>7.1. Determine eutectic temperature.</p> <p>7.2. Plot phase diagram.</p>	7.	Determination of eutectic temperature from phase diagram of two component system benzoic acid and urea by plotting cooling curves.	CO3

Outcomes		S. No.	Tutorial Titles	Relevant COs Number(s)
8.1.	Determine total suspended and dissolved solids in water.	8.	Determination of total suspended and dissolved solids in water.	CO4
9.1.	Determine of dissolved oxygen in given sample of water.	9.	Determination of Dissolved Oxygen (DO) in the given Sample of Water.	CO4
9.2.	Perform Iodometric titration			
10.1.	Determine the total hardness of given sample of water in terms of CaCO ₃ by EDTA titration method.	10.	Determination of total, permanent and temporary hardness of water sample in terms of CaCO ₃ by EDTA titration method using Eriochrome black-T as an indicator.	CO4
10.2.	Draw the structure of complex of metal ions with ethylene diamine tetra acetic acid (EDTA).			
11.1.	Describe the principle behind the estimation of the dissolved oxygen in water.	11.	Determination of adsorption isotherm of acetic acid on activated charcoal.	CO5
11.2.	Determine the oxygen content of the different aquatic habitats.			

L) **Suggested Term Work and Self Learning: S2414201** 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. Explain synthesis and reactions of alkane, alkene and alkynes.
2. List different identification tests of aldehyde and ketones.
3. Determine hardness of given sample of water using EDTA titration.
4. Differentiate between homogeneous and hydrogenous catalysis.
5. Describe Freundlich adsorption isotherm.
6. Explain resonance in benzene using Kekule structures.
7. Discuss the effect of addition of solute on vapor pressure, boiling point and freezing point of solvent.

b. **Micro Projects:**

1. Prepare a report on impurities present in effluent wastewater from nearby industries.
2. Prepare a chart showing some important catalysts used in industry.
3. Test the presence of unsaturated hydrocarbons in petrol and diesel.
4. Design different isomers of aliphatic hydrocarbons using ball stick model.
5. Determine the hardness of water collected from different sources.

c. **Other Activities:**

1. Seminar Topics:
 - Importance of organic compounds in industry.
 - Aromaticity.
 - Catalysis.

2. Visits: Visit nearby industries to learn process used for removing unwanted and toxic impurities from effluent water

3. Self-Learning Topics:

- Nomenclature of organic compounds.
- Concept of aromaticity.
- Ideal, real gas and Van der Waals equation.
- Phase rule.
- Catalyst used in industries.

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

Legend:

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

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

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

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

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Aliphatic Hydrocarbons	10	CO1	14	4	4	6
Unit-2.0 Aromatic Compounds	10	CO1	14	4	4	6
Unit-3.0 Fundamental Concepts of Gases, Solution & Phase Rule	10	CO3	14	4	4	6
Unit-4.0 Wastewater Treatment	8	CO4	10	4	2	4
Unit-5.0 Catalysis	10	CO5	18	4	6	8
Total	48	-	70	20	20	30

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

O) Suggested Assessment Table for Laboratory (Practical): (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 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, round bottom flask, conical flask test tube, beaker, Bunsen burner ,pipet ,funnel, measuring cylinder thermometer volumetric flask, watch glass, tripod stand,	Scale range of 0.001g to 500g. Pan size 100 mm; response time 3-5 sec.;	All
2.	Electric oven	Inner size 18''x18''x18''; temperature range 100 to 250° C. with the capacity of 40lt. & 350 litre	

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Organic Chemistry	Morrison and Boyd	Allyn and Bacon universal, ISBN-13: 978-8131704813
2.	Organic Chemistry	P.L Soni, H.M. Chawla	Sultan Chand & Sons, ISBN-9788180547676
3.	Organic Chemistry	Bahl and Bahl	S Chand. Publication, New Delhi, ISBN-13: 978-9352531967
4.	Physical Chemistry	Puri Sharma and Pathania	Vishal publication, ISBN-13: 978-9382956013
5.	Chemistry for Engineers	Rajesh Agnihotri	Wiley India Pvt. Ltd., 2014, ISBN: 9788126550784
6.	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)

(b) Online Educational Resources:

1. NPTEL LOCAL CHAPTER.
2. MOOCS/SWAYAM.
3. VIRTUAL LABS.
4. <https://ncert.nic.in>
5. <https://www.khanacademy.org>
6. <https://www.wastewaterlearning.com/elearning/> (Water Treatment)
7. <http://www.gcekjr.ac.in> (phase rule)
8. <https://www.eolss.net> (Fundamental concept of gas & phase rule)
9. Courses: NPTEL
10. <https://chem.libretexts.org>(Aliphatic compounds & Aromatic hydrocarbons)

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

(c) Others:

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

- A) **Course Code** : 2420103(T2414201/P2414201/S2414201)
- B) **Course Title** : Fundamentals of Electrical and Electronic Engg.
(CSE, AIML, ME, ME (Auto), MIE, AE, CRE, CHE, TE)
- C) **Pre- requisite Course(s)** : Engineering Physics, Basic Algebra and Calculus
- D) **Rationale** :

This course is a fundamental course included in the curriculum mainly to introduce the students of Computer Science and Engineering, Artificial Intelligence and Machine Learning diploma courses to the basic concepts and basic laws of electricity, principle of magnetism and electromagnetic induction, basic electrical and electronics components and also to the basics of digital electronics so that students will be able to apply the same for solving the day to day basic electrical engineering problems in their own discipline. Diploma holders are expected to apply the fundamentals of this course while working with equipment being operated with electrical sources and while using various types of electrical equipment and instruments in their field.

- 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. Apply basic concepts of electricity to determine various electric parameters in a given electrical system.
- CO-2. Apply the fundamental laws and concepts of DC and AC circuits to a given electrical system.
- CO-3. Apply the principles of magnetism and electromagnetism to a given equipment.
- CO-4. Test the functionality of a given basic electronic component.
- CO-5. Use Boolean expressions and number systems to realize the basic logic circuits.

F) Suggested Course Articulation Matrix (CAM):

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

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Studies (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (SW+ SL)	Total Hours (CI+LI+SW+SL)	Total Credits(C)
		L	T				
2420103	Fundamentals of Electrical and Electronic Engineering	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 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, open educational resources (OERs)

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)	
2420103	Fundamentals of Electrical and Electronic Engg.	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: T2420103**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.1a Apply the concept of charge, voltage and current in the given electrical circuit TSO.1b Differentiate between AC and DC currents. TSO.1c Differentiate between practical and Ideal current/voltage source TSO.1d Calculate work, power, and energy in the given circuit TSO.1e Calculate the equivalent resistance/Capacitance/inductance in the given series and parallel electric circuit. TSO.1f Explain the heating/magnetic/chemical effect of the electric current with a relevant application. TSO.1g Calculate the energy stored in a given resistor/capacitor/inductor. TSO.1h Explain the effect of various media on capacitance TSO.1i Explain behavior of current in a resistor/capacitor/inductor.	Unit-1.0 Basic Electrical Parameters and Concepts 1.1 Electric charge, flow of charges, Electric Current D.C and A.C, Concept of ideal and practical current sources 1.2 Analogy of charge, potential /Voltage difference D.C and A.C, Induced emf/voltage, Terminal voltage, Concept of Ideal & Practical voltage sources 1.3 Resistor - Properties, Classification, Practical application of resistors, Effect of temperature on resistance, Series and parallel combination of resistors, Phase difference 1.4 Heating, magnetic and chemical effect of current, Electrical work, Power and energy, Open and short circuit condition of electric circuit 1.5 Capacitors – Properties, Capacitance formation, Expression for capacitance, Capacitive reactance, Energy stored in capacitor, Series & parallel combination of capacitors, Types of capacitors including super capacitors and their applications 1.6 Inductors – Properties, Self and mutual inductance, inductive reactance, Voltage and current equations of inductor, Energy stored in inductor, Inductance in A.C. and D.C. circuits, Types of Inductors including MEMS inductor and their applications	CO-1
TSO.2a Differentiate between- <ul style="list-style-type: none"> ● AC and DC current in all aspects (Generation, Waveforms and applications) ● Active and passive elements ● Linear & Non-linear circuit ● Unilateral and Bilateral circuit ● Loop and mesh in a given circuit TSO.2b Apply Ohm's law and Kirchoff's laws to determine current and voltage in a given circuit. TSO.2c Explain various AC fundamental parameters. TSO.2d Use operator 'j' to calculate various quantities in A.C circuit	Unit-2.0 Fundamentals of D.C. and A.C. Circuits DC Circuits 2.1 AC and DC current, voltage and Power 2.2 Ohm's law, Kirchoff's Current Law, Kirchoff's Voltage law 2.3 Active & Passive elements, Linear & Non-linear circuit, unilateral and Bilateral circuit element, 2.4 Node, Branch, Loop, Mesh A.C Circuits 2.5 Frequency, Time period, Amplitude, Angular Velocity, RMS Value, Average Value, Form factor, Peak factor, Power factor 2.6 Phasor representation and transformation from Polar to rectangular form and vice versa of alternating quantities	CO1, CO2
TSO.3a Explain various terms related to magnetic circuit.	Unit-3.0 Magnetic Circuits and Electromagnetic Induction	CO2, CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>TSO.3b Calculate various parameters of a given magnetic circuit.</p> <p>TSO.3c Plot B-H curve and Hysteresis loop of a given magnetic materials</p> <p>TSO.3d Explain the phenomenon of induced e.m.f and current</p> <p>TSO.3e Apply principles of Faraday's law to calculate induced e.m.f in the given circuit</p> <p>TSO.3f Apply various Laws in a given magnetic circuits</p>	<p>3.1 Magnetic flux, Magnetomotive force, Magnetic field strength, Permeability, Reluctance.</p> <p>3.2 Magnetic leakage, leakage coefficient</p> <p>3.3 Magnetic Hysteresis, Hysteresis loop,</p> <p>3.4 Magnetization (B-H) Curve</p> <p>3.5 Analogy between electric and magnetic circuits</p> <p>3.6 Electromagnetism</p> <p>3.7 Induced e.m.f -Statically (self and mutual) and dynamically induced emf,</p> <p>3.8 Faraday's Laws of electromagnetic Induction.</p> <p>3.9 Lenz's Law, Fleming's R.H. rule; direction of induced E.M.F, Fleming's L.H. rule, Ampere's Law</p>	
<p>TSO.4.a Describe the construction and working principle of the given type of semiconductor</p> <p>TSO.4.b Describe the principle of the given type of semiconductor.</p> <p>TSO.4.c Describe between the given type insulator, conductor and semiconductor based on energy band theory.</p> <p>TSO.4.d Describe working principle, characteristics and application of the given type of diode.</p> <p>TSO.4.e Describe working principle of the given type of Bipolar Junction Transistor.</p> <p>TSO.4.f Describe working principle of the given type of Field Effect Transistor.</p>	<p>Unit-4.0 Basic Electronic Components</p> <p>4.1 Semiconductors: Definition, types of semiconductors and their materials. Energy band theory and effect of temperature.</p> <p>4.2 Diodes: Basic Concept of Diodes, N-type & p-type PN Junction Diode – Forward and Reverse Bias Characteristics i.e., PN junction Barrier voltage, depletion region, Junction Capacitance. Forward biased & reversed biased junction, Diode symbol</p> <p>4.3 Bipolar Junction Transistor (BJT): NPN and PNP Transistor – Operation and characteristics. symbol</p> <p>4.4 Field Effect Transistor (FET): FET – Operation and characteristics, Classification FET and advantages, FET symbol</p>	CO4
<p>TSO.5a Convert one number system to other number system.</p> <p>TSO.5b Use Boolean Algebra to solve expressions</p> <p>TSO.5c Implement Boolean expressions for given logic gates</p>	<p>Unit-5.0 Overview of Digital Electronics</p> <p>5.1 Introduction to different Number systems: Binary, Octal, Decimal & Hexadecimal & their Conversion from one another</p> <p>5.2 Introduction to Boolean Algebra, rules and Laws of Boolean Algebra – DE Morgan's Law</p> <p>5.3 Study of logic gates (NOT, OR, NOR, AND, NAND) Symbolic representation, Truth Table and Implementation of Boolean expressions</p>	CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2420103

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
LSO 1.1 Classify given electrical components in to Resistor, Inductor and Capacitor.	1.	Classification of electrical components	CO1
LSO 1.2 Plot the terminal voltage of a source starting from no load to different load (Current) conditions	2.	Terminal voltage of a source for different load conditions	CO1
LSO 1.3 Measure current and voltage in a branch of the given electric circuit	3.	Measurement of current and voltage in a branch of the electric circuit	CO1
LSO 1.4 Verify the zero Phase difference between current and voltage waveform for a resistor connected to an AC source with respect to time (using CRO).	4.	Phase difference between voltage and current waveform in a given resistor using CRO	CO1
LSO 1.5 Calculate the value of color-coded resistor and verify it by measuring the value of resistor using digital multimeter	5.	Value of color-coded resistor	CO1
LSO 1.6 Measure resistance in an series and parallel combination of resistors using digital multimeter	6.	Measurement of resistances in series and combination in an electric circuit.	CO1
LSO 1.7 Calculate the value of equivalent capacitance in series and parallel combination and verify by measuring the value of capacitance using digital multimeter	7.	Measurement of capacitance in series and parallel combination of Capacitors.	CO1
LSO 2.1 Apply ohm's law to calculate voltage across each element in a given circuit	8.	Measurement of voltage across each element of the given linear circuit	CO1, CO2
LSO 2.2 Determine currents using KCL in a given electric circuit and verify it by conducting experiment	9.	Measurement of current in the given electric circuit.	CO1, CO2
LSO 2.3 Determine voltages using KVL in a given electric circuit and verify it by conducting experiment	10.	Measurement of voltage in a given electric circuit	CO1, CO2
LSO 2.4 Verify the Phase difference (Lag) between current and voltage waveform for an inductor connected to an AC source with respect to time using CRO.	11.	Phase difference(lag) between voltage and current waveform in a given inductor	CO1, CO2
LSO 2.5 Verify the Phase difference(lead) between current and voltage waveform for a capacitor connected to an AC source with respect to time using CRO.	12.	Phase difference(lead) between voltage and current waveform in a given capacitor using CRO	CO1, CO2
LSO 2.6 Perform experiment to plot BH curve in a magnetic material	13.	BH curve of a given magnetic material	CO1, CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
LSO 3.1 Perform experiment to demonstrate statically and dynamically induced emf.	14.	Statically and Dynamically induced emf.	CO2, CO3
LSO 3.2 Perform experiment to demonstrate self and mutual inductance.	15.	Self and Mutual inductance.	CO2, CO3
LSO 3.3 Perform experiment to demonstrate Faraday's laws of electromagnetism	16.	Faraday's laws of electromagnetism.	CO2, CO3
LSO 3.4 Perform experiment to demonstrate Flemings right hand and left-hand rules	17.	Flemings right hand and left-hand rules.	CO2, CO3
LSO 3.5 Perform experiment to demonstrate Lenz's law	18.	Lenz's law.	CO2, CO3
LSO 4.1 Test the working of a given diode, and plot the labelled V-I characteristics	19.	VI characteristics of Diode.	CO4
LSO 4.2 Test the working of a given BJT and plot the labelled V-I characteristics.	20.	VI characteristics of BJT.	CO4
LSO 4.3 Test the working of a given FET and plot the labelled V-I characteristics	21.	VI characteristics of FET	CO4
LSO 5.1 Build and verify the truth tables for all logic gates – NOT, OR, NOR, AND, NAND	22.	Logic Gates – NOT, OR, NOR, AND, NAND	CO5

L) **Suggested Term Work and Self-Learning: S2420103** 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.

- i. Prepare a report on comparison of a physical system (containing two vertical water columns connected with a horizontal capillary tube and liquid flow due to gravity) to demonstrate the analogy of charge, potential difference and current flow in electrical system.
- ii. Prepare a report on types of resistors, their power ratings and relevant applications.
- iii. Calculate resistance value of a given resistor based on color codes and verify its value using multimeter.
- iv. Prepare a chart showing range of resistances used for electrical insulating materials.
- v. Sketch a plot of BH curve for soft and hard magnetic materials respectively.
- vi. Collect the information regarding various types of inductors used in different domestic appliances.
- vii. Prepare a chart of different types of capacitors used with their applications.
- viii. Prepare a chart illustrating an example to differentiate between useful and leakage flux.

b. **Micro Projects:**

1. Demonstrate the working of resistor, Inductor and Capacitor through role play or using animation
2. Prepare detailed specifications of a typical capacitor bank used for power factor improvement in an industry.

3. Prepare a chart for commonly used capacitors used in different domestic appliances (name of appliances with type and ratings)
4. Build and test the capacitor and choke in a fluorescent lamp for its proper working.
5. Connect three chokes in series and 40 Watt lamp in series with a switch across a single phase AC supply. Analyze the effect of switching action and comment on variation of voltage and current with respect to time.
6. Search animations demonstrating Faraday's laws of electromagnetic induction and Lenz's law to understand the concepts of electromagnetic induction and develop a presentation
7. Prepare a report on the comparison of technical parameters of NPN and PNP transistor.
8. Build and test the transistor switch circuit.
9. Build the logic gates and verify the truth table

c. Other Activities:

1. Seminar Topics;
 - Types of resistors, Inductors and capacitors and their application
 - Basic laws governing DC and AC circuits
 - Applications based on principle of electromagnetic induction.
2. Surveys;
 - Carry out a market survey for availability of different types of resistors used for small projects.
 - Survey a market for availability of different types of semiconductor diodes used for small projects.
3. Visit;
 - Visit institute laboratory/workshop and prepare report about the various electrical sources available along with their specifications.
 - Visit to a nearby electrical substation and observe the capacitors installed

d. Self-Learning Topics:

- Industrial/commercial applications of AC and DC supply
- Differentiate between AC and DC in terms of generation, waveforms, and power
- Conduct a literature survey and prepare list of materials (conducting, insulating, magnetic) and their corresponding applications commonly used in electrical system.
- Applications of statically and dynamically induced emf
- Different types of CROs available in the market
- Different types of Multimeter available in the market

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 (SWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	20%	20%	33%	20%	20%
CO-2	20%	25%	20%	20%	33%	25%	20%
CO-3	25%	25%	20%	20%	34%	20%	20%
CO-4	25%	20%	20%	20%	--	20%	20%
CO-5	15%	15%	20%	20%	--	15%	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 Basic Electrical Parameters and Concepts	8	CO1	11	4	4	3
Unit-.2.0 Fundamentals of DC and AC Circuits	12	CO2	17	4	6	7
Unit-.3.0 Magnetic circuits and Electromagnetic Induction	10	CO3	17	4	6	7
Unit-.4.0 Basic Electronic Components	10	CO4	14	4	6	4
Unit-.5.0 Overview of Digital Electronics	8	CO5	11	4	3	4
Total Marks	48	-	70	20	25	25

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.	Classification of electrical components	CO1	50	40	10
2.	Terminal voltage of a source for different load conditions	CO1	50	40	10
3.	Measurement of current and voltage in a branch of the electric circuit	CO1	50	40	10
4.	Phase difference between voltage and current waveform in a given resistor using CRO	CO1	45	45	10
5.	Value of color-coded resistor	CO1	50	40	10
6.	Measurement of resistances in series and combination in an electric circuit.	CO1	50	40	10
7.	Measurement of capacitance in series and parallel combination of Capacitors.	CO1	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA (%)	PDA (%)	
8.	Measurement of voltage across each element of the given linear circuit	CO1, CO2	50	40	10
9.	Measurement of current in the given electric circuit.	CO1, CO2	50	40	10
10.	Measurement of voltage in a given electric circuit.	CO1, CO2	50	40	10
11.	Phase difference(lag) between voltage and current waveform in a given inductor.	CO1, CO2	50	40	10
12.	Phase difference(lead) between voltage and current waveform in a given capacitor using CRO.	CO1, CO2	50	40	10
13.	BH curve of a given magnetic material.	CO1, CO2	50	40	10
14.	Statically and Dynamically induced emf.	CO2, CO3	50	40	10
15.	Self and Mutual inductance.	CO2, CO3	50	40	10
16.	Faraday's laws of electromagnetism.	CO2, CO3	50	40	10
17.	Flemings right hand and left-hand rules.	CO2, CO3	50	40	10
18.	Lenz's law.	CO2, CO3	60	30	10
19.	VI characteristics of Diode.	CO4	60	30	10
20.	VI characteristics of BJT.	CO4	60	30	10
21.	VI characteristics of FET.	CO4	60	30	10
22.	Logic Gates – NOT, OR, NOR, AND, NAND	CO4	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 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.	DC Source (Variable)	0-20/50 Volts	1-18
2.	AC Source (Variable)	0-300 Volts	1-18
3.	Voltmeter	0-300 V, 0-75 V (MI & MC)	1-18
4.	Ammeter	0-5/10/20 A (MI), 0-2 A (MC)	1-18
5.	Rheostats	0-50 Ohms, 5 Amp; 0-300 Ohms, 2 amp	1-18
6.	Resistors, Capacitors, and Inductors	Appropriate ratings and different types	1, 6
7.	Demonstration kit for demonstrating statically and dynamically induced emf	Lab experiment purpose	14
8.	Demonstration kit to demonstrate self and mutual inductance.	Lab experiment purpose	15
9.	Demonstration kit for Faraday's laws of electromagnetic induction.	Lab experiment purpose	16
10.	Demonstration kit for Flemings right hand and left hand rules.	Lab experiment purpose	17
11.	Demonstration kit for Lenz's law.	Lab experiment purpose	18
12.	Multimeter	Digital Multimeter: 3 1/2-digit display, 9999 counts digital multimeter measures: V_{ac} , V_{dc} (1000V max), A_{dc} , A_{ac} (10 amp max), Resistance: (0 - 100 M Ω), Capacitance and Temperature measurement	5,7,19,20,21,22
13.	Electronic Work Bench	Bread Board 840 -1000 contact points: Positive and Negative power rails on opposite side of the board, 0-30 V, 2 Amp Variable DC power supply, Function Generator 0-2MHz, CRO: 0-30 MHz, Digital Multimeter	19,20,21,22
14.	CRO dual trace	25 MHz, 230 V AC, 50 Hz	4,12,19,20,21,22
15.	Electronic components Connecting probes	PN diode -NPN and PNP, BJT, FET, Logic gates OR, AND, NOT, NOR, NAND Connecting probes -1 set	19,20,21,22

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Basic Electrical Engineering	Mittle and Mittal	McGraw Education, New Delhi, 2015, ISBN: 978-0-07-0088572-5
2.	Fundamentals of Electrical Engineering	Saxena, S. B. Lai	Cambridge University Press, ISBN: 9781107464353
3.	Electrical Technology Vol- I	Theraja, B. L.	S. Chand Publications, New Delhi. 2015, ISBN: 9788121924405
4.	Basic Electrical and Electronics Engineering	Jegathesan, V.	Wiley India, New Delhi, 2015, ISBN: 97881236529513
5.	Principles of Electronics	Mehta, V.K.; Mehta, Rohit	S. Chand and Company, Ram Nagar, New Delhi-110 055, 504, 2014, ISBN: 9788121924
6.	Basic Electronic Engineering	Baru V.; Kaduskar R.; Gaikwad S.T.	Dream tech Press, New Delhi, 2015, ISBN: 9789350040126

(b) Online Educational Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee64/preview
2. <https://archive.nptel.ac.in/courses/108/108/108108076/>
3. <https://nptel.ac.in/courses/122106025>
4. https://www.youtube.com/watch?v=Zr2SxTiKUCM&list=PLJvKqQx2Atc61XCOHXm_ACNkOkAm3yO4&index=4
5. <https://www.youtube.com/watch?v=9LNRAwf3uqs>
6. <https://de-iitr.vlabs.ac.in/List%20of%20experiments.html>

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

(c) Others:

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

- A) **Course Code** : 2425103(T2425103/P2425103/S2425103)
 B) **Course Title** : Fundamentals of Mechanical Engineering (CE, CHE, CRE)
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Now a days as an advancement of technology interdisciplinary knowledge is must for the engineering diploma holders. An engineering diploma holder expected to look after many activities at work place, which may be of interdisciplinary. Knowledge other than own discipline plays important role in the development of individual as well as society. This course mainly encompasses the major areas of mechanical engineering which are being used by engineering diploma holders and are required to perform tasks such as selection of hand tools, power tools, welding, cutting, manufacturing processes, IC engines, refrigeration and air conditioning and power transmission drives used for various purposes. Such skills can be developed by knowing the basic principles of mechanical engineering. The motive of this subject is to enhance the knowledge & skill level in the interdisciplinary area. This course is designed in such a way that practical performed in this course will develop these basic skills to perform well in industry as well as in field work.

- 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. Interpret laws of thermodynamics
 CO-2. Calculate brake thermal efficiency for the given data of an IC engines.
 CO-3. Select relevant material and mechanical tools for a given job.
 CO-4. Use relevant manufacturing process for a given component.
 CO-5. Select relevant power transmission drives in real life application.

- F) **Suggested Course Articulation Matrix (CAM):**

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

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

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

G) Teaching & Learning Scheme:

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				
2425103	Fundamental of Mechanical Engineering	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)	
2425103	Fundamentals of Mechanical Engineering	30	70	20	30	20	30	200

Legend:

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

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

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: T2425103**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the role of thermodynamics in engineering.</p> <p><i>TSO 1b.</i> Explain thermodynamics systems and its types.</p> <p><i>TSO 1c.</i> Interpret laws of thermodynamics</p> <p><i>TSO 1d.</i> Describe thermodynamic properties, process and cycle</p> <p><i>TSO 1e.</i> Describe different modes of Heat transfer.</p> <p><i>TSO 1f.</i> Use modes of heat transfer for the given situation.</p>	<p>Unit-1.0 Introduction to Thermodynamics</p> <p>1.1 Role of thermodynamics in engineering and science,</p> <p>1.2 Types of thermodynamics systems</p> <p>1.3 Specific volume, enthalpy, pressure, temperature, thermodynamic work thermodynamic equilibrium</p> <p>1.4 First law, second law and zeroth of thermodynamics</p> <p>1.5 Enthalpy of wet steam, superheated steam, dryness fraction, degree of superheat</p> <p>1.6 Modes of heat transfer: conduction-composite walls, combined conduction, convection, radiation, application of heat transfer modes</p>	CO1
<p><i>TSO.2a</i> Differentiate between two stroke and four stroke engines</p> <p><i>TSO.2b</i> Describe construction and working of a given diesel engine.</p> <p><i>TSO.2c</i> Describe construction and working of a given petrol engine</p> <p><i>TSO.2d</i> Calculate brake thermal efficiency of an IC engines.</p> <p><i>TSO.2e</i> Identify simple faults in the given engine.</p> <p><i>TSO.2f</i> Suggest remedial measures to rectify the given fault</p> <p><i>TSO.2g</i> Calculate coefficient of performance and of tonnage capacity of an air conditioning system</p> <p><i>TSO.2h</i> Explain construction and working of a given refrigeration system.</p> <p><i>TSO.2i</i> Describe the troubleshooting procedure of a given refrigeration system and air-conditioning system.</p>	<p>Unit-2.0 Internal Combustion Engine and Refrigeration</p> <p>2.1 Types of internal combustion engines- S.I. and C.I. Engines,</p> <p>2.2 Construction and working two stroke and four stroke petrol engines and two stroke and four stroke diesel engines</p> <p>2.3 BP, heat supplied and brake thermal efficiency of IC engines.</p> <p>2.4 Common faults in IC engines, remedial measures to rectify the faults</p> <p>2.5 Air pollution due to IC engines.</p> <p>2.6 Heat engine, concept of refrigeration, ton of refrigeration, unit of refrigeration, COP</p> <p>2.7 Major components of vapor compression systems, heat pump, Carnot cycle, Carnot efficiency,</p> <p>2.8 Types of refrigerants</p> <p>2.9 Types of air conditioning systems - window, package, central air-conditioning systems</p> <p>2.10 Domestic refrigerator.</p> <p>2.11 Basic fault finding in refrigerator and window air-conditioner.</p> <p>2.12 Methods of energy saving in refrigeration and air-conditioning systems.</p>	CO2
<p><i>TSO 3a.</i> Classify engineering materials.</p> <p><i>TSO 3b.</i> Select engineering materials as per the given situation</p>	<p>Unit-3.0 Engineering Materials</p> <p>Introduction to engineering materials, classification of materials</p>	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 3c.</i> Describe different properties of the given material.</p> <p><i>TSO 3d.</i> Identify the properties of a given material.</p> <p><i>TSO 3e.</i> Differentiate between metallic and nonmetallic material</p>	<p>3.1 Metallic materials</p> <ul style="list-style-type: none"> • Ferrous alloys- carbon steel, low-alloy steel, tool steel, stainless steel, cast iron • Aluminum alloys, nickel alloys, copper alloys, titanium alloys, • Magnetic, dielectric and superconducting materials <p>3.2 Non-metallic materials</p> <ul style="list-style-type: none"> • Ceramics – types and applications • Polymers-thermoplastic polymers, thermosetting polymers, elastomers • Metallic glasses: types, glass forming ability of alloys, melt spinning process • Composites-particulate composites, fibrous composites, laminated composites <p>3.3 Mechanical properties</p> <p>Tensile strength, elasticity, plasticity, hardness, toughness, brittleness stiffness, ductility, malleability, cohesion, impact strength, fatigue, creep, hooke's law, poisson's ratio</p> <p>3.4 Magnetic properties of materials</p> <p>Intensity of magnetization, magnetic field (h) or magnetic intensity, magnetic susceptibility, retentivity, coercivity</p> <p>3.5 Optical properties of materials- elastic properties of materials, dielectric properties of materials</p> <p>3.6 Physical properties of materials Electrical conductivity, melting temperature of material, semiconductors, thermal conductivity, fusibility, reluctance (as magnetic properties), density, melting point and boiling point.</p>	
<p><i>TSO.4a</i> Select machine tool as per the given job.</p> <p><i>TSO.4b</i> Use machine tools for the given job.</p> <p><i>TSO.4c</i> Explain different operation performed on the given machine tool.</p> <p><i>TSO.4d</i> Select welding equipment for the given job</p> <p><i>TSO.4e</i> Explain working of arc and gas welding</p> <p><i>TSO.4f</i> Explain brazing and soldering process</p> <p><i>TSO.4g</i> Describe the procedure for casting of given job.</p> <p><i>TSO.4h</i> Explain concept of various metal forming processes.</p> <p><i>TSO.4i</i> Identify metal forming process for the given job.</p>	<p>Unit-4.0 Manufacturing Processes and Machine Tools</p> <p>4.1 Basic machine tools.</p> <ul style="list-style-type: none"> • Introduction to lathe, drill, milling and grinding machines. • Types of operations / jobs which can be performed on machine tools listed above. <p>4.2 Metal joining processes.</p> <ul style="list-style-type: none"> • Welding-types, working setup of arc and gas welding, precautions and safety during arc and gas welding. • Brazing and soldering-general set up, applications. <p>4.3 Foundry- concept, process of casting a component, applications.</p>	<p>CO4</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.4j</i> Prepare a simple job with ABS material using 3D printer</p> <p><i>TSO.4k</i> Select suitable 3D Printer and software for the given application with justification.</p>	<p>4.4 Basic metal forming processes-bending, rolling, forging and extrusion –concept and its application</p> <p>4.5 Additive manufacturing techniques-introduction to various additive manufacturing processes-stereo-lithography, LOM, FDM, SLS, SLM, Binder Jet technology, Direct Energy Deposition</p> <p>4.6 FDM based 3D printer, its working and construction, Process parameters</p>	
<p><i>TSO 5a.</i> Identify different mode of power transmission.</p> <p><i>TSO 5b.</i> Select suitable power transmission mode for given application.</p> <p><i>TSO 5c.</i> Identify the different types of Brake, Clutch and Coupling.</p> <p><i>TSO 5d.</i> Explain with sketches construction and working of given brake, clutch and coupling</p> <p><i>TSO 5e.</i> Explain the types of belts and its velocity ratio.</p>	<p>Unit-5.0 Power Transmission</p> <p>5.1 Belt drives - flat belt and v- belt drive, ropes and chain, velocity ratio slip, length of the belt, open belt and cross belt drives the ratio of friction tensions, centrifugal tension in a belt Power transmitted by belts and ropes Initial tensions in the belt</p> <p>5.2 Gear drives-classification, simple, compound – reverted and epicyclic gear trains, their selection for different applications, gear trains velocity ratio, velocity ratio, gear ratio,</p> <p>5.3 Couplings- muff coupling and flange coupling joints-cotter joint and knuckle joint</p> <p>5.4 Helical springs (closed and open coil)</p> <p>5.5 Friction clutches: single plate, multi plate, cone clutch, variable speed clutch, positive drive clutches: claw and jaw clutch. (construction and working)</p> <p>5.6 Brakes: shoe brake, internal expanding and disc brakes. (construction and working)</p> <p>5.7 Fasteners: keys, nut-bolt connections, screws, rivets</p>	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425103

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Calculate thermal conductivity for thick & composite slab	1	Determine the thermal conductivity of a thick slab	CO1
	2	Determine the thermal conductivity of Composite Wall.	CO1
<i>LSO 2.1.</i> Dismantle and assemble given engines	3	Dismantle and Assemble two stroke and four stroke petrol engines.	CO2
<i>LSO 2.2.</i> Identify the various component in IC engines	4	Identify the various processes and components of two stroke and four stroke petrol engines.	CO2
<i>LSO 2.3.</i> Use trainer to Design and assemble given circuit	5	Design and assemble a circuit that extends and retracts a single acting (spring return) and double acting cylinder on a given trainer.	CO2
<i>LSO 2.4.</i> Determine the properties and coefficient of performance.	6	Determine properties of air (Dry bulb temperature, Wet bulb temperature, Humidity)	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
	7	Determine of coefficient of performance and of tonnage capacity of an Air conditioning system	CO2
LSO 2.5. Identify components of refrigeration system.	8	Identify the components of refrigeration system and air conditioning system	CO2
LSO 3.1. Identify the microstructure of different materials	9	Use microscope to identify microstructure of material	CO3
LSO 3.2. Use hardness testing machine	10	Measure hardness of given material using given hardness tester.	CO3
LSO 3.3. Use tensile testing machine	11	Measure tensile strength of given metallic materials using tensile test method.	CO3
	12	Determination of tensile properties of composite	CO3
LSO 3.4. Use compressive testing material	13	Determination of compressive properties and shear properties of unidirectional lamina	CO3
LSO 3.5. Use charpy impact machine	14	Use the charpy impact test to measure the values of the impact energy (also called notch toughness) of steel samples.	CO3
LSOs 4.1 Use lathe machine	15	Prepare a plain turning and taper turning job as per the given drawing.	CO4
LSOs 4.2 Use milling machine	16	Prepare a job on the milling machine as per the given drawing.	CO4
LSOs 4.3 Use of gas & arc welding for given metal.	17	Perform gas welding operation on the given job.	CO4
	18	Perform arc welding operation on the given job	CO4
LSOs 4.4 Use soldering and brazing equipment	19	Perform soldering and brazing operation on the given job.	CO4
LSOs 4.5 Use sheet metal operation for the given job.	20	Prepare a sheet metal product (Funnel) and report the various parameters for the various passes during the rolling of the given metal piece.	CO4
LSOs 4.6 Use different foundry tools and equipment's	21	Select different foundry tools and equipment's for a given job	CO4
LSOs 4.7 Prepare sand mold	22	Identify various stages of casting through demonstration of Sand-Casting Process.	CO4
	23	Prepare of a sand mold with a simple pattern	CO4
LSOs 4.8 Prepare solid pattern	24	Produce wooden solid pattern as per given drawings.	CO4
LSOs 4.9 Produce a component using available 3D printer	25	Print one single component on available 3D printer with PLA/ABS material	CO4
LSO 5.1. Identify the various component in Clutches.	26	Dismantle and assemble different clutches as per the given instruction	CO5
LSO 5.2. Select different drives for the given job	27	Use belt, chain and gear drive for the given job.	CO5
LSO 5.3. Determine velocity ratio of given drives	28	Calculate the velocity ratio for given compound gear train	CO5
	29	Determine the velocity ratio of a flat belt drive.	CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
	30	Determine the velocity ratio of simple gear drive.	CO5
LSO 5.4. Identify the various component in brakes and couplings	31	Dismantle and Assemble different brakes and couplings as per the given instruction	CO5

L) **Suggested Term Work and Self Learning: S2425103** 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.

- a. Calculate the refrigeration capacity of a given room in ton.
- b. Write 05 uses of sheet metal in detail in our daily life
- c. Identify the types of manufacturing process used in a given 10 samples.
- d. Select the power transmitting element for the five situations with reason.
- e. Draw and Study circuit diagram for starting motor of IC engines and Battery Ignition system.
- f. Collect videos, animations showing working of different types of air compressors.
- g. Make a troubleshooting chart for Domestic refrigerators.
- h. Collect manufacturer's specifications for various refrigeration controls.

b. **Micro Projects:**

- Print two pieces of same components using ABS and PLA and compare their strength, surface roughness, weight, cost.
- Build model of different gears from cardboard.
- Build model of IC Engine parts from cardboard.
- Prepare cast product with wax material
- Make models of controls demonstrating their functions at least 3 under guidance of instructor/teacher in lab/ workshop.
- Prepare a given product using arc welding/gas welding.
- Market survey on gears and collect information of different types of gear used in machine equipment, prepare a chart showing different gears and its uses.
- Prepare a report on refrigerant used in domestic refrigeration, car refrigeration system etc.
- Prepare a report on emission of petrol engine and diesel engine.

c. **Other Activities:**

1. Seminar Topics:

- Refrigerants used in Commercial air conditioning & Refrigeration system
- Properties of PLA and ABS 3D printing materials.
- Sheet metal operations and its application.
- Recent advancement in brake and its advantages.
- Classification of engineering materials and its properties.
- Application of solar energy as a power source.
- Future scope of **renewable energy** source as power generation system.

2. Visits:

- Visit nearby workshop/industry with sheet metal facilities. Prepare report of visit with special comments on different operation performed and material used in production.
- Visit nearby workshop/industry with welding facilities. Prepare report of visit with special comments on different joining process used and material.
- Visit a nearby dairy plant and prepare a report on process involve in storage of diary product.
- Visit a nearby power plant and prepare a report on step involve/equipment used in power generation.
- Visit nearby tool room/industry with 3D Printing facilities. Prepare report of visit with special comments of 3D printing technique used, material used, single component/batch production/mass production and cost of printed component.

3. Self-Learning Topics:

- 3D printing of micro/mini components.
- Conversion of CAD file formats into IGES.
- Types of nut-bolt/coupling devices/rivets used in industry.
- Refrigerant used in commercially available refrigeration and air conditioning system.
- Different types of energy sources available in India.

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%	12%	15%	-	-	20%	20%
CO-2	10%	22%	10%	25%	-	10%	20%
CO-3	15%	22%	15%	25%	33%	15%	20%
CO-4	30%	22%	30%	25%	33%	15%	20%
CO-5	30%	22%	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 Introduction to Thermodynamics	9	CO1	10	4	4	2
Unit-2. 0 Internal Combustion Engine and Refrigeration	10	CO2	15	4	6	5
Unit-3.0 Engineering Materials	9	CO3	15	4	5	6
Unit-4.0 Manufacturing processes and machine tool	10	CO4	15	4	5	6
Unit-5.0 Power transmission	10	CO5	15	4	4	7
Total Marks	48	-	70	20	24	26

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1	Determine the thermal conductivity of a thick slab	CO1	40	50	10
2	Determine the thermal conductivity of Composite Wall.	CO1	40	50	10
3	Dismantle and Assemble two stroke and four stroke petrol engines.	CO2	40	50	10
4	Identify the various processes and components of two stroke and four stroke petrol engines.	CO2	40	50	10
5	Design and assemble a circuit that extends and retracts a single acting (spring return) and double acting cylinder on a given trainer.	CO2	40	50	10
6	Determine properties of air (Dry bulb temperature, Wet bulb temperature, Humidity)	CO2	40	50	10
7	Determine of coefficient of performance and of tonnage capacity of an Air conditioning system	CO2	40	50	10
8	Identify the components of refrigeration system and air conditioning system	CO2	40	50	10
9	Use microscope to identify microstructure of material	CO3	40	50	10
10	Measure hardness of given material using given hardness tester.	CO3	40	50	10
11	Measure tensile strength of given metallic materials using tensile test method.	CO3	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
12	Determination of tensile properties of composite	CO3	40	50	10
13	Determination of compressive properties and shear properties of unidirectional lamina	CO3	40	50	10
14	Use the charpy impact test to measure the values of the impact energy (also called notch toughness) of steel samples.	CO3	40	50	10
15	Prepare a plain turning and taper turning job as per the given drawing.	CO4	40	50	10
16	Prepare a job on the milling machine as per the given drawing.	CO4	40	50	10
17	Perform gas welding operation on the given job.	CO4	40	50	10
18	Perform arc welding operation on the given job	CO4	40	50	10
19	Perform soldering and brazing operation on the given job.	CO4	40	50	10
20	Prepare a sheet metal product (Funnel) and report the various parameters for the various passes during the rolling of the given metal piece.	CO4	40	50	10
21	Select different foundry tools and equipment's for a given job	CO4	40	50	10
22	Identify various stages of casting through demonstration of Sand-Casting Process.	CO4	40	50	10
23	Prepare sand mold with a simple pattern	CO4	40	50	10
24	Produce wooden solid pattern as per given drawings.	CO4	40	50	10
25	Print one single component on available 3D printer with PLA/ABS material	CO4	40	50	10
26	Dismantle and assemble different clutches as per the given instruction	CO5	40	50	10
27	Use belt, chain and gear drive for the given job.	CO5	40	50	10
28	Calculate the velocity ratio for given compound gear train	CO5	40	50	10
29	Determine the velocity ratio of a flat belt drive.	CO5	40	50	10
30	Determine the velocity ratio of simple gear drive.	CO5	40	50	10
31	Dismantle and Assemble different brakes and couplings as per the given instruction	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.	Experimental setup for the measurement of thermal conductivity of thick slab and composite wall	Guarded Hot Box, Solar Calorimeter, Large Diameter Integrating Sphere, Environmental Chambers, Heat Flow Meters, Computer Simulation Software, Guarded Hot Plate (ASTM C177), Guarded-Comparative-Longitudinal Heat Flow Meter, Comparative-axial-heat-flow (cut-bar) Method, Transient Hot Wire, Laser Flash Diffusivity	1,2
2.	Single cylinder two stroke petrol engine	Two stroke single cylinder horizontal petrol engine Power:3- 4.5 HP, Speed: 4000-6000 rpm, bore: 70-80 mm, stroke length:66.7-70mm, starting: rope & self-starting, working cycle: four strokes, Engine cooling: forced air cooled, V C R head cooling: water cooled, Method of ignition: spark ignition, Orifice dia: 20mm, Compression ratio: 2.5:1 to 8:1, Spark plug	3,4
3.	Single cylinder four stroke diesel engine test rig	Bore: 85-90 mm, Stroke: 80-85 mm, RPM: 1500-1700, BHP: 5 -5.5 HP, 3.7 KW, Fuel: High Speed Diesel oil, Sp. Gr.: 0.83, C.V: 10,833 Kcal/k	3,4
4.	Single cylinder four stroke petrol engine test rig	Four stroke single cylinder vertical petrol engine Power: 2.9 KW, Speed: 3000 -4000 rpm, Air cooled Engine, Bore: 70-75mm, Stroke: 66.7-7 mm, Capacity: 256 cc, Fuel: Petrol, Sp. Gr: 0.71	3,4
5.	Pneumatic trainer and hydraulic trainer	Pneumatic and hydraulic trainer	5
6.	Air conditioning system test rig	Compressor unit, condenser, evaporator, cooling chamber, controlling and measuring instrument control panel	7
7.	Refrigeration system test rig	Compressor unit, condenser, evaporator, cooling chamber, controlling and measuring instrument control panel	8
8.	Hardness testing machine	<ul style="list-style-type: none"> • Rockwell harness tester - JIS B 7726 ISO 6508-2 ASTM E18-10, preliminary test force 98.07N (10kgf), 29.42 (3kgf) Manual (with automatic brake-start), Test Force Rockwell- 588.4N (60kgf), 980.7N (100kgf), 1471N (150kgf) Automatic (loading, duration) Maximum Specimen Ht. 7.1-7.5", Maximum Depth 6.5-7" • Brinell hardness tester- Brinell scale load range of 612N – 29.42 KN (62.5 kgf – 3000 kgf.), display- Hardness HB value (after entering diagonal length into keypad calculator); Mean diagonal length; Test force; Dwell time; Ball diameter; Conversion; Limits, hardness Resolution 0.1 unit if HB < 100; else 1.0 unit, Standards Compliant ISO 6506, ASTM E10, JIS, Test Load Type -Load Cell Closed-Loop Control System, Test Cycle-Automatic, Test Loads-62.5, 187.5, 250, 500, 750, 1000, 1500, 3000kgf 	10

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
9.	Tensile testing machine	Motor: ¼ HP Single Phase 220 / 110 V AC Supply Speed: 100 mm/min and 200 mm/min (Changeable through Belt & Pulley mechanism), Display: Digital (LED), Accuracy: ± 2% at Full Load (with master load) Grip to Grip separation: Min 25mm and Max. 700mm	11,12
10.	Compressive testing machine	1000 KN - for load cell calibration - fully automatic - servo controlled	13
11.	Impact testing machine	Impact tester should confirm to the Standards: ASTM D 256 & ASTM D 6110, ISO 180 & ISO 179, Microprocessor Controlled equipment with possibility to modify and create test parameters according to standard and store templates, Possibility to save data and export selected data with customized format, Real time display of impact energy, resilience, pendulum angle, impact speed and statistical analysis Pendulum Impact Energy Range- 0-25 Joules, Least Count of Indication- 0.01 Joules, Release Angle of Pendulum -150°, Striking velocity range of Pendulum -2.5 – 3.8 m/s, Hammers -Hammers for Izod Impact Tests –2.75 J, 5.5 J,11.0 J ,Hammers for Charpy Impact Tests – 1.0 J, 2.7 J, 5.4 J (ASTM D 6110), Hard chrome plated vice , Notch cutting device, Digital Notch depth measuring device (0 to 12 mm), specimens for Izod & Charpy impact test as per ASTM & ISO specification, Motor driven, attached with constant profile tungsten carbide knife, "V" notch (45°), Type A, Type B and Type C Comply to ASTM D 256	14
12.	Hand tools	Different spanners (Wrench), Pliers, Screw drives, Chisel, Hand hacksaw, Hammers.	15,16
13.	Power tools-	Portable Drilling and grinding machine, Electric power saw, portable electric cutter, electric demolition hammer, power screw driver.	15,16
14.	Belt arrangement	Working models of different belts in different arrangement.	27,28
15.	Belt and gear drives	Working models of belt drives, chain and sprocket, various gear drives.	27, 29,30
16.	Cut section models of brakes	Working and cut section models of various types of brake assemblies.	31
17.	Models of clutch	Models (Wooden/Plastic/Metallic) of various clutch (suitable for dismantling)	26
18.	Models of coupling	Models (Wooden/Plastic/Metallic) of various coupling. (suitable for dismantling)	
19.	Center Lath	Medium Duty Lathe Machine, Bed Width-240 to 350 mm, Universal Gear Box Center lathe machine (length between centers:1200mm), Max Spindle Speed-1600 to 2000 RPM, Spindle Bore 40 mm to 55 mm, Layout-Horizontal, Automation Grade, Number of Spindle Speeds- 8 to 12, Power 2.2 kW to 5.5 kW, Drive Type-Geared	15
20.	Milling machine	Automatic for Multi-purpose, Table size of Vertical Drive Milling Machine - 325 x 1470 approx, Longitudinal Travel-700-800, Vertical Travel-480-500, cross travel- 350-400, power feed – 700-800, head and ram rotate parallel on body -360-degree, Ram travel – 400-500, Motor, 3 to 3.5 HP, No. of Speeds- 8 Min 75 RPM, Max 3000-4000 RPM	16

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
21.	Arc welding machine	Arc Welding machine welding current 20-400A. Arc welding tools-electrode holder, cable connector, cable lugs, earthing clamp, wire brush.	18
22.	Gas welding machine	Oxygen and acetylene gas welding and cutting kit with cylinders and regulators. welding torch, welding tip, spark lighters.	17
23.	Brazing and soldering kit	Brazing kit with suitable silver and copper brazing alloy rods for ¼ " to 7/8" tubes- cu to cu, cu to steel, cu to brass and appropriate flux.)	19
24.	Sheet metal tools	<ul style="list-style-type: none"> • Cutting Tools- Chisels, Snips or Shears • Striking Tools- Hammers and Punches • Supporting Tools- Stakes, Anvils, Swage Block • Marking and Measuring Tools- Steel rule, Scriber, Trammel, Divider, Swing Blade Protractor, Wire Gauge • Bending and Folding Tools • Other Tools- Grooving Tools, Bench Plate 	20
25.	Foundry tools	Hand tools- Hand riddle, Shovel, Rammers- Hand rammer, Peen rammer, Floor rammer, Pneumatic rammers, Sprue pin, strike off bar, Mallet, Draw spike, Vent rod, Lifters, Trowels, Slicks, Smoothers, Swab, Spirit level, Gate cutter, Gaggers, Spray-gun, Nails and wire pieces, Wire pieces, spring and nails, Bellows, Clamps, cotters and wedges Kinds of molding sand- Green sand, Dry sand, Loam sand, facing sand, Backing sand, System sand, Parting sand, Core sand	21
26.	Casting and molding	Hand riddle, Shovel, Rammer, Sprue pin, Strike of bar, Mallet, Draw spike, Vent rod, Lifter, Travels, Sliclick, Smoother, Swabs, Spirit level, Gate cutter, Daggers, Bellows, Clamps, cutters, and wedges	22,23
27.	3D printer	Fused Deposition Modelling system with complete accessories; Build Volume-300 x 300 x 300mm or Higher; Layer Thickness-0.1 – 0.4 OR Available with CoE	25

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Basic Mechanical Engineering	Pravin Kumar	Pearson Education, India, 2018 ISBN: 9789386873293
2.	Basic Mechanical Engineering	S. C. Sharma & M.P. Poonia	Khanna Publishing, 2018 ISBN: 9789386173331
3.	Theory of machine	R S Khurmi & J K Gupta	Eurasia Publishing House (Pvt.) Ltd. New Delhi, 2020, ISBN: 9788121925242
4.	Elements of Mechanical Engineering	Manglik, V. K.	PHI Learning Pvt. Ltd., New Delhi, 2013, ISBN: 9788120346291
5.	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing	Lan Gibson, David W. Rosen, Brent Stucker	Springer, 2010, ISBN: 9781493921133
6.	Understanding Additive manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing	Andreas Gebhardt,	Hanser Publisher, 2011 ISBN: 156990507X, 9781569905074

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
7.	Manufacturing Technology, Volume-1	P N Rao	McGraw Hill Education, 2018 ISBN-1259062570, 978-1259062575
8.	Manufacturing Technology, Volume-2	P N Rao	McGraw Hill Education, 2018 ISBN-9789353160524, 978-9353160524
9.	Internal Combustion Engines	R.P. Mathur, M.L. & Sharma	Dhanpat Rai Publications ISBN-9383182423
10.	Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution	Liza Wallach Kloski, Nick Kloski	Make Community, LLC; 2nd edition, 2021 ISBN: 9781680450200
11.	3D Printing and Design	Sabrie Soloman	Khanna Publishing House, Delhi, 2020 ISBN: 9789386173768

(b) Online Educational Resources:

- a) <https://all3dp.com/1/types-of-3d-printers-3d-printing-technology/>
- b) <https://archive.nptel.ac.in/courses/112/103/112103262/>
- c) <http://nptel.iitm.ac.in/>
- d) <https://www.khanacademy.org/>
- e) <http://learnerstv.in/>

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

(c) Others:

- 3D Printing Projects DK Children; Illustrated edition, 2017
- Lab Manuals
- Users guide
- Material science magazine
- Manufactures manual

- 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: T2425104**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain concepts of the given terms.</p> <p><i>TSO 1b.</i> Use relevant units of various quantities in the given situations.</p> <p><i>TSO 1c.</i> Explain effects of a force on the given object.</p> <p><i>TSO 1d.</i> Resolve the given single force.</p> <p><i>TSO 1e.</i> Calculate the resultant of the given force system.</p> <p><i>TSO 1f.</i> Find the resultant of the given force system using law of parallelogram</p> <p><i>TSO 1g.</i> Determine graphically the resultant of the given force system by triangle law and polygon law.</p>	<p>Unit-1.0 Mechanics and Force System</p> <p>1.1 Significance and relevance: Mechanics, applied mechanics, statics and dynamics.</p> <p>1.2 Space, time, mass, particle, body, rigid body.</p> <p>1.3 Scalar and vector quantity, Units of measurement (SI units) Fundamental units and derived units.</p> <p>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.</p> <p>1.5 Resolution of a force - Orthogonal and Non-Orthogonal components of a force, moment of a force, Avignon's Theorem.</p> <p>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.</p> <p>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.</p>	CO1, CO2
<p><i>TSO 2a.</i> Draw the free body diagram for the given condition.</p> <p><i>TSO 2b.</i> Determine unknown force in the given situation using Lami's theorem.</p> <p><i>TSO 2c.</i> Identify the types of beams required for the given situation.</p> <p><i>TSO 2d.</i> Determine reactions in the given type of beam analytically.</p> <p><i>TSO 2e.</i> Solve problems using free body diagram and Lami's theorem.</p>	<p>Unit-2.0 Static Equilibrium</p> <p>2.1 Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical conditions of equilibrium.</p> <p>2.2 Equilibrium of force systems analytically</p> <p>2.3 Lami's Theorem.</p> <p>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.</p> <p>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.</p> <p>2.6 Beam reaction for simply supported beam subjected to vertical loads only.</p>	CO1, CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 3a.</i> Calculate force of friction and coefficient of friction for the given condition or situation</p> <p><i>TSO 3b.</i> Describe the conditions for friction for the given situation.</p> <p><i>TSO 3c.</i> Identify the various forces acting on a ladder for the given conditions using free body diagram.</p> <p><i>TSO 3d.</i> Compare the value of coefficient of friction between different surfaces.</p> <p><i>TSO 3e.</i> Interpret the effect of change of masses, change of angle of inclination or both on the coefficient of friction</p> <p><i>TSO 3f.</i> Calculate forces acting on a body that is moving on a horizontal rough surface</p> <p><i>TSO 3g.</i> Determine the forces acting on a body that is moving on an inclined plane</p>	<p>Unit 3.0 Friction</p> <p>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.</p> <p>3.2 Equilibrium of bodies on level surface subjected to force parallel and</p> <p>3.3 inclined to plane.</p> <p>3.4 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. FBD of ladder in friction</p>	<p>CO3, CO4</p>
<p><i>TSO 4a.</i> Distinguish between centroid and center of gravity</p> <p><i>TSO 4b.</i> Calculate the centroid of geometrical plane figures.</p> <p><i>TSO 4c.</i> Calculate centroid of the given composite plane lamina</p> <p><i>TSO 4d.</i> Determine centre of gravity of the given simple solid.</p> <p><i>TSO 4e.</i> Determine centre of gravity of the given composite solid.</p> <p><i>TSO 4f.</i> Calculate Moment of Inertia of different geometric shapes.</p>	<p>Unit 4.0 Centroid, Centre of Gravity and Moment of Inertia</p> <p>4.1 Introduction to Centroid, Centre of Gravity and Areas</p> <p>4.2 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle).</p> <p>4.3 Centroid of composite figures composed of not more than three geometrical figures and centroid of perforated section, axis of symmetry</p> <p>4.4 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere).</p> <p>4.5 Centre of Gravity of composite solids composed of not more than two simple solids.</p> <p>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</p>	<p>CO4</p>
<p><i>TSO.5a</i> Describe the components of the given lifting machine.</p> <p><i>TSO.5b</i> Differentiate the working principle of the given two types of lifting machines.</p> <p><i>TSO.5c</i> Determine velocity ratio, efficiency of the given lifting machine.</p> <p><i>TSO.5d</i> Calculate effort required and load lifted by the given lifting machine.</p> <p><i>TSO.5e</i> Draw the graph with the given data</p> <p><i>TSO.5f</i> Interpret the given graphs</p> <p><i>TSO.5g</i> Select the relevant lifting machine for the given purpose with justification</p>	<p>Unit-5.0 Simple Lifting Machine</p> <p>5.1 Simple lifting machine, load, effort, mechanical advantage, Applications and advantages. Velocity ratio, efficiency of machines, Law of machine.</p> <p>5.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility</p> <p>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.</p>	<p>CO2, CO5</p>

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)
<i>LSO 1.1.</i> 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
<i>LSO 2.1</i> Apply Lami's theorem <i>LSO 2.2</i> 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 <ul style="list-style-type: none"> • Beam reaction apparatus • Circular dial type weight 	
<i>LSO 3.1.</i> Apply law of friction on horizontal plane and inclined plane	5	Determine coefficient of friction on horizontal and inclined plane.	CO2, CO3
<i>LSO 3.2.</i> Coefficient of friction between different materials	6	Determine the coefficient of friction between two surfaces by <ul style="list-style-type: none"> • angle of repose methods • friction plane method 	
<i>LSO 3.3.</i> Coefficient of friction between belt and pulley.	7	Find the coefficient of friction between belt and pulley in a belt friction set up.	
<i>LSO 4.1.</i> Determine the centroid of different geometrical figures.	8	Determine the centroid of geometrical plane figures (squares, rectangle, triangle)	CO4
<i>LSO 4.2.</i> Find moment of inertia	9	Determine the moment of inertia of a fly wheel	
<i>LSO 5.1</i> Use simple screw jack <i>LSO 5.2</i> Use differential axle and wheel <i>LSO 5.3</i> Use single and double purchase crab winch <i>LSO 5.4</i> Use jib crane <i>LSO 5.5</i> 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 <ul style="list-style-type: none"> • 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 coefficient of friction between two surfaces by <ul style="list-style-type: none"> • 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 in steps 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.

- A) **Course Code** : 2400105A(T2400105A/S2400105A)
 B) **Course Title** : Applied Mathematics- A (ME, ME (Auto), CE, MIE, AE, CHE, FTS, CRE)
 C) **Prerequisite Course(s)** : Basic Engineering Mathematics
 D) **Rationale** :

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

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

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

- CO-1** Demonstrate the ability to solve engineering-related problems based on applications of integration.
CO-2 Develop the ability to use differential equations as a tool to solve problems related to engineering.
CO-3 Select a suitable method to solve nonlinear equations based on engineering applications.
CO-4 Measure the area and volume of engineering-related problems using the concept of numerical integration.
CO-5 Develop the ability to use probability distribution to solve broad-based engineering-related problems.

- F) **Suggested Course Articulation Matrix (CAM):**

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

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

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

G) Teaching & Learning Scheme:

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

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400105A	Applied Mathematics- A	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: T2400105A**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Use standard forms of integration to find the integral of given simple functions.</p> <p><i>TSO 1b.</i> Apply suitable Trigonometric transformation to solve a given Integration problem.</p> <p><i>TSO 1c.</i> Solve given problems using the properties of the definite integral.</p> <p><i>TSO 1d.</i> Invoke the concept of Integration to solve problems based on area and volume of irregular shapes.</p>	<p>Unit-1.0 Integral Calculus and its Applications</p> <p>1.1 Concept and Definition of Integration.</p> <p>1.2 Working rules and Integral of standard Functions.</p> <p>1.3 Method of Substitution, Trigonometric transformation, Integration by parts, and Partial fraction.</p> <p>1.4 Applications: Area and volume</p>	CO1
<p><i>TSO 2a.</i> Find the order and degree of given differential equations.</p> <p><i>TSO 2b.</i> Solve differential equations using the variable separable method.</p> <p><i>TSO 2c.</i> Obtain the solution of a given homogeneous differential equation.</p> <p><i>TSO 2d.</i> Solve the given linear differential equation based on engineering application.</p> <p><i>TSO 2e.</i> Solve the given Bernoulli differential equation.</p> <p><i>TSO 2f.</i> Solve the homogeneous linear differential equations of second order with constant coefficient.</p>	<p>Unit-2.0 Differential Equations</p> <p>2.1 Concept and Definition, Order, and Degree of Differential Equation.</p> <p>2.2 Differential equation of first order and first degree, variable separable Method.</p> <p>2.3 Homogeneous, linear Differential equation and Bernoulli equation.</p> <p>2.4 Homogeneous linear differential equations of second order with constant coefficient.</p>	CO2
<p><i>TSO 3a.</i> Find the root(s) of the given equation using Iterative methods up to the desired accuracy.</p> <p><i>TSO 3b.</i> Calculate the root(s) of given equations using the Newton-Raphson Method.</p> <p><i>TSO 3c.</i> Apply the Newton-Raphson Method for engineering applications.</p> <p><i>TSO 3d.</i> Solve problems using the Bakhshali iterative method for finding approximate square roots. (IKS)</p>	<p>Unit-3.0 Numerical Solution of Nonlinear Equations</p> <p>3.1 Algebraic and Transcendental equations.</p> <p>3.2 Iteration Methods.</p> <p>3.3 Newton-Raphson Method.</p> <p>3.4 Bakhshali iterative method for finding the approximate square root. (IKS)</p>	CO3
<p><i>TSO 4a.</i> Apply the concept of Numerical integration to find the area from given data by the Trapezoidal rule, also use any open source software to find the same.</p> <p><i>TSO 4b.</i> Apply the concept of Numerical integration to find the area from given data by Simpson's one-third rule, also use any open</p>	<p>Unit-4.0 Numerical Integration</p> <p>4.1 Trapezoidal rule</p> <p>4.2 Simpson's one third rule</p> <p>4.3 Simpson's three eighth rule</p>	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>source software to find the same by comparing the findings.</p> <p><i>TSO 4c.</i> Apply the concept of Numerical integration to find the area from given data by Simpson's three eight rules, and compare the obtained result with the result found by the analytical method.</p>		
<p><i>TSO 5a.</i> Select discrete and continuous probability distribution for given data.</p> <p><i>TSO 5b.</i> Solve given problems based on repeated trials using binomial distribution.</p> <p><i>TSO 5c.</i> Use suitable distribution to solve the given problems when the number of trials is large and the probability is very small.</p> <p><i>TSO 5d.</i> Utilize the concept of normal distribution to solve broad-based engineering-related problems.</p>	<p>Unit-5.0 Probability distribution</p> <p>5.1 Discrete and continuous probability distribution.</p> <p>5.2 Binomial distribution.</p> <p>5.3 Poisson's distribution.</p> <p>5.4 Normal distribution.</p>	CO5

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

K) Suggested Tutorial and Outcomes:

Outcomes	S. No.	Tutorial Titles	Relevant COs Number(s)
<p>1.1 Calculate the area of the hexagon using integration.</p> <p>1.2 Calculate the average temperature of a city over a certain period.</p> <p>1.3 Calculate the total force on the bottom of the tank due to the water.</p> <p>1.4 Estimate the amount of force required to move a component.</p> <p>1.5 Apply the concept of definite integration to find the volume.</p>	1.	<ul style="list-style-type: none"> Area of irregular shape using integration. Average value of a function using integration. Calculation of force using integration. Volume of an irregular shape using integration. 	CO1
<p>1.1 Solve population dynamics using first-order ODEs.</p> <p>1.2 Calculate the vibration of a Mechanical system using differential equations.</p> <p>1.3 Calculate the concentration of a reactant in a chemical reaction over time.</p> <p>1.4 Calculate mechanical vibrations using second-order ODEs.</p>	2.	<ul style="list-style-type: none"> Analysis of a population model through differential equations. Response of vibration of Mechanical system through differential equations. Analysis of chemical system using ODEs Vibrations of a mass-spring system. 	CO2
<p>1.1 Use Newton's method to find the roots of a non-linear equation in one variable.</p> <p>1.2 Use the concept of Newton's method to solve financial modeling-related problems based on the Black-Scholes model.</p> <p>1.3 Calculate the electric field (that satisfies Maxwell's equations) around a wire with a</p>	3.	<ul style="list-style-type: none"> Applications of iterative techniques. Application of Newton Raphson's method. Iterative scheme using Newton's method. Bakhshali iterative methods for finding the approximate value of square root. (IKS) 	CO3

Outcomes	S. No.	Tutorial Titles	Relevant COs Number(s)
given shape and current, using Newton Raphson's method. 1.4 Use Bakhshali iterative methods for finding the approximate value of the square root. (IKS)			
4.1 Use Numerical integration to determine the total quantity of Heat of given a material. 4.2 Use Simpson's 1/3rd rule to find the effective force on the mast of a racing sailboat. 4.3 Apply Numerical integration to calculate work done for a given engineering problem.	4.	<ul style="list-style-type: none"> • Calculation of Heat (Chemical/Bio Engineering based problem). • Calculation of effective force (Civil/Environment engineering). • Calculation of work done (Mechanical/Aerospace engineering-based problems). 	CO4
1.1 Use Binomial distribution to solve the problems when the trials are repeated. 1.2 Use Poisson's distribution to solve the problems when the number of trials is large and the probability is minimal. 1.3 The birth weight follows the normal distribution curve, justified through an example.	5.	<ul style="list-style-type: none"> • Applications of Binomial distribution. • Applications of Poisson's distribution. • Applications of Normal distribution. 	CO5

L) Suggested Term Work and Self-Learning: S2400105A

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

1. Calculate the flow rate of a fluid through a pipe with a given velocity profile using integration through open-source software.
2. Given the plan view of a concrete structure and the desired thickness of the concrete, calculate the area between the curves to determine the surface area of the formwork required.
3. A beam is subjected to a distributed load. The beam has a length of L and a flexural rigidity EI , where E is Young's modulus and I is the moment of Inertia of the beam cross-section. Write down the differential equations that describe the deflection of the beam and solve it to find the deflection equation.
4. Use open-source software to plot the family of curves and compute its differential equations.
5. Write down a program to compute the root of a nonlinear equation the Newton-Raphson method.
6. Write down a program to find the root of the transcendental equation by iterative method to correct up to 4 decimal places.
7. Implement Simpson's rule to approximate the definite integral of the function. Choose an appropriate number of sub-intervals and calculate the approximate value of the Integral using open-source software.
8. Use the Trapezoidal rule to estimate the Integration for a given function using open-source software.
9. Use Binomial Distribution in decision-making related to Quality control and process improvement in the manufacturing process.
10. Use Poisson distribution to calculate the number of website visitors per hour.

b. Micro Projects:

1. Prepare charts displaying various standard integration formulas.
2. Explore the use of Integral calculus to calculate the velocity and acceleration of a particle.
3. Prepare charts showing the area and volume of various geometrical shapes using Integral calculus.
4. Prepare a model showing the applications of differential equations for the rate of decay of radioactive materials.
5. Prepare a model showing the applications of differential equations for Newton's law of cooling.
6. Prepare a simulated environment to study the motion of a particle under the influence of gravity.
7. Prepare a comparative chart showing the convergence of various iterative techniques.
8. Prepare a chart consisting of 8-10 nonlinear equations made of real-world problems.
9. Download 5-7 videos based on applications of numerical integration in mechanical, civil, and auto engineering branches, watch them, and write a report to detail the mathematical steps involved.
10. Make a short video of duration 5-7 minutes for the applications of numerical integration in Chemical, Agriculture, and Ceramic engineering branches.
11. Download 5-7 videos based on engineering applications of Binomial and Poisson's distribution, watch them, and write a report to detail the mathematical steps involved.
12. Make a short video of duration 10-15 minutes on at least 7-8 engineering applications of Normal distribution.

c. Other Activities:

1. Seminar Topics:

- Applications of Integral calculus in control systems, dynamics, and vibrations.
- Applications of Integral calculus in production and cost analysis.
- Applications of Integral calculus in algorithms and optimization.
- Applications of Integral calculus in population dynamics and bio-mathematics.
- Applications of Integral calculus in filtering and feature extraction.
- Solving Differential Equations through SCILAB.
- Applications of Differential Equations in population dynamics and epidemiology.
- Differential Equations with discontinued input via Laplace Transform: Techniques and Applications.
- Applications of Numerical Methods for engineers.
- Numerical Solution of Nonlinear Equations using Root-Finding Algorithms: Techniques and Applications.
- Numerical integration and its engineering applications.
- Engineering applications of Binomial and Poisson's distribution.
- Real-life examples of Normal Distribution.
- Probability distribution and its engineering applications.

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 Science museum.
- Visit a mathematics research institute.
- Visit to a Data Science Center.
- Visit the mathematics department of a college or university.
- Visit a software company.
- Visit to a Space Agency.
- Visit to a Gaming Studio.
- Participation in mathematics competitions.

3. Self-Learning Topics:

- Participate in MOOCs on Integration Techniques and Applications.
- Participate in MOOCs on Ordinary Differential Equations: Methods and Applications.
- Participate in an Open courseware of MIT on the Newton-Raphson Method: rate of convergence.
- Watching videos on numerical integration: Concepts and Applications.
- Watching video on Probability distribution and its engineering applications.

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

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

N) Suggested Specification Table for End Semester Theory Assessment: The specification table represents the reflection of sample representation of assessment of the cognitive domain of 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 Integral Calculus and its Applications	10	CO1	11	4	4	3
Unit-2.0 Differential Equation	12	CO2	16	4	6	6
Unit-3.0 Numerical Solution of Nonlinear Equations	8	CO3	10	3	4	3
Unit-4.0 Numerical integration	8	CO4	12	4	6	2
Unit-5.0 Probability distribution	10	CO5	21	5	8	8
Total	48	-	70	20	28	22

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

O) Suggested 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, Portfolio, Learning, Role Play, Live Demonstrations in Classrooms, Labs, Field Information, and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs, etc.

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

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

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Elementary Engineering Mathematics	B. S. Grewal	Khanna Publishers, 15th Edition. ISBN: 978-81-7409-257-1
2.	Engineering Mathematics (Third edition)	Croft, Anthony	Pearson Education, New Delhi, 2014. ISBN 978-81-317-2605-1
3.	Calculus and Its Applications	Marvin L. Bittinger David J. Ellenbogen Scott A. Sargent	Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1
4.	Calculus and Analytic Geometry	G. B. Thomas, R. L. Finney	Addison Wesley, 9th Edition, 1995. ISBN 978-8174906168
5.	Understanding Engineering Mathematics	John Bird	Routledge; First Edition ISBN 978-0415662840
6.	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publ., New Delhi, 2014, ISBN: 978-0-470-45836-5
7.	Studies in the History of Indian Mathematics	C. S. Seshadri	Hindustan Book Agency (India) P 19 Green Park Extension New Delhi. ISBN 978-93-80250-06-9
8.	Mathematics-I	Deepak Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-42-4
9.	Mathematics-II	Garima Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-52-3
10.	Consider Dimension and Replace Pi	M.P. Trivedi and P.Y. Trivedi	Notion Press; 1st edition (2018), ISBN: 978-1644291795

(b) Online Educational Resources:

1. <https://ocw.mit.edu/>
2. <https://tutorial.math.lamar.edu/>
3. <https://www.khanacademy.org/>
4. <https://www.feynmanlectures.caltech.edu/>
5. <https://www.wolframalpha.com/>
6. <https://www.dplot.com/>
7. <https://www.geogebra.org/>
8. <https://www.easycalculation.com/>
9. <https://www.scilab.org/>
10. <https://www.desmos.com/>
11. <https://nptel.ac.in/>
12. <https://swayam.gov.in/>
13. <https://ndl.iitkgp.ac.in/>
14. <https://parakh.aicte-india.org/>
15. <https://ekumbh.aicte-india.org/>
16. <https://learnegg.com/LE/Index>
17. <https://ncert.nic.in/textbook.php>
18. [https://nios.ac.in/online-course-material/sr-secondary-courses/mathematics-\(311\).aspx](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.

- A) **Course Code** : 2425106(P2425106/S2425106)
- B) **Course Title** : Mechanical Workshop (CE, AE, ME, ME (Auto), MIE, CRE, CHE)
- C) **Pre- requisite Course(s)** :
- D) **Rationale:**

Mechanical Workshop is a basic practical engineering course. Knowledge of basic workshops such as wood working shops, fitting & machine shop, sheet metal shop, welding shop, black smithy and is essential for students to perform duties in industries and field agencies. This course will help the students to develop practical skills by performing various practical tasks using various hand tools, equipment and machinery in the respective shops, which will be useful in many fields like workshop, home and agriculture, construction etc. Job making in the workshop develops an attitude of teamwork and safety awareness. 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** Undertake wood working operations economically and safely.
- CO-2** Carryout fitting and turning operations properly in a given situation.
- CO-3** Perform various joining operations using welding, brazing, and soldering methods.
- CO-4** Perform various sheet metal operations as per given sketch/ drawing.
- CO-5** Undertake black smithy operations safely.

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

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2425106	Mechanical 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, field or other locations using different instructional/Implementations strategies)

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

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

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

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

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

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2425106	Mechanical 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 Unit: (Not Applicable)**

K) **Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425106**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1</i> Use relevant wood working tools and instruments as per given job.</p> <p><i>LSO 1.2</i> Undertake wood working operations like marking, cutting, planing and finishing etc.</p> <p><i>LSO 1.3</i> Prepare given wooden joints as per given sketch / drawing.</p>	1.	<p>1.1 Prepare one simple job of wood working comprises of marking, cutting, planing and finishing as per given drawing/sketch.</p> <p>1.2 Prepare any two wooden joints safely as per given drawing using suitable tools-</p> <ul style="list-style-type: none"> - Mortise joint - Dovetail joint - Half lap joint. - Cross joint - Tenon Joint - Bridle joint 	CO-1
<p><i>LSO 2.1</i> Prepare list of relevant tools, equipment, machines and measuring instruments used in fitting shop as per given situation.</p> <p><i>LSO 2.2</i> Perform marking, cutting, filing, punching, drilling, and finishing operations as per given fitting job safely.</p> <p><i>LSO 2.3</i> Select relevant single point cutting tool and associated parameters for a given turning job.</p> <p><i>LSO 2.4</i> Undertake turning operations economically and safely in a given situation</p>	2.	<p>2.1 Selection of different fitting tools, equipment, machines and measuring instruments in a given situation.</p> <p>2.2 Prepare one simple fitting job (square of 50 mm side /square of 40 mm side with 5mm drill at Centre) comprises of marking, filing, punching, drilling, and finishing as per given drawing/sketch.</p> <p>2.3 Prepare given step turning / taper turning job as per given sketch/ drawing.</p>	CO-2
<p><i>LSO 3.1</i> Select suitable joining process in a given situation.</p> <p><i>LSO 3.2</i> Use Personal Protective Equipment in welding shop.</p> <p><i>LSO 3.3</i> Perform gas welding operations in a given situation to prepare joint safely.</p> <p><i>LSO 3.4</i> Prepare given welding joint safely using arc welding in a given situation.</p> <p><i>LSO 3.5</i> Carryout soldering / brazing operation(s) as per given job.</p>	3.	<p>3.1 Prepare simple job of joining by using suitable joining process as per given sketch.</p> <p>3.2 Prepare a Butt joint / lap joint using gas welding as per given sketch / drawing safely.</p> <p>3.3 Prepare a Butt joint / lap joint by arc welding using suitable welding parameters as per given sketch / drawing economically and safely.</p> <p>3.4 Prepare simple job using soldering/ brazing operations as per given drawing.</p>	CO-3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 4.1</i> Select suitable sheet metal tools, machinery / equipment for given used as per requirements.</p> <p><i>LSO 4.2</i> Select suitable sheet metal operations in a given situation.</p> <p><i>LSO 4.3</i> Perform relevant sheet metal operations such as shearing, bending, drawing, squeezing, snipping, riveting, grooving etc. to prepare utility jobs safely as given sketch/ drawing.</p>	4.	<p>4.1 Prepare one sheet metal job using cutting, bending, edging and joining operations as per given drawing.</p> <p>4.2 Prepare a sheet metal rectangular tray of dimension of 300X100X50 mm.</p> <p>4.3 Prepare any one utility job of sheet metal using suitable sheet metal tools and operations.</p>	CO-4
<p><i>LSO 5.1</i> Select suitable black smithy tools and operations to complete jobs as per requirements.</p> <p><i>LSO 5.2</i> Perform various operations safely to prepare given black smithy job(s).</p> <p><i>LSO 5.3</i> Follow safety procedures and use personal safety equipment during black smithy.</p>	5.	<p>5.1 Selection of various black smithy tools, equipment, machines and measuring instruments used as per given situations.</p> <p>5.2 Prepare S shaped hook from given MS rod of length 220mm and diameter 6 mm in black smithy shop.</p> <p>5.3 Prepare a garden trowel, sickle, and shovel as per the instruction provided by the instructor</p>	CO-5

L) **Suggested Term Work and Self Learning: S2425106** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

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

b. Micro Projects:

1. Visit different classrooms and prepare a list of wooden joints used in sitting furniture.
2. List the various lathe operations and their applications used in machine repairing shop.
3. Visit nearby welding shop and prepare a list of welding consumables used for various types of welding.
4. Observe small agricultural equipment used nearby you and repair it.
5. Prepare a list of different types of sheets with specification available in market.

c. Other Activities:

1. Seminar Topics:

- Safety practices and use of personal safety equipment in workshops.
- Different types of machines tools and their functions used in workshops.
- Operating precautions and safety norms for various types of machine and tools in workshops

2. Visits:

- Visit any nearby machine shop / carpentry shop / fitting shops /welding shops and sheet metal workshop and prepare a report.
- Make a detailed market survey of local dealers for procurement of workshop tools, equipment machinery and raw materials.

3. Self-learning topic:

- Causes and remedies of welding defects.
- Prepare a brief proposal for making of various small agricultural equipment/machinery.
- Repairing of defective tools and machines in workshop.

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%	10%	20%	20%
CO-4	-	-	20%	20%	25%	20%	20%
CO-5	-	-	20%	20%	25%	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 Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Prepare one simple job of wood working comprises of marking, cutting, planing and finishing as per given drawing/sketch.	CO-1	50	40	10
2.	Prepare any two wooden joints safely as per given drawing using suitable tools- <ul style="list-style-type: none"> • Mortise joint • Dovetail joint • Half lap joint. • Cross joint • Tenon Joint • Bridle joint 	CO-1	40	50	10
3.	Selection of different fitting tools, equipment, machines and measuring instruments in given situation.	CO-2	60	30	10
4.	Prepare one simple fitting job (square of 50 mm side /square of 40 mm side with 5mm drill at center) comprises of marking, filing, punching, drilling and finishing as per given drawing/sketch.	CO-2	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		Viva-Voce (%)
			Performance		
			PRA* (%)	PDA** (%)	
5.	Prepare given step turning / taper turning job as per given sketch/ drawing.	CO-2	30	60	10
6.	Prepare simple job of joining by using suitable joining process as per given sketch.	CO-3	60	30	10
7.	Prepare a Butt joint / lap joint using gas welding as per given sketch / drawing safely.	CO-3	40	50	10
8.	Prepare a Butt joint / lap joint by arc welding using suitable welding parameters as per given sketch / drawing economically and safely.	CO-3	40	50	10
9.	Prepare simple job using soldering/ brazing operations as per given drawing.	CO-3	30	60	10
10.	Prepare one sheet metal job using cutting, bending, edging and joining operations as per given drawing.	CO-4	50	40	10
11.	Prepare a sheet metal rectangular tray of dimension of 300X100X50 mm.	CO-4	30	60	10
12.	Prepare any one utility job of sheet metal using suitable sheet metal tools and operations.	CO-4	30	60	10
13.	Selection of various black smithy tools, equipment, machines and measuring instruments used as per given situations.	CO-5	60	30	10
14.	Prepare S shaped hook from given MS rod of length 220mm and diameter 6 mm in black smithy shop.	CO-5	30	60	10
15.	Prepare a garden trowel, sickle, and shovel as per the instruction provided by the instructor.	CO-5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical 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.	Lathe machine	Capacity Light Duty Heavy Duty Height of center 165 mm 254 mm Swing Over Bed 325 mm 490 mm Swing Over Cross Slide 175 mm 290 mm Movement of Cross Slide 225 mm 300 mm Swing in gap 500mm 800 mm With suitable motor drive with all accessories.	All
2.	Drilling machine	Up to 15 mm drill cap with 1 HP motor 1000mm height	1,2

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
3.	Wood working tools	Marking and measuring tools, saw, claw hammer, mallet, chisels, planers, squares	1,2
4.	vice	Carpentry vice 200 mm, bench vice 100mm, pipe vice 100 mm	1,2,3,4,5,6,7,8,9,10,11
5.	Work benches	Size 2000x1000x750 mm	1,2,3,4,5,6,7,8
6.	Fitting tools	Ball pen Hammers(500g), cross pean hammer, chisels, files, hacksaw, surface plate, punch, v block, angle plate, try square, marking block, steel rule, twist drills, reamers, tap set, die set of suitable sizes	3,4,5
7.	Surface plate	600x900 mm grade I	All
8	Welding machine	20 KV, 400 A Welding current, welding cable 400 amp, with all accessories	6,7,8
9	Soldering and brazing equipment	Solder. Soldering iron (35 W) soldering wick, magnifying glass, wire cutters, brazing torch, aluminum brazing rod,	9
10	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
11	Arc welding and hand tools	Electrode holder, cable connector, chipping hammer, earthing clamp, wire brush.	6,7,8
12	Sheet bending and cutting machine	Mild steel automatic metal sheet bending machine (size 0.5 mm-20 mm X 1000 mm -6300 mm), compound saw (blade diameter 305 mm, power consumption 1520 W, 4000 RPM)	10,11,12
13	Sheet metal and hand tools	Snip, shears sheet gauge, straight edge, L/T square scribe, divider trammel, punches, pliers, stakes, groovers, limit set	10,11,12
14	Black smithy tools and equipment	Anvil (WEIGHT-167 lbs, horn-73/4", face length-10", rear-71/2"), hammer (double face sledge hammer 10 kg), scaling hammer, chipping hammer, tongs (500g ,flat nose size 15 inch) open hearth ,air blower (60 hp capacity 40000 m3/hr.), swage block (14X14X5 inch material iron)	13,14,15
15	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	R. K. Rajput	Laxmi Publications, New Delhi ISBN: 978-9380856650
2.	Workshop practice	Bawa,H.S	McGraw Hill Education, Noida ISBN:978-0070671195
3.	Engineering Workshop Practice	A.K. Sarathe	Khanna Book Publishing Co.(P) LTD. New Delhi ISBN:978-93-91505-51-6
3.	A textbook of workshop Technology.	R.S. Khurmi and J.K. GUPTA	S.Chand and Co. New Delhi ISBN:9788121908689
4.	Manufacturing Technology Volume-01	P.N. Rao	McGraw Hill Education, Noida ISBN-9789353160500

(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. **Fitting tools:** <https://www.youtube.com/watch?v=jbRgJblGAWc>
4. **V -fitting:** https://www.youtube.com/watch?v=iDJ_sMvXsYs
5. **Square -fitting:** <https://www.youtube.com/watch?v=NHLpRgLGEO>
6. **Lathe and its parts:** <https://www.youtube.com/watch?v=LtMJonWHKyU>
7. **Lathe operation:** <https://www.youtube.com/watch?v=hheFVuUBpxo&t=235s>
8. **Classification of welding joints:** https://www.youtube.com/watch?v=cQEUJnMYf_U
9. **Gas welding:** <https://www.youtube.com/watch?v=-SA4D098u-Q>
10. **Arc welding:** <https://youtu.be/5hRgwnejWPs>
11. **Soldering and brazing:** <https://www.youtube.com/watch?v=fnEFuzeM8cc>
12. **Sheet metal working:** <https://www.youtube.com/watch?v=KFdoAYvU4SI>
13. **Sheet metal working:** <https://www.youtube.com/watch?v=k8VskWhx0AY>
14. **Sheet metal work:** <https://www.youtube.com/watch?v=fNB1sunQ66g>
15. **Black smithy tools:** <https://www.youtube.com/watch?v=O3xyNWHxQN8>
16. **Black smithy operation:** <https://www.youtube.com/watch?v=uYvgBwP-1nY>

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

(c) Others:

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

- A) **Course Code** : 2400111(T2400111)
 B) **Course Title** : Principles of Management
 (CE, AIML, AE, CHE, CSE, ME (Auto), FTS, MIE)
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

The course is designed to provide students with an overview of the management functions and its role in organizations and society. The course aims to provide students with the basic managerial knowledge necessary for engineering students in the world of work. The course focuses on providing students with analytical, developmental, managerial, and technical skills that relate to managerial positions in organizations. This course is an introduction to the critical management skills involved in planning, organizing, controlling, leading and decision making in an organization. It provides a framework for understanding issues involved in both managing and being managed, and it will help you to be a more effective contributor to organizations that you join.

- 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** Design strategic plan for various types of organizations.
CO-2 Take decisions to handle world of work situations.
CO-3 Formulate organizational hierarchy for different situations.
CO-4 Identify various leadership styles.

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

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)				
		Classroom Instruction (CI)		Notional Hours (TW/ Activities+ SL)	Total Hours (CI+TW/ Activities)	Total Credits (C)
		L	T			
2400111	Principles of Management	01	-	-	01	01

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)	
2400111	Principles Of Management	25	-	-	-	-	-	25

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: T2400111

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the nature of management</p> <p><i>TSO 1b.</i> List the steps of evolution of management.</p> <p><i>TSO 1c.</i> Differentiate between different plans.</p> <p><i>TSO 1d.</i> Design Strategic plan for the given world of work situation.</p> <p><i>TSO 1e.</i> Take decisions in the given situation with justification.</p>	<p>Unit-1.0 Introduction to Management and Planning</p> <p>1.1 Nature and Purpose.</p> <p>1.2 Evolution of Management Thoughts.</p> <p>1.3 System approach to Management Process.</p> <p>1.4 Types of Plans: Missions or Purpose, Objective or Goals, Strategies, Policies, Procedures.</p> <p>1.5 Decision Making.</p>	CO1, CO2
<p><i>TSO 2a.</i> Differentiate formal and informal organizations.</p> <p><i>TSO 2b.</i> Identify the levels of hierarchy in the given organization.</p> <p><i>TSO 2c.</i> List the staffing principles.</p>	<p>Unit-2.0 Organizing and Staffing</p> <p>2.1 Nature of Organizing</p> <p>2.2 Formal and Informal Organization</p> <p>2.3 Principles of Organizing, Organizational Hierarchy, Authority, and Power.</p> <p>2.4 Staffing, Recruitment, Selection, Performance Appraisal.</p>	CO3
<p><i>TSO 3a.</i> Explain the theories of motivation</p> <p><i>TSO 3b.</i> Differentiate between leadership styles</p>	<p>Unit-3.0 Motivation and Leadership</p> <p>3.1 Motivation</p> <p>3.2 McGregor Theory of X and Y</p> <p>3.3 Maslow Hierarchy of Needs Theory</p> <p>3.4 Herzberg's Motivation- Hygiene Theory</p> <p>3.5 Leadership: Definition, Ingredients, Styles, theories</p>	CO4

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

K) Suggested Term Work and Self Learning: 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.

- Describe about adopting the systems approach in any organization.
- Write in brief about grapevine communication.
- Compare the traits Theory of X and Y as proposed by McGregor

b. **Micro Projects:**

- Apply Maslow's need hierarchy theory in workplace.

c. **Other Activities:**

1. Seminar Topics:

- Importance of management theories in the corporates.
- The hierarchy levels create smoothness in functioning of any organization.
- Leadership practices that are popular in current scenario.

2. Visits:

- Visit nearby corporate setup and report
- Interview leaders in the organization and identify leadership style'

3. Self-Learning Topics:

- Herzberg's Motivation- Hygiene Theory
- Leadership theories
- Motivation for efficient productivity

L) 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.

M) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

N) Suggested Learning Resources:

(a) **Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fundamentals of Management: Essential Concepts and Applications	Robbins S.P. and DeCenzo David A	Pearson Education
2.	Koontz Essentials of Management	Koontz	Tata McGraw Hill Latest Edition
4.	Principles and Practices of Management	Shejwalkar and Ghanekar	Tata McGraw Hill Latest Edition
5.	Fundamentals of Management	Robbins and Dinzo	2002, Pearson India.
6.	Organization Theory, Structure, Design and Application	Stephen P. Robbins	PHI, New Delhi, 2005

(b) Online Educational Resources:

1. <https://www.coursera.org/learn/principles-of-management>
2. <https://alison.com/course/an-introduction-to-the-principles-of-management>
3. <https://www.udemy.com/course/principles-of-management-j/>
4. <https://lumenlearning.com/courses/principles-of-management/>
5. <https://www.mygreatlearning.com/academy/learn-for-free/courses/principles-of-management>
6. <https://onlineprogrammes.insead.edu/leadership-programme-for-senior-executives>
7. implilearn.com/general-management-certification-training-course?utm_source=google&utm_medium=cpc&utm_term
8. <https://discovery.ucl.ac.uk/id/eprint/10115948/1/Educational-Resource-Management.pdf>
9. <https://libraries.etsu.edu/research/guides/management/oer>
10. <https://www.cmu.edu/teaching/designteach/syllabus/checklist/learningresources.html>

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

(c) Others: -