# Curriculum of Diploma Programme

# in

# Fire Technology Engineering

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

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

# Semester – I

## Teaching & Learning Scheme

| Course Codes | Category of course | CourseTitles | Teaching & Learning Scheme (Hours/Week) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Classroom Instruction (CI) | | Lab Instruction (LI) | Notional Hours (TW+ SL) | Total Hours (CI+LI+TW+SL) | Total Credits (C) |
| | | | L | T | | | | |
| **2448101** | **PCC** | **Occupational Health, Hygiene & Safety** | 02 | 01 | - | 02 | 05 | 04 |
| **2400102A** | **ASC** | **Applied Physics -A** (CE, ME, ME (Auto), MIE, AE, FTS, CRE, CHE) | 03 | - | 04 | 02 | 09 | 06 |
| **2400103A** | **ASC** | **Applied Chemistry -A** (ME, ME (Auto), CE, MIE, AE, CHE, FTS, CRE) | 03 | - | 04 | 02 | 09 | 06 |
| **2400104** | **HSC** | **Communication Skills (English)** (Common for all Programmes) | 03 | - | 04 | 02 | 09 | 06 |
| **2400105A** | **ASC** | **Applied Mathematics -A** (ME, ME (Auto), CE, MIE, AE, CHE, FTS, CRE) | 02 | 01 | - | 02 | 05 | 04 |
| **2415105** | **BEC** | **Engg. Drawing & Graphics** (MIE, AE, CRE, CE, CHE, FTS, TE, EE, ELX, ELX (R)) | - | - | 04 | 02 | 06 | 03 |
| **2400009** | **NRC** | **Open Educational Resources** (FTS, CHE, CSE, EE, ME, ME (Auto), MIE, ELX, AIML, CRE, CACDDM, AE, CE, ELX (R), GT) | 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 - I
## Assessment Scheme

| Course Codes | Category of Course | Course Titles | Assessment Scheme (Marks) | | | | | | Total Marks (TA+TWA+LA) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Theory Assessment (TA) | | Term work & Self-Learning Assessment (TWA) | | Lab Assessment(LA) | | |
| | | | Progressive Theory Assessment (PTA) | End Theory Assessment (ETA) | Internal | External | Progressive Lab Assessment (PLA) | End Laboratory Assessment (ELA) | |
| **2448101** | **PCC** | **Occupational Health, Hygiene & Safety** | 30 | 70 | 25 | - | - | - | 125 |
| **2400102A** | **ASC** | **Applied Physics -A** (CE, ME, ME (Auto), MIE, AE, FTS, CRE, CHE) | 30 | 70 | 20 | 30 | 20 | 30 | 200 |
| **2400103A** | **ASC** | **Applied Chemistry -A** (ME, ME (Auto), CE, MIE, AE, CHE, FTS, CRE) | 30 | 70 | 20 | 30 | 20 | 30 | 200 |
| **2400104** | **HSC** | **Communication Skills (English)** (Common for all Programmes) | 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 |
| **2415105** | **BEC** | **Engg. Drawing & Graphics** (MIE, AE, CRE, CE, CHE, FTS, TE, EE, ELX, ELX (R)) | - | - | 20 | 30 | 20 | 30 | 100 |
| **2400009** | **NRC** | **Open Educational Resources** | 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 : 2448101 (T2448101/S2448101)**
**B) Course Title :** Occupational Health, Hygiene & Safety
**C) Pre- requisite Course(s) :**
**D) Rationale :**

Industrial or Occupational health, hygiene and safety is concerned with identifying, managing as well as and controlling real or potential workplace environmental hazards that can affect the wellbeing and safety of workers and peoples at work. The role of fire technicians is to anticipate health and safety concerns and provide solutions to prevent and control at the quickest possible. Proper Housekeeping is one of important aspect of health and hygiene.

This course is designed to provide a clear and concise account of the principles and practices of occupational health safety and hygiene, and it is primarily suitable for students of diploma in Fire Technology and Safety .

**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** Identify the occupational health safety and hygiene hazards in workplaces
- **CO-2** Evaluate of Occupational Health Safety and Hygiene Hazards
- **CO-3** **A**ct responsibly to prevention and Control of Occupational Health safety and Hygiene Hazards and safe working environment
- **CO-4** Perform Maintenance of required housekeeping at workplace
- **CO-5** Enforce Safety, health and welfare Act & regulation at work place /construction site

## F) Suggested Course Articulation Matrix (CAM):

| Course Outcomes (COs) | Programme Outcomes(POs) | | | | | | | Programme Specific Outcomes* (PSOs) | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO-1** Basic and Discipline Specific Knowledge | **PO-2** Problem Analysis | **PO-3** Design/ Developmentof Solutions | **PO-4** Engineering Tools | **PO-5** Engineering Practices for Society, Sustainability and Environment | **PO-6** Project Management | **PO-7** Life Long Learning | **PSO-1** | **PSO-2** |
| **CO-1** | 3 | - | 3 | 2 | - | - | 2 | | |
| **CO-2** | 3 | 2 | - | 2 | - | - | - | | |
| **CO-3** | 3 | 3 | - | 2 | 3 | - | - | | |
| **CO-4** | 3 | 3 | - | 2 | - | - | - | | |
| **CO-5** | 3 | - | 3 | 3 | - | 3 | 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 | | | | |
| 2448101 | Occupational Health, Hygiene & Safety | 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)

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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) | |
| 2448101 | Occupational Health, Hygiene & Safety | 30 | 70 | 25 | - | - | - | 125 |

**Legend:**

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

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

## J) Theory Session Outcomes (TSOs) and Units: T2448101

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO 1a.* Enlist the occupational diseases<br>*TSO 1b.* Develop awareness about health and hygiene requirement at industry and workplace<br>*TSO 1c.* Take measures to control and prevent dieses at work place<br>*TSO 1d.* Ensure medical examinations of workers<br>*TSO 1e.* Assess occupational hygiene parameters<br>*TSO 1f.* Distinguish between hygiene and health parametric conditions of industrial occupation | **Unit-1.0 Occupational Health & Hygiene**<br>1.1 Common occupational & Job-related diseases such as silicosis, asbestosis,<br>1.2 Methods of prevention of occupational diseases. Compensation of occupational diseases. Occupational dermatitis,<br>1.3 Medical examination of workers, occupational health center, health records,<br>1.4 Occupational hygiene parameters<br>1.5 Hygiene Health hazards, control and preventions<br>1.6 Difference between industrial hygiene and occupational health | **CO1** |
| *TSO 2a.* Explain the given STL interface terminology.<br>*TSO 2b.* foster a safe and healthy occupational environment<br>*TSO 2c.* Generate STL file for the given CAD file.<br>*TSO 2d.* Give reasons od unsafe working condition in industry | **Unit-2.0 Occupational Health Safety**<br>2.1 Scope of occupational health and safety (OHS)<br>2.2 Health associated risk factors,<br>2.3 Physical, mental and social well-being of workers in all occupations<br>2.4 Unhealthy or unsafe working conditions in industries /factories | **CO1, CO2** |
| *TSO 3a.* Explain the prevention and control methods of Occupational Hygiene<br>*TSO 3b.* Enlist the personal Protecting Equipment<br>*TSO 3c.* Eliminate hazards at early developmental stage<br>*TSO 3d.* Ensure sanitary facilities as per standard requirements | **Unit-3.0 Prevention &Control of Occupational Hygiene & Safety Hazards**<br>3.1 Prevention and control methods<br>3.2 Types of PPE<br>3.3 Emergency action plan<br>3.4 Safety committee roles and functions<br>3.5 Level of prevention of hazards | **CO3, CO4** |
| *TSO 4a.* Identify the indicators of maintaining housekeeping in the workplace<br>*TSO 4b.* Prepare Standard Operating Procedures for maintaining good housekeeping at work place<br>*TSO 4c.* Explain the necessity of ventilations to maintain comfort and . | **Unit-4.0 Good Housekeeping and Maintenance**<br>4.1 Housekeeping principles and procedures<br>4.2 Physiology and comfort level<br>4.3 Ventilation systems | **CO3, CO4** |
| *TSO 5a.* Follow the safety norms set for fire control<br>*TSO 5b.* Use safety devices as per the health maintenance protocol<br>*TSO 5c.* Explain the community welfare act in case fire hazardous<br>*TSO 5d.* General safety facilities in construction sites - Interface between civil & erection works - Construction Safety – Contractors Safety | **Unit-5.0 Safety, Health and Welfare Act & Regulation**<br>5.1 General Safety Provision<br>5.2 Community Health maintenance act<br>5.3 Fire safety regulation<br>5.4 Normal safety and health maintenance at construction site | **CO4, 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) |
|---|---|---|---|
| 1.1 Enlist common disease in the industry workers | 1. | Diagnose common occupational & job-related diseases | CO1 |
| 2.1 Analyze risk factors for health of workers | 2. | Measure health associated risk factors | CO2 |
| 3.1 Perform examination to maintain the record the industry worker | 3. | Carryout medical examination of workers, occupational health center, health records | CO2, CO3 |
| 4.1 Use PPE at right time for observing safety | 4. | Perform demonstration of use PPE used in fire safety | CO3 |
| 1.1 Use the SOP of House keeping | 5. | Demonstrate good housekeeping at work place | CO3, CO4, CO5 |
| 6.1 Ensure safety at work place | 6. | Prepare a flow chart on safety at a workplace | CO3, CO4, CO5 |
| 1.1 Ensure safety in case of fire breakout s | 7. | Develop emergency exit plan for fire safety | CO4, CO5 |
| 8.1 Develop skills for preventing fire appropriate | 8. | Carry out drill for safety against fire as standard/ regulation | CO3, CO4, CO5 |

**L)** **Suggested Term Work and Self Learning: S2448101** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

**a. Assignments**: Preparing drill exercise for event of fire at work place

**b. Micro Projects:**

1. Develop fire audit check list
2. Workout the possible losses due to fire in industry
3. Develop norms for maintaining health safety at work place

**c. Other Activities:**

Visit fire station to develop the list of PPE

1. Seminar Topics:
   - Fire regulation in high rise buildings.
   - Hygiene & Safety Hazards in smart city
2. Visits: Visit fire station
3. Self-Learning Topics:
   - Emergency exit plan in fire outbreak
   - Workers health and Hygiene as per fire act and regulations

**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% | 15% | 15% | - | - | - | - |
| **CO-2** | 10% | 15% | 10% | 25% | - | - | - |
| **CO-3** | 15% | 15% | 15% | 25% | 33% | - | - |
| **CO-4** | 30% | 25% | 30% | 25% | 33% | - | - |
| **CO-5** | 30% | 30% | 30% | 25% | 34% | - | - |
| **Total Marks** | **30** | **70** | **20** | **20** | **10** | **20** | **30** |
| | | | **50** | | | | |

**Legend:**

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

**Note:**

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

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

| Unit Title and Number | Total Classroom Instruction (Cl) Hours | Relevant COs Number(s) | Total Marks | ETA (Marks) | | |
|---|---|---|---|---|---|---|
| | | | | Remember (R) | Understanding (U) | Application & above (A) |
| **Unit-1.0** Occupational health & hygiene | 8 | CO1 | 10 | 3 | 3 | 4 |
| **Unit-2.0** Occupational Health Safety | 8 | CO1, CO2 | 10 | 3 | 2 | 5 |
| **Unit-3.0** Prevention &Control of Occupational Hygiene & Safety Hazards | 8 | CO3, CO4 | 10 | 5 | 2 | 3 |
| **Unit-4.0** Good Housekeeping and Maintenance | 12 | CO3, CO4 | 20 | 5 | 6 | 9 |
| **Unit-5.0** Safety, health and welfare Act & regulation | 12 | CO4, CO5 | 20 | 4 | 6 | 10 |
| **Total** | **48** | **-** | **70** | **20** | **19** | **31** |

**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. | ILO List of Occupational Diseases (revised 2010) | Diagnostic and exposure criteria for occupational diseases - Guidance notes for diagnosis and prevention of the diseases in the | 1 |
| 2. | WHO health risk factors list | Determinants of Health, Health Risk, and Health Hazard Factors | 2 |
| 3. | Health Examination Card | medical examination and health record as cards developed by medical agencies | 2, 3 |
| 4. | Fire safety PPE Kit | Fire Safety Kit with Fire Blanket, Heat Resistant Gloves, Escape Rope, Glass Hammer, Glow Sticks, Flashlight, First Aid Supplies with Burn Injury Care Treatment and More | 4 |
| 5. | Housekeeping material | Housekeeping Material List & Cleaning Products List \| Amazon ...<br>Housekeeping materials list – All-Purpose Cleaner<br>Abrasive Cleaners.<br>Non-Abrasive Cleaner.<br>Drain Openers.<br>Multi-Surface Cleaners.<br>Hard Water Mineral Removers. | 5, 7 |
| 6. | Health and Safety Process Flow Chart Template | health-safety at work place - Personalized it with modern colors, bold text | 6 |
| 7. | Housekeepers' SOPs | **set of checklists** of the cleaning process as per requirement | 5, 7 |

## R) Suggested Learning Resources:

**(a) Books**:

| S. No. | Titles | Author(s) | Publisher and Edition with ISBN |
|---|---|---|---|
| 1. | Occupational Health and Hygiene in Industry | SK. Haldar | CBS Publishers & Distributors<br>ISBN 9789354664922 |
| 2. | Textbook of Occupational Health | Jugal Kishore Ranabir Pal , Sumeet dixit , Amrita Ghosh | CBS Publishers & Distributors Pvt Ltd, 2022)<br>ISBN-10 : 9390709679 |
| 3. | Industrial Safety Management: Safety, Health & Environment Management Paperback – 18 | Pravin M. Pathak & Jayant P. Khairnar (Author) | Notion Press Media Pvt Ltd Notion Press; 1st edition 2022<br>ISBN-13 : 979-8886676044 |
| 4. | Handbook of Occupational Safety And Health | Koradecka, | T&F India<br>ISBN 9780367270315 |

**(b) Online Educational Resources:**

1. https://youtu.be/Zps9ttCgj1I
2. https://youtu.be/vbmcWz92nyc
3. https://youtu.be/E94UBndA58s

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

**(c) Others:**

1. https://youtu.be/n7oUOUCIblg
2. https://youtu.be/ANiJU50JgbM
3. https://youtu.be/_mFZWmSiPHA
4. https://youtu.be/0k7GPWBoCa0

******

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

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

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

**D) Rationale :**

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

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

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

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

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

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

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

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

## F) Suggested Course Articulation Matrix (CAM):

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

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

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

## G) Teaching & Learning Scheme:

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| | | L | T | | | | |
| **2400102A** | Applied Physics- A | 03 | - | 04 | 02 | 09 | 06 |

**Legend:**

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## H) Assessment Scheme:

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**Legend:**

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## J) Theory Session Outcomes (TSOs) and Units: T2400102A

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO 1a.* Distinguish between fundamental and derived physical quantity.<br>*TSO 1b.* Estimate the errors in the measurement of given physical quantity.<br>*TSO 1c.* Derive dimensional formula of a given physical quantity.<br>*TSO 1d.* Apply dimensional analysis for inter conversion of units.<br>*TSO 1e.* Establish relation between physical quantities using dimensional analysis.<br>*TSO 1f.* Use dimensional analysis to check the correctness of a given equation. | **Unit-1.0 Unit and Measurements**<br>1.1 Physical quantities, fundamentals and derived units and system of units<br>1.2 Accuracy, precision and errors (systematic and random) in measurements, Method of estimation of errors (absolute and relative) in measurement, propagation of errors, significant figures<br>1.3 Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimension in an equation<br>1.4 Applications of dimensions: conversion from one system of units to other, corrections of equations and derivation of simple equations<br>1.5 Ancient astronomical instruments: Chakra, Dhanuryatra , Yasti and Phalaka yantra . (IKS) | **CO1** |
| *TSO 2a.* Explain circular motion and various terms related to circular motion.<br>*TSO 2b.* Apply the concept of centripetal and centrifugal forces in a given situation.<br>*TSO 2c.* Distinguish between translational and rotational motion.<br>*TSO 2d.* Explain the terms torque and angular momentum.<br>*TSO 2e.* Apply the principle of conservation of angular momentum in a given situation.<br>*TSO 2f.* Find the moment of inertia of a given regular shape body. | **Unit-2.0 Circular and Rotational Motion**<br>2.1 Circular motion, angular displacement, angular velocity, frequency, time period, angular acceleration, relation between angular & linear velocity, linear acceleration & angular acceleration<br>2.2 Centripetal and centrifugal forces: banking of roads and bending of cyclist<br>2.3 Translational and rotational motion, torque and angular momentum, conservation of angular momentum and its applications<br>2.4 Moment of inertia and its physical significances, radius of gyration of rigid body, theorem of parallel and perpendicular axes (statements only), moment of inertia of rod, ring, disc and sphere (hollow and solid) | **CO2** |
| *TSO 3a.* Explain the stress-strain curve of a given elastic or plastic body.<br>*TSO 3b.* Interrelate different coefficient of elasticity.<br>*TSO 3c.* Apply the concepts of surface tension and viscosity to solve a given engineering problem.<br>*TSO 3d.* Explain the behavior of given fluids on the basis of their viscosity.<br>*TSO 3e.* Determine the various modes heat transfer in a given engineering problem.<br>*TSO 3f.* Establish relation between coefficients of thermal expansion. | **Unit-3.0 Physical Properties of Matter and Heat**<br>3.1 Elasticity: Hooke's law, Coefficient of elasticity; Young's modulus, Bulk Modulus and modulus of rigidity and their inter-relation (No derivation), Poisson's ratio, stress-strain curve, elastic potential energy<br>3.2 Surface tension: Intermolecular Force, cohesive and adhesive forces, Surface Tension, Surface Energy, angle of contact, Ascent formula (No derivation), applications of surface tension, capillary action, effect of temperature and impurity on surface tension<br>3.3 Viscosity: Fluid, Viscosity and coefficient of viscosity, Critical Velocity, Reynold's number, streamline and turbulent flow, Terminal | **CO3** |

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| | velocity, Stokes law and effect of temperature on viscosity.<br>3.4 Heat: Concept of Heat and Temperature and it's difference, modes of heat transfer: conduction, convection, radiation, coefficient of thermal conductivity, thermal expansion of solid, liquid and gas, coefficient of linear, surface and cubical expansions and relation amongst them. | |
| *TSO 4a.* Differentiate among periodic, oscillatory and simple harmonic motion.<br>*TSO 4b.* Explain the various terms related to SHM.<br>*TSO 4c.* Derive the expression for time period of given Bar pendulum.<br>*TSO 4d.* Distinguish between mechanical and electromagnetic waves with examples<br>*TSO 4e.* Differentiate between longitudinal and transverse waves with examples<br>*TSO 4f.* Find the relation between the terms used to describe wave motion.<br>*TSO 4g.* Explain the principle of Superposition of waves and beat formation with examples. | **Unit-4.0 Simple Harmonic Motion and Wave Motion**<br>4.1 Periodic and Oscillatory Motion<br>4.2 Simple Harmonic Motion (SHM): Displacement, Amplitude, phase, velocity, acceleration, time period, frequency and their interrelation, Conservation of energy in SHM, Compound pendulum: Bar pendulum<br>4.3 Types of waves: Mechanical and Electromagnetic waves, Transverse and longitudinal waves, wave velocity, frequency and wave length and their relationship, wave equation, amplitude, phase, phase difference, superposition of waves, Beats formation | **CO4** |
| *TSO 5a.* Apply the concept of photoelectric effect to explain the of photonic devices.<br>*TSO 5b.* Explain Laser, components of laser and its various engineering applications.<br>*TSO 5c.* Explain propagation of light in optical fiber and its engineering applications.<br>*TSO 5d.* Describe the properties of nanomaterials and its various applications. | **Unit-5.0 Modern Physics**<br>5.1 Photoelectric effect; Photon, threshold frequency, work function, Stopping Potential, Einstein's photoelectric equation.<br>5.2 Lasers: Properties, Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, types of lasers: Ruby laser, He-Ne Laser, engineering and medical applications of lasers.<br>5.3 Optical fibers: Total internal reflection, acceptance angle and numerical aperture, Optical fiber types, applications of optical fibers<br>5.4 Nanotechnology: Properties (optical, magnetic and dielectric properties) of Nanomaterials and its application, Metallic, Bhasma (Ancient Ayurveda, IKS) (IKS) | **CO5** |

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

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

| Practical/Lab Session Outcomes (LSOs) | S. No. | Laboratory Experiment/Practical Titles | Relevant COs Number(s) |
|---|---|---|---|
| *LSO 1.1.* Use Vernier caliper to measure the known and unknown dimensions of a given small object.<br>*LSO 1.2.* Estimate the mean absolute error up to two significant figures. | 1. | Vernier caliper | CO1 |
| *LSO 2.1.* Use screw gauge to measure the diameter/ thickness of a given object.<br>*LSO 2.2.* Estimate the mean absolute, relative and percentage errors up to three significant figures. | 2. | Screw gauge | CO1 |
| *LSO 3.1.* Use Spherometer to measure radius of curvature of given convex and concave mirror/surface.<br>*LSO 3.2.* Estimate errors in the measurement. | 3. | Spherometer | CO1 |
| *LSO 4.1.* Determine the spring constant of a given spring. | 4. | Spring Oscillator | CO4 |
| *LSO 5.1.* Determine the time period of oscillation of given bar pendulum.<br>*LSO 5.2.* Determine the radius of gyration and moment of inertia about an axis perpendicular to the plane of oscillation and passing through its center of mass of given bar pendulum. | 5. | Bar Pendulum | CO2, CO4 |
| *LSO 6.1.* Find the moment of inertia of a given flywheel | 6 | Fly wheel | CO2 |
| *LSO 7.1.* Determine the coefficient of linear expansion of material of a given rod. | 7 | Pullingger's apparatus | CO3 |
| *LSO 8.1.* Use Searle's apparatus to determine the Young's modulus of a given wire. | 8 | Searle's apparatus | CO3 |
| *LSO 9.1.* Apply Stokes law to determine the coefficient of viscosity of a given viscous liquid. | 9 | Stokes law | CO3 |
| *LSO 10.1.* Determine the inverse square law relation between the distance of photocell and light source v/s intensity of light source. | 10 | Photo-electric cell experiment | CO5 |
| *LSO 11.1.* Determine the Numerical Aperture (NA) of a given step index optical fiber. | 11 | Numerical Aperture of an optical fiber | CO5 |
| LSO 12.1 Measure wavelength of a He-Ne/diode laser by using a plane diffraction grating. | 12 | He-Ne/diode laser | CO5 |
| LSO 13.1 Plot the graph between KE of Photo electron v/s frequency of incident light<br>LSO 13.2 Determine the value of Plank's Constant (*h*) from the graph between KE v/s frequency of incident light.<br>LSO 13.3 Determine the variation of stopping potential w.r.t frequency of incident photon | 13 | Photo electric effect (virtual lab experiment) | CO5 |

| Practical/Lab Session Outcomes (LSOs) | S. No. | Laboratory Experiment/Practical Titles | Relevant COs Number(s) |
|---|---|---|---|
| LSO 14.1 Determine the wave length of different spectral lines of Hydrogen spectra | 14 | Emission Spectra of Hydrogen (virtual lab experiment) | CO5 |

**L) Suggested Term Work and Self Learning: S2400102A** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

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

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

**b. Micro Projects:**

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

**c. Other Activities:**

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

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

3. Self-Learning Topics:

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

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

| COs | Course Evaluation Matrix | | | | | | |
|---|---|---|---|---|---|---|---|
| | Theory Assessment (TA)** | | Term Work Assessment (TWA) | | | Lab Assessment (LA)# | |
| | Progressive Theory Assessment (PTA) Class/Mid Sem Test | End Theory Assessment (ETA) | Term Work & Self Learning Assessment | | | Progressive Lab Assessment (PLA) | End Laboratory Assessment (ELA) |
| | | | Assignments | Micro Projects | Other Activities* | | |
| **CO-1** | 12% | 12% | 20% | 20% | 10% | 30% | 20% |
| **CO-2** | 18% | 18% | 20% | 20% | 10% | 10% | 20% |
| **CO-3** | 30% | 30% | 30% | 20% | 30% | 30% | 20% |
| **CO-4** | 15% | 15% | 15% | 20% | 20% | 10% | 20% |
| **CO-5** | 25% | 25% | 15% | 20% | 30% | 20% | 20% |
| **Total Marks** | **30** | **70** | **20** | **20** | **10** | **20** | **30** |
| | | | **50** | | | | |

**Legend:**

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

**Note:**

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

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

| Unit Title and Number | Total Classroom Instruction (Cl) Hours | Relevant COs Number(s) | Total Marks | ETA (Marks) | | |
|---|---|---|---|---|---|---|
| | | | | Remember (R) | Understanding (U) | Application & above (A) |
| **Unit-1.0** Unit and Measurements | 6 | CO1 | 8 | 4 | 2 | 2 |
| **Unit-2.0** Circular and Rotational motion | 10 | CO2 | 12 | 4 | 4 | 4 |
| **Unit-3.0** Physical Properties of Matter and Heat | 12 | CO3 | 20 | 4 | 8 | 8 |
| **Unit-4.0** Simple Harmonic motion and Wave Motion | 8 | CO4 | 12 | 2 | 4 | 6 |
| **Unit-5.0** Modern Physics | 12 | CO5 | 18 | 6 | 6 | 6 |
| **Total** | **48** | **-** | **70** | **20** | **24** | **26** |

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

## O) Suggested Assessment Table for Laboratory (Practical):

| S. No. | Laboratory Practical Titles | Relevant COs Number(s) | PLA/ELA | | |
|---|---|---|---|---|---|
| | | | Performance | | Viva-Voce (%) |
| | | | PRA* (%) | PDA** (%) | |
| 1. | Vernier caliper | CO1 | 60 | 30 | 10 |
| 2. | Screw gauge | CO1 | 60 | 30 | 10 |
| 3. | Spherometer | CO1 | 60 | 30 | 10 |
| 4. | Spring Oscillator | CO3 | 50 | 40 | 10 |
| 5. | Bar Pendulum | CO2 | 50 | 40 | 10 |
| 6. | Pullingger's apparatus | CO3 | 60 | 30 | 10 |
| 7. | Searle's apparatus | CO3 | 50 | 40 | 10 |
| 8. | Stokes law | CO3 | 60 | 30 | 10 |
| 9. | Photo-electric cell experiment | CO5 | 40 | 50 | 10 |
| 10. | Numerical Aperture of an optical fiber | CO5 | 50 | 40 | 10 |
| 11. | He-Ne/diode laser | CO5 | 60 | 30 | 10 |
| 12. | Fly wheel | CO2 | 60 | 30 | 10 |
| 13. | Photo electric effect (virtual lab experiment) | CO5 | 70 | 20 | 10 |
| 14. | Emission spectra of Hydrogen (virtual lab experiment) | CO5 | 70 | 20 | 10 |

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

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

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

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

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

## R) Suggested Learning Resources:

### (a) Books:

| S. No. | Titles | Author(s) | Publisher and Edition with ISBN |
|---|---|---|---|
| 1. | Concept of physics-1 | H.C. Verma | Bharti Bhawan Publications, 2021 ISBN: 8177091875, 978-8177091878 |
| 2. | Concept of physics-2 | H.C. Verma | Bharti Bhawan Publications, 2021 ISBN: 8177092324, 978-8177092325 |
| 3. | Text Book of Physics for Class XI (Part-I, Part-II) | N.C.E.R.T., Delhi | N.C.E.R.T., Delhi, 2019 ISBN: 81-7450-508-3(Part-I) & ISBN: 81-7450-566-0 (Part-II) |
| 4. | Text Book of Physics for Class XII (Part-I, Part-II) | N.C.E.R.T., Delhi | N.C.E.R.T., Delhi, 2019 ISBN: 81-7450-631-4 (Part-I) & ISBN: 81-7450-671-3 (Part II) |
| 5. | Engineering Physics | P. V. Naik | Pearson Education Ltd., 1993 ISBN: 817758362X,978-8177583625 |
| 6. | Applied Physics-I | Dr. Mina Talati & Vinod Kumar Yadav | Khanna Book Publishing (2021) ISBN : 978-93-91505-43-1 |
| 7. | Applied Physics-II | Dr. Hussain Jeevakhan | Khanna Book Publishing (2021) ISBN: 978-93-91505-57-8 |
| 8. | Engineering Physics | D. K. Bhattacharya & Poonam Tandon | Oxford University Press, ISBN: 0199452814, 978-0199452811 |
| 9. | The Surya Siddhanta | Aryabhatta | Baptist Mission press , Calcutta |

### (b) Online Educational Resources:

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

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

### (c) Others:

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

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**A) Course Code** : **2400103A(T2400103A/P2400103A/S2400103A)**

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

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

**D) Rationale** :

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

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

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

- **CO-1** Solve various engineering problems applying the basic concepts of atomic structure, chemical bonding, and solutions.
- **CO-2** Use relevant **water treatment** techniques to solve domestic and industrial problems.
- **CO-3** Solve engineering problems using concepts of engineering materials and properties.
- **CO-4** Use relevant fuels and lubricants for domestic and industrial applications.
- **CO-5** Solve engineering problems using the concepts of electrochemistry and corrosion.

## F) Suggested Course Articulation Matrix (CAM):

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

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

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

## G) Teaching & Learning Scheme:

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

**Legend:**

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

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

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

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

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

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

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

## H) Assessment Scheme:

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

**Legend:**

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

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

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

**Note:**

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

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

## J) Theory Session Outcomes (TSOs) and Units: T2400103A

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO-1a* Describe the three subatomic particles in an atom.<br>*TSO-1b* Conclude Rutherford model of atom.<br>*TSO-1c* Apply the different atomic theories and principles for structural illustration.<br>*TSO-1d* Calculate uncertainty in position and momentum.<br>*TSO-1e* Draw the shapes of s, p and d orbitals.<br>*TSO-1f* Write the electronic configuration of different elements.<br>*TSO-1g* Differentiate between ionic, covalent, and coordinate compounds based on the type of chemical bonding.<br>*TSO-1h* Explain the unique behavior of water.<br>*TSO-1i* Prepare the solution of given concentration. | **Unit-1.0 Atomic Structure and Chemical Bonding and Solutions:**<br>1.1 Atoms and its fundamental particles.<br>1.2 Rutherford Model of Atom.<br>1.3 Bohr's Theory, Hydrogen spectrum explanation based on Bohr's Model of Atom.<br>1.4 Wave Mechanical model of atom, de Broglie relationship, Heisenberg Uncertainty Principle<br>1.5 Quantum Numbers, Shapes of Atomic Orbitals.<br>1.6 Pauli's Exclusion Principle, Hund's Rule of Maximum Multiplicity, Aufbau Principle, Electronic Configuration (till atomic number 30).<br>1.7 Concept of Chemical bonding - Cause of chemical bonding, Types of Bonds: Ionic Bond (NaCl, $CaCl_2$, MgO), Covalent Bond, Polar and Nonpolar Covalent Bonds ($H_2$. $F_2$. HF, HCl) & Co-ordinate Bond (CO, $NH_4^+$, $O_3$, $H_2SO_4$),<br>1.8 Dipole Moment ($NH_3$, $NF_3$), Hydrogen bonding.<br>1.9 Solution- (solute, solvent) and their strength- Molarity, Normality, Molality.<br>1.10 Indian Chemistry: -Philosophy of atom by Acharya Kanad. (IKS) | **CO1** |
| *TSO-2a* Classify hard and soft water based on their properties.<br>*TSO-2b* List the impurities responsible for hardness.<br>*TSO-2c* Calculate the hardness of water.<br>*TSO-2d* Determine the hardness by EDTA method.<br>*TSO-2e* Apply different water softening techniques to soften the hard water.<br>*TSO-2f* Calculate the amount of lime and soda required for removal of hardness.<br>*TSO-2g* Differentiate between BOD and COD.<br>*TSO-2h* Use the Indian standard specification of drinking water. | **Unit-2.0 Water**<br>2.1 Introduction, Sources of Water. Hardness of Water- Temporary & Permanent hardness.<br>2.2 Degree of Hardness (In terms of CaCO3 equivalent), Unit of Hardness, Quantitative Measurement of Water Hardness by EDTA method.<br>2.3 Municipal supply of Water, Treatment of water, Water Softening Technique-Soda Lime Process, Zeolites method and ion exchange method,<br>2.4 Water Quality Index - Biological Oxygen Demand, Chemical Oxygen Demand, Determination of Dissolved Oxygen<br>2.5 Indian standard specification of drinking water. | **CO2** |
| *TSO-3a* List ores of metals.<br>*TSO-3b* Describe ore, gangue, matrix.<br>*TSO-3c* Select Appropriate metallurgical processes for concentration, extraction, and purification of given ore.<br>*TSO-3d* Describe alloy with examples.<br>*TSO-3e* Write the constituent of given alloy.<br>*TSO-3f* Write the composition properties and uses of ferrous and non-ferrous alloys.<br>*TSO-3g* Distinguish between homopolymer and copolymer.<br>*TSO-3h* Write the monomers of given polymers.<br>*TSO-3i* Explain vulcanization process.<br>*TSO-3j* Explain cement & its manufacture.<br>*TSO-3k* Differentiate among the different engineering materials based on their | **Unit-3.0 Engineering materials**<br>3.1 Natural Occurrence of Metals- Minerals, ores.<br>3.2 Metallurgy - General principles of Metallurgy, Gangue, Flux and Slag, Steps involved in metallurgy.<br>3.3 Extraction of Aluminium, Iron and Copper from their important ores along with reactions, Properties and uses.<br>3.4 Alloys – Definition, Purpose of alloying, Ferrous and Non-Ferrous Alloy with suitable examples, Composition, Properties, and their applications.<br>3.5 Ancient Indian Metallurgy (IKS)<br>3.6 Polymers-Homopolymers and Copolymers, Natural polymers and synthetic polymers, Addition and Condensation polymerization, Thermoplastic and Thermosetting plastic.<br>3.7 Monomers, applications, and synthesis of | **CO3** |

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| chemical composition and composition-based applications. | Polythene, PVC, Orlon, Terylene, Nylon 66, Nylon 6, Bakelite.<br>3.8 Natural Rubber and its vulcanization, advantages of vulcanized rubber.<br>3.9 Cement, Average composition of Portland cement, Raw material for manufacture of cement, Setting of Cement. | |
| *TSO-4a* Classify fuels.<br>*TSO-4b* Describe HCV and LCV.<br>*TSO-4c* Explain knocking, octane number and cetane number.<br>*TSO-4d* Use different gaseous fuels based on their composition, calorific value, and other properties.<br>*TSO-4e* Explain uses of NPK fertilizers.<br>*TSO-4f* Select relevant lubricant based on their composition, calorific value, and other properties.<br>*TSO-4g* Determine viscosity, flash, and fire point of given lubricant for its specific use.<br>*TSO-4h* Explain Flash, Fire, Cloud & Pour point. | **Unit-4.0 Chemistry of Fuel and Lubricants**<br>4.1 Fuels, Characteristics of an Ideal Fuel.<br>4.2 Classification of Fuel- Solid, liquid and gas fuel, Calorific Values (HCV and LCV),<br>4.3 Petroleum and its fractional distillation.<br>4.4 Cracking, knocking, Fuel Rating (Octane Number, Cetane Number).<br>4.5 Composition, uses, advantages and disadvantages of LPG, CNG and Biogas.<br>4.6 Manures, NPK fertilizers (preparation and uses).<br>4.7 Fire Extinguishers and their types.<br>4.8 Lubricants- Classification of Lubricants with examples, Functions and Properties of Good Lubricant.<br>4.9 Viscosity &Viscosity Index. Flash point. Fire point, Cloud & Pour point | **CO4** |
| *TSO-5a.* Describe Electrolyte and Nonelectrolyte.<br>*TSO-5b.* Describe Metallic and electrolytic conduction.<br>*TSO-5c.* Explain the faraday law of electrolysis.<br>*TSO-5d.* Calculate the mass of metal deposited after passing a certain amount of current.<br>*TSO-5e.* Calculate the emf at different temperature, pressure, and molar concentration.<br>*TSO-5f.* Predict the feasibility of a cell.<br>*TSO-5g.* Explain the working of a cell.<br>*TSO-5h.* Describe corrosion.<br>*TSO-5i.* Explain the different methods to prevent corrosion. | **Unit-5.0 Electrochemistry**<br>5.1. Introduction, Electrolyte and Nonelectrolyte, Electrolytic and Metallic Conduction, Factors affecting Electrolytic Conductance.<br>5.2. Molar Conductivity and Equivalent Conductivity. Variation of Molar Conductivity, Kohlrausch's law.<br>5.3. Faraday's Laws of Electrolysis.<br>5.4. Galvanic Cell, Electrode Potential, Measurement of Electrode Potential SHE (Standard Hydrogen electrode), EMF, Electrochemical Series, Nernst Equation for Electrode Potential.<br>5.5. Batteries, Primary Cells-Dry cell, Secondary cell - Lead storage battery, Fuel cells.<br>5.6. Corrosion, their types (Dry & Wet corrosion) and prevention. | **CO5** |

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

## K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400103A

| Practical/Lab Session Outcomes (LSOs) | S. No. | Laboratory Experiment/Practical Titles | Relevant COs Number(s) |
|---|---|---|---|
| *LSO-1.1.* Calculate amount of oxalic acid required.<br>*LSO-1.2.* Prepare N/10 oxalic acid solution. | 1. | Preparation of 250 ml of N/10 Oxalic acid Solution | CO1 |
| *LSO-2.1.* Calculate amount of Sodium Carbonate required.<br>*LSO-2.2.* Prepare N/10 Sodium Carbonate Solution. | 2. | Preparation of 250ml of N/10 Sodium Carbonate Solution. | CO1 |
| *LSO 3.1. Perform acid base titration.*<br>*LSO 3.2.* Prepare oxalic acid solution | 3. | Determination of strength of Sodium Hydroxide solution by titrating against Oxalic Acid Solution | CO1 |
| *LSO 4.1.* Perform Complexometric titration.<br>*LSO 4.2.* Standardize EDTA solution. | 4. | Determination of the total hardness of tap water by EDTA method | CO2 |
| *LSO 5.1.* Calculate % of moisture | 5. | Estimation of moisture content in given coal sample gravimetrically. | CO4 |
| *LSO-6.1.* Perform double displacement reaction.<br>*LSO-6.2.* Test the presence of sulphate. | 6. | Preparation of Barium Sulphate from Barium Chloride. | CO2 |
| *LSO-7.1.* Use viscometer.<br>*LSO-7.2.* Calculate viscosity using the drop number method. | 7. | Determination of viscosity of liquid Using Ostwald Viscometer. | CO4 |
| *LSO-8.1.* Construct Daniel cell.<br>*LSO-8.2.* Compare the effect of dilution of electrolytes on the emf of a Daniel cell. | 8. | Comparison of the effect of dilution of electrolytes on the emf of a Daniel cell. | CO5 |
| *LSO 9.1.* Perform acid base titration using pH meter. | 9. | Determination of pH of given solution by pH meter. | CO2 |
| *LSO-10.1.* Carry out Polymerization.<br>*LSO-10.2.* Set the environment for carrying out polymerization. | 10. | Preparation of Phenol Formaldehyde Resin (Bakelite). | CO3 |
| *LSO-11.1.* Perform iodometry titration.<br>*LSO-11.2.* Use of starch as indicator. | 11. | Determination of dissolved Oxygen in given sample of Water. | CO2 |
| *LSO-12.1. Calculate pH.* | 12. | Determination of pH of soil using baking soda and vinegar. | CO2 |

**L) Suggested Term Work and Self Learning: S2400103A** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

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

1. Write electronic structure of given atoms.
2. Compare the wavelengths of different macroscopic and microscopic particles moving with same velocity.
3. Prepare a model to find the soap lather forming capacity of tap water on addition of lime.
4. Prepare chart showing different industrial application of metal and relate it with required property or properties using internet.
5. Explain the working principle of TEL as antiknock.
6. Prepare chart showing different types of liquid fuels with their calorific values and uses.
7. Prepare a comparative chart of commercially available lubricants based on mechanism of lubrication.
8. Compare the EMF of Zinc - Copper cell with different cathodic concentration and predict out of low and high cathodic concentration, which increases EMF?
9. Prove the statement mathematically. “It is impossible to determine the position and momentum simultaneously with accuracy.”

**b. Micro Projects:**

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

**c. Other Activities:**

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

2. Visits: Visit nearby **Water treatment** plant. Prepare report of visit.
   Visit a nearby battery shop. Prepare a report of visit.

3. Self-Learning Topics:

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

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

**Legend:**

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

**Note:**

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

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

| Unit Title and Number | Total Classroom Instruction (Cl) Hours | Relevant COs Number(s) | Total Marks | ETA (Marks) | | |
|---|---|---|---|---|---|---|
| | | | | Remember (R) | Understanding (U) | Application & above (A) |
| **Unit-1.0** Atomic Structure and Chemical Bonding | 8 | CO1 | 14 | 4 | 4 | 6 |
| **Unit-2.0** Water | 8 | CO2 | 14 | 4 | 4 | 6 |
| **Unit-3.0** Engineering Material | 8 | CO3 | 14 | 4 | 6 | 4 |
| **Unit-4.0** Chemistry of fuels and Lubricants | 12 | CO4 | 10 | 4 | 2 | 4 |
| **Unit-5.0** Electrochemistry | 12 | CO5 | 18 | 4 | 6 | 8 |
| **Total** | **48** | **-** | **70** | **20** | **22** | **28** |

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

## O) Suggested Assessment Table for Laboratory (Practical):

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

**Legend:**

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

| S. No. | Name of Equipment, Tools and Software | Broad Specifications | Relevant Experiment/Practical Number |
|---|---|---|---|
| 1. | Electronic balance, | Scale range of 0.001g to 500g. Pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt. | 1,2,3,5,6,7,8,9 |
| 2. | Electric oven | Inner size 18''x18''x18''; temperature range 100 to $250^0$ C. with the capacity of 40lt. | 5 |
| 3. | Ostwald Viscometer | Size 120x1 mm (length x internal diameter)<br>Overall, Height 237 nm<br>Material- Glass | 7 |
| 4. | Digital pH Meter | Type: Microcontroller Based, Display: LED / LCD / Touch Screen, 3 digits, Calibration: up to 3 points with auto buffer, pH Range (pH): 0.00 to 14.00, +/- 0.05, Power Requirements: 230 V +/- 10, 50 Hz AC, Modes: pH mV- C, Temperature Compensation Type: Automatic, Temperature Compensation Range (Degree C): 0 to 100, Temperature Accuracy (Degree C): +/- 0.3, Resolution (pH): 0.01 | 9,12 |

## R) Suggested Learning Resources:

### (a) Books:

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

**(b) Online Educational Resources:**

1. www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2. www.visionlearning.com (Atomic structure and chemical bonding)
3. www.chem1.com (Atomic structure and chemical bonding)
4. https://www.wastewaterelearning.com/elearning/ (Water Treatment)
5. www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
6. https://iksindia.org
7. www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel & Combustion)
8. www.chemcollective.org (Metals, Alloys)
9. www.wqa.org(Water Treatment)
10. PhET: Free online physics, chemistry, biology, earth science and math simulations (colorado.edu)
11. https://www.ancient-origins.net/history-famous-people/indian -sage-acharya-kanad-001399
12. Courses: NPTEL
13. Virtual Labs (vlab.co.in)
14. olabs.edu.in
15. Khan Academy | Free Online Courses, Lessons & Practice

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

**(c) Others:**

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

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**A) Course Code** : **2400104(T2400104/P2400104/S2400104)**

**B) Course Title** : Communication Skills (English) (Common for all Programmes)

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

**D) Rationale**

Communication forms a crucial element in the success of any organization or industry in the globalized economy. The global village gives due weightage to the English language and it enjoys a privileged status. Engineering students with English as a communicative language are open to many opportunities across the globe. This course will develop Listening, Speaking, Reading, and Writing Skills (LSRW) in the students for effective dissemination of their ideas, projects, patents, and research in the form of presentations, reports, research papers, memos, circulars, etc. Additionally, it will help students of diploma in engineering to present concepts and designs effectively along with writing CVs, Group Discussions, and Mock Interview sessions in placements and job recruitments. Though communication skills in SBTE, Bihar largely emphasizes to communicate effectively in English communication in Hindi is also focused to some extent at the diploma level. Effective Communication can be easily learned through Indian mythological scriptures like Bhagwat Geeta, Ramayana, Mahabharata, and others. (IKS)

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

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

**CO-1** Communicate contextually in different situations.

**CO-2** Use Verbal Communication Effectively

**CO-3** Deploy Non-Verbal Communication Contextually.

**CO-4** Write various texts using vocabulary and correct grammar.

**CO-5** Draft effective business correspondence with brevity and clarity.

## F) Suggested Course Articulation Matrix (CAM):

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

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

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

## G) Teaching & Learning Scheme:

| Course Code | Course Title | Scheme of Study (Hours/Week) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Classroom Instruction (CI) | | Lab Instruction (LI) | Notional Hours (TW+ SL) | Total Hours (CI+LI+TW+SL) | Total Credits (C) |
| | | L | T | | | | |
| **2400104** | Communication Skills (English) | 03 | - | 04 | 02 | 09 | 06 |

**Legend:**

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

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

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

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

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

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

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

## H) Assessment Scheme:

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

**Legend:**

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

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

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

**Note:**

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

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

**J) Theory Session Outcomes (TSOs) and Units: T2400104** The details of TSOs and units for communication in English is mentioned in Part – A while communication in Hindi is mentioned in Part – B in the following table.

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| **Part -A (English)**<br>TSO1.a Define communication and its different forms.<br>TSO1.b Explain the elements of communication with Case Studies from Bhagwat Geeta's conversation between Krishna and Arjun before the war. (IKS)<br>TSO1.c Explain the linkages between different stages of communication with the help of a diagram.<br>TSO1.d Apply the principles of effective communication and state two examples of communication from Ramayana (IKS)<br>TSO1.e State eight for explaining different types of barriers to communication Case Studies from Mahabharata - the conversation between Kauravas and Pandavas in the war field (IKS)<br>TSO1.f Identify the barriers to communication.<br>TSO1.g Suggest the ways to overcome/minimize communication barriers. | **Unit-1.0 Communication**<br>1.1 Communication: Role, Relevance, Elements (Context-Sender-Message-Channel-Receiver-Feedback)<br>1.2 Process / Stages: Ideation- Encoding, Selecting Proper Channel, Transmission, Receiving, Decoding, Giving Feedback<br>1.3 7 Cs / Principles of Effective Communication: Considerate, Correct, Concrete, Concise, Clear, Complete. Courteous<br>1.4 Barriers to Communication: Physiological, Physical, Psychological, Mechanical, Semantic/Language, Cultural. Overcome/ minimize Barriers.<br>1.5 Case Studies from:<br>• Bhagwat Geeta's conversation between Krishna and Arjun before the war (IKS)<br>• Mahabharata the conversation between Kauravas and Pandavas in the war field (IKS) | **CO1**<br>**CO2** |
| *TSO 2a.* Distinguish between formal and informal communication Case Studies from Bhagwat Geeta and the different conversations of Krishna and Arjun during the war (IKS).<br>*TSO 2b.* Illustrate the types of Formal Communication with examples.<br>*TSO 2c.* Define verbal & non-verbal communication.<br>*TSO 2d.* TSO 2d. Explain the advantages of oral and written Communication.<br>*TSO 2e.* Interpret non-verbal codes from Mahabharata (IKS)<br>*TSO 2f.* Explain the role of tables, charts & graphs in communication.<br>*TSO 2g.* Differentiate Intrapersonal and Interpersonal Communication with Case Studies<br>*TSO 2h.* List the advantages and disadvantages of Group Communication. | **Unit- 2.0 Types of Communication**<br>**2.1** Based on organizational structure: Formal (Vertical, Horizontal, Diagonal), Informal (Grapevine)<br>2.2 Based on the method of expression: Verbal-Oral & Written communication. Non-verbal communication and its Codes- Kinesics, Chronemics, Proxemics, Haptics, Vocalics/Paralanguage, Artifacts, Graphic and Visual Communication<br>2.3 Based on the number of people involved: Interpersonal, and Group Communication.<br>2.4 Case Studies from Bhagwat Geeta's different conversations with Krishna and Arjun during the war (IKS). | **CO3** |
| TSO 3a. Prepare a glossary of new words from the given texts.<br>TSO 3b. Summarize the given texts in your own words.<br>TSO 3c. Recognize the types of sentences in the given texts. | **Unit-3.0 Reading Comprehension**<br>Comprehension, vocabulary enhancement and grammar exercises based on the reading of the following texts: | **CO4**<br>**CO5** |

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| TSO 3d. Find out idioms and phrases used in the given texts.<br>TSO 3e. Write a short biography of the given writers.<br>TSO 3f. Identify the figures of speech used in the given texts.<br>TSO 3g. Classify the forms of poetry.<br>TSO 3h. Elaborate the central idea / theme of the given poems in your own words. | **Section-1 (Prose)**<br>3.1 An Astrologer's Day by R K Narayan<br>3.2 Indian Civilization and Culture by M K Gandhi<br>3.3 The Secret of Work by Swami Vivekanand<br>3.4 My Struggle for an Education by Brooker T Washington<br>**Section-2 (Poetry)**<br>3.5 Where the Mind is without Fear by R N Tagore<br>3.6 Ode on Solitude by Alexander Pope<br>3.7 Stopping by Woods on a Snowy Evening by Robert Frost<br>3.8 A Psalm of Life by H W Longfellow | |
| *TSO 4a.* Form new words adding prefix and suffix to the given root words.<br>*TSO 4b.* Write synonyms and antonyms of the given words.<br>*TSO 4c.* Use the given idioms and phrases in your own sentences.<br>*TSO 4d.* Distinguish between acronym and abbreviation.<br>*TSO 4e.* Prepare a list of technical jargons of your respective branch.<br>*TSO 4f.* Identify the parts of speech of the specific words in the given sentences.<br>*TSO 4g.* Fill in the blanks with suitable verb forms in the given sentences.<br>*TSO 4h.* Transform the given sentences as directed.<br>*TSO 4i.* Punctuate the given paragraphs. | **Unit-4.0 Vocabulary and Grammar**<br>4.1 Word Formation: Prefix, Suffix, Acronym<br>4.2 Synonyms, Antonyms, Homonyms, One Word Substitution, Idioms and Phrases<br>4.3 Technical Jargons -Related to the respective program<br>4.4 Parts of speech<br>4.5 Time and Tense<br>4.6 Transformation: Voice, Narration, Removal of 'Too', Question Tag<br>4.7 Punctuation | **CO4, CO5** |
| TSO 5a. Write the precis of the given passage with suitable title.<br>TSO 5b. Draft letters and applications for the given purpose.<br>TSO 5c. Compose E-mails, Notices, Memos, and Circulars.<br>TSO 5d. Prepare reports of the projects of your respective branch.<br>TSO 5e. Write a report on the events organized in your institute. | **Unit-5.0 Professional Writing**<br>5.1 Precis Writing<br>5.2 Business Letters / Applications<br>5.3 Drafting E-mails, Notices, Memos, Circulars<br>5.4 Report Writing: Project and Event/ Incident Report Writing | **CO5** |
| **Part -B (हिंदी)**<br>*TSO 1a* सम्प्रेषण कौशल का अर्थ स्पष्ट कर सकेंगे.<br>*TSO 1b* भाव एवं सम्प्रेषण में अंतर बता पाएँगे.<br>*TSO 1c* सम्प्रेषण की प्रक्रिया का उल्लेख कर सकेंगे.<br>*TSO 1d* श्रवण अविव्यक्ति, वाचन और लेखन की अवधारणा को स्पष्ट कर सकेंगे.<br>*TSO 1e* सम्प्रेषण कौशल के निर्धारक तत्वों का विवेचन कर सकेंगे.<br>*TSO 1f* प्रभावशाली सम्प्रेषण के सिद्धांतों का समावेश अपने वार्तालाप में कर सकेंगे. | **Units-1.0: सम्प्रेषण सिद्धान्त एवं व्यवहार**<br>1.1 सम्प्रेषण : परिचय , अर्थ एवं परिभाषा<br>1.2 सम्प्रेषण की प्रक्रिया एवं तत्त्व<br>1.3 सम्प्रेषण के प्रकार : औपचारिक एवं अनौपचारिक, शाब्दिक एवं अशब्दिक<br>1.4 प्रभावशाली सम्प्रेषण के सिद्धांत एवं सम्प्रेषण व्यवधान<br>कुरुक्षेत्र में श्रीकृष्ण- अर्जुन संवाद | **CO1, CO2, CO3** |

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| | महाभारत युद्ध प्रारम्भ होने से पहले कुरुक्षेत्र में श्री कृष्ण ने अर्जुन के प्रश्नों के उत्तर देते हुए जीवन के सूत्र समझाए थे।ये उपदेश श्रीमद्भागव गीता में मिलते | |
| TSO 2a तकनीकी कौशल एवं व्यव्हार कौशल में अन्तर बता पाएँगे .<br>TSO 2b व्यव्हार कौशल का म महत्व स्पष्ट कर पाएँगे .<br>TSO 2c आत्मा जागरूकता एवं आत्मा विश्लेषण का विवेचन सोदाहरण कर पाएँगे .<br>TSO 2d भावनात्मक बुद्धिमत्ता एवं करुणा, अनुकूलनशीलता एवं लचीलापन का विकास कर पाएँगे.<br>TSO 2e दैनिक जीवन में अनुकूलनशीलता एवं लचीलापन को आत्मसात कर पाएँगे . | **Unit-2.0: व्यावसायिकउत्कृष्टता हेतु व्यव्हार कौशल**<br><br>2.1 परिचय : तकनीकी कौशल एवं व्यवहार कौशल<br>2.2 व्यवहार कौशल का महत्त्व<br>2.3 जीवन कौशल : आत्म जागरूकता एवं आत्म विश्लेषण<br>2.4 वनात्मक बुद्धिमत्ता एवं करुणा, अनुकूलनशीलता एवं लचीलापन, व्यवहार कौशल का उपयोग<br><br>श्रीराम केवट संवाद<br>श्रीराम जब लक्ष्मण और सीता के साथ वन गमन के लिए प्रस्थान करते हैं तब सरयू नदी के पार उतारने लिए केवट से अनुरोध करते हैं। | **CO1** |
| TSO 3aपठित गद्यांश एवं पद्यांश से प्राप्त नयी शब्दावली विकसित कर पाएँगे<br>TSO 3b दिए गये कहानियों, कविताओं एवं निबंधों का सारांश अपने शब्दों में लिख पाएँगे.<br>TSO 3c दिए गये कहानियों, कविताओं एवं निबंधों में प्रयुक्त मुहावरों एवं अलंकारों को बता पाएँगे .<br>TSO 3d कविताओं का भावार्थ स्पष्ट कर पाएँगे . | **Unit-3.0: पाठ-बोध : शब्दावली परिवर्धन एवं व्याकरण अभ्यास**<br>3.1 नमक का दरोगा, ईदगाह – मुंशी प्रेमचंद<br>3.2 बात (निबंध)- प्रताप नारायण मिश्र<br>3.3 वह प्रदीप जो दिख रहा है झिलमिल दूर नहीं है – रामधारी सिंह दिनकर<br>3.4 नर हो न निराश करो मन को – मैथिलीशरण गुप्त<br>3.5 कबीर के दोहे -काल्ह करे सो आज कर , जाति न पूछो साधू की , ऐसी वाणी बोलिए | **CO4** |
| TSO 4a अपनी शाखा से सम्बन्धित तकनीकी शब्दावली का चयन कर पाएँगे .<br>TSO 4b पर्यायवाची एवं विलोम शब्दों से सम्बंधित शब्दावली तैयार कर सकेंगे .<br>TSO 4c दिये गये गद्यांशों में विराम चिह्नों का सही प्रयोग कर पाएँगे . | **Unit-4.0: शब्दावली एवं व्याकरण** 2 Hrs<br><br>4.1 सामान्य शब्दावली<br>4.2 प्रशासनिक शब्दावली<br>4.3 शब्द भेद, अनेक शब्दों के लिए एक शब्द<br>4.4 विराम चिन्ह<br>4.5 मुहावरें एवं कहावतें | **CO4**<br>**CO5** |
| TSO 5a दिए गये दिए गये गद्यांशों का संक्षेपण कर पाएँगे .<br>TSO 5b विभिन्न प्रकार के पत्रों, आवेदनों ,सूचनाओं, विज्ञप्तियों को लिख पाएँगे .<br>TSO 5c अपनी शाखा से सम्बंधित प्रतिवेदन लेखन कर पाएँगे .<br>TSO 5d अपने संस्थान में हुए आयोजनों का प्रतिवेदन लिख पाएँगे. | **Unit-5.0: लेखन कौशल**<br><br>5.1 सार- लेखन<br>5.2 औपचारिक एवं व्यवसायिक पत्र लेखन<br>5.3 प्रारूप लेखन – सूचना, निविदा लेखन, प्रतिवेदन लेखन, बायोडाटा | **CO5** |

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

**K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400104** These practical's are common for both Part – A and Part -B.

| Practical/Lab Session Outcomes (LSOs) | S. No. | Laboratory Experiment/Practical Titles | Relevant COs Number(s) |
|---|---|---|---|
| *LSO1.a* Identify the emotions of the speakers. | 1 | Emotions of the speakers. | CO1 |
| *LSO2.a* Interpret instructions of audio transcripts. | 2 | Instructions of audio transcripts. | CO1 |
| *LSO3.a* Solve the language puzzles based on the audio transcript. | 3 | Language puzzles. | CO1 |
| *LSO4.a* Repeat words on language lab software after listening to them. | 4 | Repetition of words | CO1 |
| *LSO5.a* Summarize the excerpt in their own words. | 5 | Summarize the excerpt. | CO1 |
| *LSO6.a* Answer the questions based on the listening excerpt | 6 | Listening excerpt | CO2 |
| *LSO7.a* Differentiate the sounds of minimal pairs, syllables, words, etc. | 7 | Sounds of minimal pairs, syllables words etc. | CO2 |
| *LSO8.a* Pronounce the words/ sentences correctly based on the phonetic transcription. | 8 | Phonetic transcription. | CO2 |
| *LSO9.a* Read out the words and sentences based on stress and intonation marks. | 9 | Stress and intonation. | CO2 |
| *LSO10.a* Apply the paralanguage codes in verbal dialogues to show different emotions. | 10 | Paralanguage Codes | CO2 |
| *LSO11.a* Integrate the non-verbal codes in their verbal dialogues. | 11 | Non-verbal Codes | CO2 |
| *LSO12.a* Correct the verbal and non-verbal presentations of their peer while giving feedback. | 12 | Feedback on Presentations | CO2 |
| *LSO13.a* Differentiate the sounds of minimal pairs, syllables, words, etc. | 13 | Syllables and Words | CO2 |
| *LSO14.a* Locate the dictated words from the excerpt. | 14 | Dictated words | CO3 |
| *LSO15.a* Arrange the correct and logical sequence of the jumbled sentences. | 15 | Jumbled Sentences. | CO3 |
| *LSO16.a* Read the given texts aloud with proper pauses and proper pronunciation. | 16 | Pronunciation. | CO3 |
| *LSO17.a* Compare the point of view with their peers. | 17 | Point of view of Self and Peers | CO4 |
| *LSO18.a* Identify the main ideas of the excerpt | 18 | Main ideas of the excerpt | CO4 |
| *LSO19.a* Prepare a list of technical jargon and register specific to their program /industry. | 19 | Technical Jargons | CO5 |
| *LSO20.a* Write the specifications of the machines/ equipment available in the workshops/labs. | 20 | Specifications of the machines/ equipment | CO5 |
| *LSO21.a* Write a report on the projects of their respective branches. | 21 | Report on the Projects | CO5 |

**L)** **Suggested Term Work and Self-Learning: S2400104** Some sample suggested assignments, micro-projects, and other activities are mentioned here for reference.

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

1. Visit your institute's library/ web search and enlist the books, journals, and magazines related to your respective branches to prepare a bibliography consisting of names of the authors, titles of the books, publication, and place of publication.
2. SWOT Analysis: Analyze yourself concerning your strengths and weaknesses, opportunities, and threats for your communication.
3. Interview an eminent personality and write a report on it.
4. Deliver a seminar for 10-12 minutes using PPT on the topic given.
5. Prepare your timetable for a week and prioritize your activities.
6. Visit any historical places/offices/farms/industries/development sites etc. near your city and prepare a report on it.
7. Prepare a video of effective professional communication after listening to Bhagwat Geeta's conversation between Arjun and Krishna in the war field (IKS).

**b. Micro Projects:**

i. Book review – students should read a book and then write their reviews about the book and present it in the class.
ii. Interview any successful person in your locality in context with his life journey, inspiration social contribution, role model, and keys to success.
iii. Prepare a register of technical jargon of the industry related to their specific branch.
iv. Prepare a presentation on environmental issues of their locality with their solution.
v. Listen to the dialogues of the conversation between Krishna and Arjun before the war for specific and effective Communication (IKS)

**c. Other Activities:**

1. Arrange a Blood Donation Camp in collaboration with a blood bank and prepare a communication plan for the same.
2. Organize a cleanliness campaign in your campus premises and nearby places and prepare hoardings, boards, collages, and posters for the same.
3. Organize a campaign on educational awareness in the nearby places and prepare an advertising campaign for the same.

**d. Self- learning topics:**

- Listen to different Conversations of Ramayana,(the Rama -Bharat conversation before going to Vanvaas) Mahabharata (Bheem and Arjun Conversation during War ), and Bhagwat Geeta (discussions of Strategies before War) to develop effective communication Skills (IKS)
- Collect new words from daily newspapers.
- Observe negotiation skills in the nearby shops.
- Watch educational channels for improving English communication.

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

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

**Legend:**

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

**Note:**

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

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

| **Unit Title and Number** | **Total Classroom Instruction (Cl) Hours** | **Relevant COs Number (s)** | **Total Marks** | **ETA (Marks)** | | |
|---|---|---|---|---|---|---|
| | | | | **Remember (R)** | **Understanding (U)** | **Application & above (A)** |
| **(Part - A)** **Unit-1.0** Communication Theory and Practice | 5 | CO1, CO2 | 10 | 3 | 3 | 4 |
| **Unit- 2.0** Types of Communication | 5 | CO3 | 8 | 2 | 2 | 4 |
| **Unit-3.0** Reading Comprehension | 8 | CO4, CO5 | 12 | 3 | 3 | 6 |
| **Unit-4.0** Vocabulary and Grammar | 7 | CO4, CO5 | 10 | 3 | 3 | 4 |
| **Unit-5.0** Professional Writing | 7 | CO5 | 10 | 3 | 4 | 3 |
| **(Part-B)** **Units-1.0: सम्प्रेषण सिद्धान्त एवं व्यवहार** | 2 | CO1, CO2 | 3 | 1 | 1 | 1 |
| **Unit-2.0: व्यावसायिक उत्कृष्टता हेतु व्यव्हार कौशल** | 2 | CO3 | 3 | 1 | 1 | 1 |
| **Unit-3.0: पाठ-बोध :शब्दावली परिवर्धन, एवं व्याकरण अभ्यास** | 5 | CO4, CO5 | 5 | 1 | 1 | 3 |

| Unit Title and Number | Total Classroom Instruction (Cl) Hours | Relevant COs Number (s) | Total Marks | ETA (Marks) | | |
|---|---|---|---|---|---|---|
| | | | | Remember (R) | Unders tanding (U) | Application & above (A) |
| Unit-4.0: शब्दावली एवं व्याकरण | 4 | CO5 | 5 | 1 | 1 | 3 |
| Unit-5.0: लेखन कौशल | 3 | CO5 | 4 | 2 | 1 | 1 |
| **Total** | **48** | - | **70** | **20** | **20** | **30** |

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

## O) Suggested Assessment Table for Laboratory (Practical):

| S. No. | Laboratory Practical Titles | Relevant COs Number (s) | PLA/ELA | | |
|---|---|---|---|---|---|
| | | | Performance | | Viva-Voce (%) |
| | | | PRA* (%) | PDA** (%) | |
| 1 | Emotions of the Speakers. | CO1 | 30 | 60 | 10 |
| 2 | Instructions of Audio Transcripts. | CO1 | 30 | 60 | 10 |
| 3 | Language Puzzles. | CO1 | 30 | 60 | 10 |
| 4 | Repetition of Words. | CO1 | 30 | 60 | 10 |
| 5 | Summarize the Excerpts. | CO1 | 30 | 60 | 10 |
| 6 | Listening Excerpts. | CO2 | 30 | 60 | 10 |
| 7 | Sounds of minimal Pairs, Syllables and Words etc. | CO2 | 30 | 60 | 10 |
| 8 | Phonetic Transcription. | CO2 | 30 | 60 | 10 |
| 9 | Stress and Intonation. | CO2 | 30 | 60 | 10 |
| 10 | Paralanguage Codes | CO2 | 30 | 60 | 10 |
| 11 | Non-Verbal Codes | CO2 | 30 | 60 | 10 |
| 12 | Verbal and Non-Verbal Presentations | CO2 | 30 | 60 | 10 |
| 13 | Sounds of minimal pairs, syllables and words | CO2 | 30 | 60 | 10 |
| 14 | Locate the Dictated Words | CO3 | 30 | 60 | 10 |
| 15 | Jumbled Sentences. | CO3 | 30 | 60 | 10 |
| 16 | Pronunciation. | CO3 | 30 | 60 | 10 |

| S. No. | Laboratory Practical Titles | Relevant COs Number (s) | PLA/ELA | | |
|---|---|---|---|---|---|
| | | | Performance | | Viva-Voce (%) |
| | | | PRA* (%) | PDA** (%) | |
| 17 | Compare the Point of view with their Peers. | CO4 | 30 | 60 | 10 |
| 18 | Main Ideas of the Excerpt | CO4 | 30 | 60 | 10 |
| 19 | Technical Jargons | CO5 | 30 | 60 | 10 |
| 20 | Specifications of the machines/ equipment | CO5 | 30 | 60 | 10 |
| 21 | Report on the Projects | CO5 | 30 | 60 | 10 |

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

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

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

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

| S. No. | Name of Equipment, Tools and Software | Broad Specifications | Relevant Experiment/Practical Number |
|---|---|---|---|
| 1. | High end computers | Intel® Core™ i5-9400 (6-Core, 9MB Cache, up to 4.1GHz with Intel® Turbo Boost Technology) RAM: 8GB DDR 4 HDD: 3.5" 1TB 7200RPM SATA Hard Drive OS: Windows 10 Pro 64bit OEM License Other ports: Gigabyte LAN card | 1 to 21 |
| 2. | Language Lab software | Teacher console supporting audio-visual language lab | 1 to 21 |
| 3. | Printer | LaserJet printer | 1 to 21 |
| 4. | Head Phones with microphones | Logitech H111 wired on headphones | 1 to 21 |
| 5. | Computer Furniture | Computer Desk, chair | 1 to 21 |
| 6. | Smart Projector | Standard Specification | 1 to 21 |

## R) Suggested Learning Resources:

**(a) Books**:

| S. No. | Titles | Author(s) | Publisher and Edition with ISBN |
|---|---|---|---|
| 1. | Communication Skills in English (AICTE Prescribed Text Book) | Dr. Anjana Tiwari | Khanna and Khanna, New Delhi |
| 2. | Business Communication | Dr. Nishith Rajaram Dubey, Anupam Singh | Publisher: Indra Publishing House, 2023 ISBN- 978-93-93577-69-6 |
| 3. | Communication Skills | Sanjay Kumar & Pushap Lata | Oxford University Press, India |
| 4. | Employability Skills | Dr. Nishith Rajaram Dubey, Anupam Singh | Indra Publishing House, 2023 ISBN - 978-93-93577-68-9 |
| 5 | Technical Communication for Engineers | Shalini Verma | S. Chand |
| 6. | English Grammar | Raymond Murphy | S. Chand |
| 7. | British English Grammar and Composition | Dr. Ashok Kumar Singh | Student's Friends |
| 8. | A Textbook of English Phonetics | T. Balasubramanian | Macmillan Publishers |
| 9. | Thesaurus of English Words and Phrases | Roget | Simon and Schuster |
| 10 | Better English Pronunciation | J. D. O'Connor | Cambridge: Cambridge University Press, 1980 |
| 11 | An English Grammar: Comprehending Principles and Rules | Lindley Murray. | London: Wilson and Sons, 1908. |
| 12 | Effective Communication Skills | Kulbhushan Kumar | Khanna Publishing House, New Delhi (Revised Edition 2018) |
| 13 | Examine your English | Margaret M. Maison | Orient Longman: New Delhi, 1964 |
| 14 | Collin's English Dictionary | Harper Collins | Harper Collins, Glasgow |
| 15 | संप्रेषण कौशल | डॉ प्रवीण कुमार अग्रवाल , डॉ अवनीश कुमार मिश्रा | साहित्य भवन पब्लिकेशन : आगरा |
| 16 | आधुनिक हिंदी व्याकरण और रचना | डॉ वासुदेवनंदन प्रसाद | भारती भवन पब्लिकेशन |

**(b) Online Educational Resources:**

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

10. http://kavitakosh.org/
11. https://bundelkhand.in/maithilisharan-gupt/nar-ho-na-nirash-karo-man-ko
12. https://etc.usf.edu/lit2go/92/up-from-slavery/1575/chapter-3-the-struggle-for-an-education/
13. https://oursmartstudy.com/english-chapter-1-class-12-pdf-download/
14. https://ve-iitg.vlabs.ac.in/Listening%20Skills(Procedure).html
15. https://nptel.ac.in/courses/109104031

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

**(c) Others:**

1. https://nptel.ac.in/courses/

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**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)** **:**

**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) |
|---|---|---|
| *TSO 1a.* Use standard forms of integration to find the integral of given simple functions.<br>*TSO 1b.* Apply suitable Trigonometric transformation to solve a given Integration problem.<br>*TSO 1c.* Solve given problems using the properties of the definite integral.<br>*TSO 1d.* Invoke the concept of Integration to solve problems based on area and volume of irregular shapes. | **Unit-1.0 Integral Calculus and its Applications**<br>1.1 Concept and Definition of Integration.<br>1.2 Working rules and Integral of standard Functions.<br>1.3 Method of Substitution, Trigonometric transformation, Integration by parts, and Partial fraction.<br>1.4 Applications: Area and volume | **CO1** |
| *TSO 2a.* Find the order and degree of given differential equations.<br>*TSO 2b.* Solve differential equations using the variable separable method.<br>*TSO 2c.* Obtain the solution of a given homogeneous differential equation.<br>*TSO 2d.* Solve the given linear differential equation based on engineering application.<br>*TSO 2e.* Solve the given Bernoulli differential equation.<br>*TSO 2f.* Solve the homogeneous linear differential equations of second order with constant coefficient. | **Unit-2.0 Differential Equations**<br>2.1 Concept and Definition, Order, and Degree of Differential Equation.<br>2.2 Differential equation of first order and first degree, variable separable Method.<br>2.3 Homogeneous, linear Differential equation and Bernoulli equation.<br>2.4 Homogeneous linear differential equations of second order with constant coefficient. | **CO2** |
| *TSO 3a.* Find the root(s) of the given equation using Iterative methods up to the desired accuracy.<br>*TSO 3b.* Calculate the root(s) of given equations using the Newton-Raphson Method.<br>*TSO 3c.* Apply the Newton-Raphson Method for engineering applications.<br>*TSO 3d.* Solve problems using the Bakhshali iterative method for finding approximate square roots. (IKS) | **Unit-3.0 Numerical Solution of Nonlinear Equations**<br>3.1 Algebraic and Transcendental equations.<br>3.2 Iteration Methods.<br>3.3 Newton-Raphson Method.<br>3.4 Bakhshali iterative method for finding the approximate square root. (IKS) | **CO3** |
| *TSO 4a.* 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.<br>*TSO 4b.* Apply the concept of Numerical integration to find the area from given data by Simpson's one-third rule, also use any open source software to find the same by comparing the findings.<br>*TSO 4c.* 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. | **Unit-4.0 Numerical Integration**<br>4.1 Trapezoidal rule<br>4.2 Simpson's one third rule<br>4.3 Simpson's three eighth rule | **CO4** |
| *TSO 5a.* Select discrete and continuous probability distribution for given data. | **Unit-5.0 Probability distribution** | **CO5** |

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO 5b.* Solve given problems based on repeated trials using binomial distribution.<br>*TSO 5c.* Use suitable distribution to solve the given problems when the number of trials is large and the probability is very small.<br>*TSO 5d.* Utilize the concept of normal distribution to solve broad-based engineering-related problems. | 5.1 Discrete and continuous probability distribution.<br>5.2 Binomial distribution.<br>5.3 Poisson's distribution.<br>5.4 Normal distribution. | |

**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) |
|---|---|---|---|
| 1.1 Calculate the area of the hexagon using integration.<br>1.2 Calculate the average temperature of a city over a certain period.<br>1.3 Calculate the total force on the bottom of the tank due to the water.<br>1.4 Estimate the amount of force required to move a component.<br>1.5 Apply the concept of definite integration to find the volume. | 1. | • Area of irregular shape using integration.<br>• Average value of a function using integration.<br>• Calculation of force using integration.<br>• Volume of an irregular shape using integration. | CO1 |
| 2.1 Solve population dynamics using first-order ODEs.<br>2.2 Calculate the vibration of a Mechanical system using differential equations.<br>2.3 Calculate the concentration of a reactant in a chemical reaction over time.<br>2.4 Calculate mechanical vibrations using second-order ODEs. | 2. | • Analysis of a population model through differential equations.<br>• Response of vibration of Mechanical system through differential equations.<br>• Analysis of chemical system using ODEs<br>• Vibrations of a mass-spring system. | CO2 |
| 3.1 Use Newton's method to find the roots of a non-linear equation in one variable.<br>3.2 Use the concept of Newton's method to solve financial modeling-related problems based on the Black-Scholes model.<br>3.3 Calculate the electric field (that satisfies Maxwell's equations) around a wire with a given shape and current, using Newton Raphson's method.<br>3.4 Use Bakhshali iterative methods for finding the approximate value of the square root. (IKS) | 3. | • Applications of iterative techniques.<br>• Application of Newton Raphson's method.<br>• Iterative scheme using Newton's method.<br>• Bakhshali iterative methods for finding the approximate value of square root. (IKS) | CO3 |
| 4.1 Use Numerical integration to determine the total quantity of Heat of given a material.<br>4.2 Use Simpson's 1/3rd rule to find the effective force on the mast of a racing sailboat. | 4. | • Calculation of Heat (Chemical/Bio Engineering based problem).<br>• Calculation of effective force (Civil/Environment engineering). | CO4 |

| Outcomes | S. No. | Tutorial Titles | Relevant COs Number(s) |
|---|---|---|---|
| 4.3 Apply Numerical integration to calculate work done for a given engineering problem. | | • Calculation of work done (Mechanical/Aerospace engineering-based problems). | |
| 5.1 Use Binomial distribution to solve the problems when the trials are repeated.<br>5.2 Use Poisson's distribution to solve the problems when the number of trials is large and the probability is minimal.<br>5.3 The birth weight follows the normal distribution curve, justified through an example. | 5. | • Applications of Binomial distribution.<br>• Applications of Poisson's distribution.<br>• 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 (Cl) 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. Surgent | Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1 |
| 4. | Calculus and Analytic Geometry | G. B. Thomas, R. L. Finney | Addison Wesley, 9th Edition, 1995. ISBN 978-8174906168 |
| 5. | Understanding Engineering Mathematics | John Bird | Routledge; First Edition ISBN 978-0415662840 |
| 6. | Advanced Engineering Mathematics | Krezig, Ervin | Wiley Publ., New Delhi,2014, ISBN: 978-0-470-45836-5 |
| 7. | 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://learnengg.com/LE/Index
17. https://ncert.nic.in/textbook.php
18. https://nios.ac.in/online-course-material/sr-secondary-courses/mathematics-(311).aspx

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

**(c) Others:**

1. Online Mathematics Courses.
2. Mathematics Communities and Forums.
3. Mathematics Journals.
4. Mathematics Podcast.
5. Mathematics Tutorials.
6. Mathematics Quizzes.
7. Mathematics Animation.
8. Mathematics Simulations.
9. Mathematics Games.
10. Mathematics Puzzles.
11. Mathematics Brain Teasers.
12. Mathematics Apps.
13. Mathematics Blog.
14. Mathematics Challenges.

******

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

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

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

**D) Rationale** :

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

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

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

- **CO-1** Use drawing instruments, drawing codes, dimensioning, conventions and symbols as per IS SP-46(2003) in engineering drawing.
- **CO-2** Draw geometrical figures, curves and engineering scales.
- **CO-3** Draw the views of objects using principles of orthographic projection.
- **CO-4** Draw isometric views of components directly or from orthographic projections.
- **CO-5** Draw free hand sketches of engineering elements, their orthographic and isometric views.
- **CO-6** Use computer aided drafting software to draw 2D and isometric geometric entities.

## F) Suggested Course Articulation Matrix (CAM):

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

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

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

## G) Teaching & Learning Scheme:

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

**Legend:**

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

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

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

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

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

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

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

## H) Assessment Scheme:

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

**Legend:**

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

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

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

**Note:**

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

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

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

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO 1a.* Use Drawing Instruments to prepare 2D drawings manually.<br>*TSO 1b.* Use different lines and annotations for a given situation.<br>*TSO 1c.* Draw engineering scale for the given situation.<br>*TSO 1d.* Choose appropriate scale factor for the drawing as per given situation.<br>*TSO 1e.* Dimension the given geometric figure using IS SP-46 standard.<br>*TSO 1f.* Draw the given regular geometric figure with tangents and normal.<br>*TSO 1g.* Draw selected engineering curve. | **Unit-1.0 Basic Elements of Drawing**<br>1.1 Methods to use different Drawing Instruments and supporting materials.<br>1.2 Different lines and conventions in engineering drawing.<br>1.3 Engineering scales and applications: Reduced, enlarged & full size (only Plain scale)<br>1.4 Dimensioning techniques: types and applications of chain, parallel and coordinate dimensioning as per SP-46.<br>1.5 Regular Geometrical figures, Tangency constructions.<br>1.6 Engineering Curves: only Ellipse and Parabola using concentric circle method, rectangular method and Eccentricity method when focus and directrix are given. | **CO1, CO2** |
| *TSO 2a.* Explain the different types of projections & their uses.<br>*TSO 2b.* Draw the orthographic projections of different objects<br>*TSO 2c.* Convert pictorial views into orthographic views | **Unit-2.0 Orthographic Projections**<br>2.1 Concept and applications of Orthographic, Perspective, Isometric and Oblique Projections.<br>2.2 Orthographic Projection: First and Third angle<br>2.3 Draw orthographic views of simple 3D entities containing lines, circles and arcs with axis/orientation parallel and/or perpendicular to the projection planes only. Problems should be restricted up to three views Front view/Elevation, Top view/Plan and Side views only using First Angle Method only.<br>2.4 Conversion of simple pictorial views into orthographic views. (Domain specific illustrative problems to be given by the teacher) | **CO1, CO2, CO3** |
| *TSO 3a.* Explain the Isometric Projection, Isometric view and Isometric Scale.<br>*TSO 3b.* Draw isometric dimensioning on the given isometric view.<br>*TSO 3c.* Explain the Methods of constructing isometric drawing<br>*TSO 3d.* Draw Isometric View of the given object containing elements like rectangular, circular, cylindrical shapes and slots on sloping and plane surfaces.<br>*TSO 3e.* Convert the given orthographic views into isometric View/Projection. | **Unit-3.0 Isometric Projection**<br>3.1 Introduction to isometric projection.<br>3.2 Isometric scale and Natural Scale.<br>3.3 Isometric view and isometric projection.<br>3.4 Illustrative problems limited to Isometric projection of objects containing rectangular, circular, cylindrical shapes and slots on sloping and plane surfaces.<br>3.5 Conversion of orthographic views into isometric View/projection. | **CO1, CO3, CO4** |
| *TSO 4a.* Sketch the given straight line, square, rectangle, circle and arc.<br>*TSO 4b.* Sketch the given simple orthographic and isometric views of the given part. | **Unit-4.0 Free Hand Sketches of Engineering Elements**<br>4.1 Materials for Sketching.<br>4.2 General Guidelines for Freehand Sketching. | **CO5** |

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO 4c.* Sketch the given domain specific engineering element/component. | 4.3 Freehand sketching of straight lines, square, rectangle, circles and arcs.<br>4.4 Free hand sketches of orthographic views.<br>4.5 Free hand sketches of isometric views.<br>4.6 Freehand sketching of domain specific engineering elements/components (e.g. Bolt, Nut, Washer, Stud, Screw, simple machine parts, etc. in case of mechanical, production, automobile, electrical engineering). | |
| *TSO 5a.* Use computer aided drafting software for creating the institute Drawing Template.<br>*TSO 5b.* Use computer aided drafting software for creating the given simple 2D entity. | **Unit-5.0 Basic Computer aided Drafting**<br>5.1 Basics of AutoCAD or any other drafting software–interface, screen layout, starting commands from menus, command line.<br>5.2 Coordinate system, Angular measurements, Point specification.<br>5.3 Drawing aids - Grid, Snap, Ortho, Osnap, Units, Limits, Layers, Linetype.<br>5.4 Opening and Saving drawing files.<br>5.5 Creating User Defined Templates.<br>5.6 Methods of Selecting and deleting Objects.<br>5.7 Undo and Redo.<br>5.8 Creating basic drawings objects - lines, arc, circles, ellipses, polyline and polygons. | **CO1, CO2, CO6** |
| *TSO 6a.* Use computer aided drafting software for creating orthographic views of the given object.<br>*TSO 6b.* Use computer aided drafting software for creating isometric views of the given object.<br>*TSO 6c.* Print the given drawing (using institute template) on A4/A3 sheet. | **Unit-6.0 Advanced Computer aided Drafting**<br>6.1 Modify commands - erase, copy, move, rotate, scale, stretch,<br>6.2 Array: concept and applications.<br>6.3 Controlling Drawing display<br>6.4 Text and Dimensioning<br>6.5 Layers: concept and application<br>6.6 Drawing orthographic vies using drafting software with principles mentioned in Unit 2.<br>6.7 Drawing isometric views using drafting software with principles mentioned in Unit 3.<br>6.8 Printing and plotting of drawings. | **CO1, CO2, CO3, CO4, CO6** |

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

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

| Practical/Lab Session Outcomes (LSOs) | S. No. | Laboratory Experiment/Practical Titles | Relevant COs Number(s) |
|---|---|---|---|
| *LSO 1.1.* Use manual drawing instruments<br>*LSO 1.2.* Draw simple 2D entities using manually drawing instruments. | 1. | Geometric Construction:<br>• Draw set of lines with different conditions (two problems).<br>• Draw circle and arcs with different geometric conditions and constraints (two problems).<br>• Draw polygons by general methods (Triangle, square, pentagon, hexagon, heptagon) (Three problems). | CO1, CO2 |
| *LSO 2.1.* Draw conic sections using manually drawing instruments.<br>*LSO 2.2.* Use different methods of construction of ellipse and parabola. | 2. | • Construct ellipse using four center method, arc of circle method and rectangle method.<br>• Construct parabola using rectangular method, and parallelogram method. | CO2 |
| *LSO 3.1.* Apply concepts of orthographic projection in drawing the given simple object on drawing sheet.<br>*LSO 3.2.* Visualize the three views related to the given object based on its shape and orientation. | 3. | Draw Orthographic projections of following using first angle method:<br>• A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P<br>• A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P<br>• Different objects having cylindrical surfaces, ribs.<br>(three views of each object, total six problems) | CO3 |
| *LSO 4.1.* Apply concepts of orthographic projection to draw three views of given domain specific object/ component. | 4. | Draw Orthographic projections of domain specific objects (three views of each object)<br>(Two problems). | CO3 |
| *LSO 5.1.* Use concepts of Isometric projection to draw the given simple object with slant surface. | 5. | Draw Isometric view of simple objects having plain and slanting surface by using natural scale.<br>(Three problems) | CO4 |
| *LSO 6.1.* Visualize the 3D shape of the given object.<br>*LSO 6.2.* Convert the given 2D figures/views into 3Dobject. | 6. | Convert the orthographic views of an object to isometric view.<br>(Two problems) | CO3, CO4 |
| *LSO 7.1.* Draw free hand sketches of the given domain specific object/component | 7. | Draw free hand sketches/conventional representation of your domain specific components (Six problems) | CO5 |
| *LSO 8.1.* Draw 3D free hand sketches from the given isometric shape. | 8. | Draw free hand sketch of isometric drawings (prepared in Sr. No. 05) without using any instruments. | CO5 |
| *LSO 9.1.* Draw 3D free hand sketches of the given real object/component. | 9. | Given the 3D model of an object, student will try to imagine the three views and draw them with free hand in the sketch book. | CO5 |
| *LSO 10.1.* Use computer aided drafting software to create and modify a template.<br>*LSO 10.2.* Insert any picture in the existing AutoCAD drawing | 10. | Prepare a template for your institute of A-4 size with title block and institute logo. | CO6 |

| Practical/Lab Session Outcomes (LSOs) | S. No. | Laboratory Experiment/Practical Titles | Relevant COs Number(s) |
|---|---|---|---|
| *LSO 10.3.* Insert text in the existing AutoCAD drawing | | | |
| *LSO 11.1.* Use computer aided drafting software to create and modify simple 2D entities.<br>*LSO 11.2.* Use computer aided drafting software to create and modify circles and arcs with different geometric conditions and constraints | 11. | Computer Aided Drafting: Use the software to draw following simple 2-D entities using Draw commands individually<br>• Draw circle and arcs with different geometric conditions and constraints (two problems).<br>• Draw polygons (Triangle, square, pentagon, hexagon, heptagon) (Three problems). | CO6 |
| *LSO 12.1.* Use computer aided drafting software to calculate Area, Perimeter, and Centroid of the given 2D entity | 12. | Use the software to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands. | CO6 |
| *LSO 13.1.* Use computer aided drafting software to draw complex 2D entities. | 13. | Use the software to draw four domain specific complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands | CO6 |
| *LSO 14.1.* Use computer aided drafting software to create and modify 2D entities.<br>*LSO 14.2.* Use computer aided drafting software to create and modify the given orthographic views. | 14. | Use the software to draw orthographic views of<br>• A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P<br>• A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P<br>• Different objects having cylindrical surfaces, ribs.<br>(three views of each object, total six problems) | CO3, CO6 |
| *LSO 15.1.* Use computer aided drafting software to create and modify the given isometric entities. | 15. | Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots | CO4, CO6 |

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

**a. Assignments**:

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

**b. Micro Projects:**

1. Through experimentation, justify that the eccentricity of an ellipse is 1.
2. Cut a Cardboard/Thermocole cone with various section planes to get circle, ellipse, parabola and hyperbola.
3. Explore the applications of engineering curves in different fields of engineering and prepare a short report.
4. List the shapes and curves you are observing around you in real life with name of place and item. (For Ex. ellipse, parabola, hyperbola, cycloid, epicycloids, hypocycloid, involute, spiral helix).
5. Cut triangular, square, rectangular and circular shaped Cardboard/Thermocole pieces and observe them by placing in different positions with respect to the protection planes.
6. Take a medium sized hexagonal nut and draw its isometric projection.
7. The teacher will assign one set of orthographic projections and ask the student to develop 3D Thermocol models of the same.
8. Prepare an A4 digital drawing template of your institute with title block and institute logo.
9. Each batch will collect 5 components/circuits/items specific to their branch and draw their orthographic views using AutoCAD software.
10. Download 5 videos on shortcuts used in AutoCAD, watch them and write a report to detail out the steps involved, Commands used.

**c. Other Activities:**

1. Seminar Topics:

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

2. Visits: Collect production/construction/circuit drawings from nearby industries/shop/builders and observe the type of orthographic projection, symbol of projection and various views used.

3. Self-Learning Topics:

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

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

| COs | Course Evaluation Matrix | | | | | | |
|---|---|---|---|---|---|---|---|
| | Theory Assessment (TA)** | | Term Work Assessment (TWA) | | | Lab Assessment (LA)# | |
| | Progressive Theory Assessment (PTA) Class/Mid Sem Test | End Theory Assessment (ETA) | Term Work& Self Learning Assessment | | | Progressive Lab Assessment (PLA) | End Laboratory Assessment (ELA) |
| | | | Assignments | Micro Projects | Other Activities* | | |
| **CO-1** | **-** | **-** | 05% | - | - | 05% | 16% |
| **CO-2** | - | - | 05% | 20% | 20% | 05% | 16% |
| **CO-3** | - | - | 20% | 20% | 20% | 15% | 16% |
| **CO-4** | - | - | 20% | 20% | 20% | 15% | 16% |
| **CO-5** | - | - | 15% | 20% | 20% | 20% | 16% |
| **CO-6** | - | - | 35% | 20% | 20% | 40% | 17% |
| **Total Marks** | **-** | **-** | **20** | **20** | **10** | **20** | **30** |
| | | | **50** | | | | |

**Legend:**

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

**Note:**

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

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

## O) Suggested AssessmentTable for Laboratory (Practical):

| S. No. | Laboratory Practical Titles | Relevant COs Number(s) | PLA/ELA | | |
|---|---|---|---|---|---|
| | | | Performance | | Viva-Voce (%) |
| | | | PRA* (%) | PDA** (%) | |
| 1. | Geometric Construction:<br>• Draw set of lines with different conditions (two problems).<br>• Draw circle and arcs with different geometric conditions and constraints (two problems).<br>• Draw polygons by general methods (Triangle, square, pentagon, hexagon, heptagon) (Three problems). | CO1, CO2 | 30 | 60 | 10 |
| 2. | • Construct ellipse using four center method, arc of circle method and rectangle method<br>• Construct parabola using rectangular method, and parallelogram method | CO2 | 30 | 60 | 10 |
| 3. | Draw Orthographic projections of following using first angle method:<br>• A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P<br>• A frustum of a hexagonal is placed in third quadrant with its axis parallel to H.P. and V.P<br>• Different objects having cylindrical surfaces, ribs.<br>(three views of each object, total six problems) | CO3 | 30 | 60 | 10 |
| 4. | Draw Orthographic projections of domain specific objects (three views of each object) (Two problems). | CO3 | 30 | 60 | 10 |
| 5. | Draw Isometric view of simple objects having plain and slanting surface by using natural scale. (Three problems) | CO4 | 30 | 60 | 10 |
| 6. | Convert the orthographic views of an object to isometric view (Two problems) | CO3, CO4 | 30 | 60 | 10 |
| 7. | Draw free hand sketches/conventional representation of your domain specific components (Six problems) | CO5 | 30 | 60 | 10 |
| 8. | Draw free hand sketch of all above isometric drawings (prepared in Sr. No. 06) without using any instruments. | CO5 | 30 | 60 | 10 |
| 9. | Given the 3D model of an object, student will try to imagine the three views and draw them with free hand in the sketch book. | CO5 | 40 | 50 | 10 |
| 10. | Prepare a template for your institute of A-4 size with title block and institute logo. | CO6 | 40 | 50 | 10 |
| 11. | Computer Aided Drafting: Use the software to draw following simple 2-D entities using Draw commands individually<br>• Draw circle and arcs with different geometric conditions and constraints (two problems).<br>• Draw polygons (Triangle, square, pentagon, hexagon, heptagon) (Three problems). | CO6 | 40 | 50 | 10 |
| 12. | Use the software to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon | CO6 | 40 | 50 | 10 |

| S. No. | Laboratory Practical Titles | Relevant COs Number(s) | PLA/ELA | | |
|---|---|---|---|---|---|
| | | | Performance | | Viva-Voce (%) |
| | | | PRA* (%) | PDA** (%) | |
| | and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands. | | | | |
| 13. | Use the software to draw four domain specific complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands | CO6 | 40 | 50 | 10 |
| 14. | Use the software to draw orthographic views of<br>• A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P<br>• A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P<br>• Different objects having cylindrical surfaces, ribs.<br>(three views of each object, total six problems) | CO3, CO6 | 40 | 50 | 10 |
| 15. | Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots | CO4, CO6 | 40 | 50 | 10 |

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

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

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

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

| S. No. | Name of Equipment, Tools and Software | Broad Specifications | Relevant Experiment/Practical Number |
|---|---|---|---|
| 1. | Drawing Table with Drawing Board | Drawing Table with Drawing Board of Full Imperial/ A1 size. | 1 to 9 |
| 2. | Models and Charts | Normal and cut sectioned Models and Charts of objects for orthographic / isometric projections | 1 to 9 |
| 3. | Drawing equipments and instruments | Drawing equipments and instruments for class room teaching-large size:<br>• T-square or drafter (Drafting Machine).<br>• Set squires (450 and 300-600)<br>• Protector.<br>• Drawing instrument box (containing set of compasses and dividers).<br>• Drawing sheets, Drawing pencils, Eraser.<br>• Drawing pins / clips | 1 to 9 |
| 4. | Sample production/construction drawings | From nearby industries, construction companies and developed by senior teachers of the state | All |
| 5. | Interactive board (165 x 130 cm) | Supports dual touch, dual write and intuitive gestures, such as toss, rotate and zoom with multitouch operating systems, such as Windows® | All |

| S. No. | Name of Equipment, Tools and Software | Broad Specifications | Relevant Experiment/Practical Number |
|---|---|---|---|
| 6. | Computer aided drafting software like AutoCAD | Latest educational licensed network version | 9 to 15 |
| 7. | CAD workstations | latest configuration<br>Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10 | 9 to 15 |
| 8. | Printer/plotter | A3 size | 9 to 15 |

## R) Suggested Learning Resources:

### (a) Books:

| S. No. | Titles | Author(s) | Publisher and Edition with ISBN |
|---|---|---|---|
| 1. | Engineering Drawing | N.D. Bhatt | Charotar Publishing House, Anand, Gujrat 2010;<br>ISBN: 978-93- 80358-17-8. |
| 2. | Engineering Drawing | R.K. Dhawan | S. Chand and Company, New Delhi; ISBN: 81-219-1431-0. |
| 3. | Engineering Drawing | P.J. Shah | S. Chand & Company, New Delhi, 2008, ISBN:81-219-2964-4. |
| 4. | Engineering Graphics with AutoCAD | A.K. Sarkar, A.P. Rastogi, D.M. Kulkarni | PHI Learning<br>Private Limited-New Delhi (2010); ISBN: 978-8120337831. |
| 5. | Engineering Drawing and Graphics using AutoCAD | T. Jeyapoovan | Vikas Publishing House Pvt. Ltd, Noida, 2011; ISBN: 978-8125953005. |
| 6. | Engineering Graphics | S. K. Pradhan<br>K.K. Jain | Khanna Book Publishing Company Pvt. Ltd., New Delhi<br>ASIN : B0BM5BMMXT<br>ISBN-10 : 9355381891<br>ISBN-13 : 978-9355381897 |

### (b) Online Educational Resources:

1. Scales: https://youtu.be/YSEZu3Ch26k
2. Dimensioning: https://youtu.be/_OSY04TnlEM
3. Simple Orthographic Projections: https://youtu.be/DW7dpKdxVrA
4. Orthographic Projections of objects with slant and curved surfaces: https://youtu.be/dCWjBvZBpjM
5. Illustrative Example: https://youtu.be/MR5de9EC940
6. Illustrative Example: https://youtu.be/mahh-WONNHA
7. Isometric Projection of 3D objects: https://youtu.be/0K-5URiyi50
8. Isometric Projection-Object with slant surfaces: https://youtu.be/qSPJOiXKv98
9. Isometric Projection-Object with curved surfaces: https://youtu.be/qSPJOiXKv98
10. Missing lines and missing views: https://nptel.ac.in/courses/105/104/105104148/
11. Launching AutoCAD and Opening drawing: https://youtu.be/aoo-t0-gEfw
12. AutoCAD Main Screen: https://youtu.be/D0YyEiCjwpk
13. Draw and Modify Toolbars: https://youtu.be/T_RN_RBFk7o
14. Illustrative Example-1: https://youtu.be/_Bheo9MzeVk
15. Block creation: https://youtu.be/ZguZZVjxaek

16. Rectangular and Polar array : https://youtu.be/YgYZgbrUJ_M
17. Illustrative Example-2: Array: https://youtu.be/yJf_IsWX4gM
18. Dimensioning: https://youtu.be/sEiRsi14u0U
19. Use of layers: https://youtu.be/fdQqNdDtOI8
20. Illustrative Example 3: Flywheel: https://youtu.be/AU-Vsd2T0DA

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

### (c) Others:

1. Bureau of Indian Standards, Engineering Drawing Practice for Schools and Colleges IS: SP-46, BIS, Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2.
2. AutoCAD e manual

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**A) Course Code** : **2400009(T2400009)**

**B) Course Title** : Open Educational Resources (OER)
(FTS, CHE, CSE, EE, ME, ME (Auto), MIE, ELX, AIML, CRE, CACDDM, AE, CE, ELX (R), GT)

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

**D) Rationale** :

Open educational resources (OER) are openly-licensed, freely available educational materials that can be modified and redistributed by users. Learning about Open Educational Resources (OER), copyright, and Creative Commons licenses is a valuable endeavor for content creators, users, and anyone interested in sharing knowledge and creative works. Creative Commons licenses, offer a standardized way to grant permissions for the use and sharing of creative works. Learning about OER, copyright, and Creative Commons licenses is an ongoing process. As these fields evolve, it's important to stay informed and continue exploring new resources and practices.

After going through this course, students will at first place have reasonable idea to explore and use various OERs useful for their course of study and secondly, be motivated for fair use of resources available to them on various platform by understanding the restrictions and legal issues related to copyright and other licensing policies.

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

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

**CO-1** Use Open Educational Resources (OER) after their evaluation
**CO-2** Use copyright material appropriately.
**CO-3** Implement suitable Creative Common License.

## F) Suggested Course Articulation Matrix (CAM):

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

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

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

## G) Teaching & Learning Scheme:

| Course Code | Course Title | Scheme of Study (Hours/Week) | | | | |
|---|---|---|---|---|---|---|
| | | Classroom Instruction (CI) | | Notional Hours (TW/ Activities+ SL) | Total Hours (CI+TW/ Activities) | Total Credits (C) |
| | | L | T | | | |
| **2400009** | Open Educational Resources | 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) | |
| **2400009** | Open Educational Resources | 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: T2400009

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO 1a.* Explain the difference between OER and other free educational materials.<br>*TSO 1b.* Describe the challenges and benefits of using OER in a class.<br>*TSO 1c.* Apply various aspects of evaluating OER before use<br>*TSO 1d.* Explain necessity to assess an OER's adaptability.<br>*TSO 1e.* Use preliminary search for open educational resource.<br>*TSO 1f.* Find OER using various resources. | **Unit-1.0 Open Educational Resources**<br>1.1 OER - definition<br>1.2 What is NOT OER.<br>1.3 Benefits of using OER – Benefits to Students - Access to Quality Education<br>1.4 OER - Benefits to Faculty - Use, Improve and Share, Network and collaborate with peers, Lower Cost, Improve access to information<br>1.5 Challenges of Using OER – Subject Availability, Format and Material type availability, Time and Support availability<br>1.6 Evaluating OER – a) Clarity, Comprehensibility, and Readability, b) Content and Technical Accuracy, c) Adaptability and Modularity, d) Appropriateness and Fit, e) Accessibility<br>1.7 Finding Open Content - OER Search Scenario Filter by Usage Rights in Google, Repositories and Search Tools, Subject-specific Repositories | **CO1** |
| *TSO 2a.* Explain benefits of copyright protection for creator<br>*TSO 2b.* Explain exceptions and limitations to copyright law<br>*TSO 2c.* List rights granted to copyright holders.<br>*TSO 2d.* Explain Exceptions and limitations to copyright law<br>*TSO 2e.* Explain Fair use/fair dealing apply to copyright<br>*TSO 2f.* Elaborate Public domain and how does it relate to copyright<br>*TSO 2g.* Elaborate penalties for copyright infringement.<br>*TSO 2h.* Explain copyright for digital content and the internet.<br>*TSO 2i.* Explain use of copyrighted works in education<br>*TSO 2j.* Explain the use of free licenses | **Unit-2.0 Copyright and Open Licensing**<br>2.1 Copyright and what it does protect, benefits of copyright protection for creators, duration of copyright protection last, rights granted to copyright holders.<br>2.2 Exceptions and limitations to copyright law, fair use/fair dealing apply to copyright<br>2.3 Public domain and its relation to copyright.<br>2.4 Penalties for copyright infringement<br>2.5 Apply copyright to digital content and the internet<br>2.6 Use of copyrighted works in education.<br>2.7 Open Licenses – GNU – Free Documentation license, Free Art License<br>2.8 Why Free Licenses – Retain, Reuse, Revise, Remix, Redistribute | **CO2** |
| *TSO 3a.* Describe the four different Creative Commons License components.<br>*TSO 3b.* Explain the reason some CC-licensed content might not be considered OER.<br>*TSO 3c.* Explain the Strength and weakness of four Open CC Licenses<br>*TSO 3d.* Choose the right Creative Commons license for work.<br>*TSO 3e.* Apply a Creative Commons license to existing work. | **Unit-3.0 Creative Common Licenses**<br>3.1 Alternatives to copyright as Creative Commons licenses.<br>3.2 Four components of creative common Licenses – Attribution, Share- Alike, Non – commercial, No Derivatives<br>3.3 Choosing a Creative common licenses – Wiley's 5 Rs and Creative Common Licenses<br>3.4 Four Open CC Licenses and Their Strengths and Weaknesses – (a) CC BY (b) CC BY SA (c) CC BY NC (d) CC BY NC SA | **CO3** |

| Major Theory Session Outcomes (TSOs) | Units | Relevant COs Number(s) |
|---|---|---|
| *TSO 3f.* Use of Creative Commons licenses for commercial purposes.<br>*TSO 3g.* Modify a work licensed under Creative Commons.<br>*TSO 3h.* Revoke a Creative Commons license, combine works with different Creative Commons licenses<br>*TSO 3i.* Differentiate between Attribution and Citation | 3.5 Attribution Vs Citation - Creative Commons licensed work without giving attribution<br>3.6 Apply a CC License - choose the right Creative Commons license for work, apply a Creative Commons license to existing work, Creative Commons licenses be used for commercial purposes, modify a work licensed under Creative Commons, revoke a Creative Commons license, combine works with different Creative Commons licenses | |

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

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

**a. Assignments**:

**Related to Open Educational Resources – CO1**

i. OER help to reduce the cost of education for students. Justify?
ii. Explain why it is necessary to assess an OER's adaptability?
iii. Identify four search tools for finding open educational resources?
iv. Identify at least two search tools for finding openly licensed media?

**Related to Copyright – CO2**

i. Explain copyright and what does it protect
ii. Explain the rights granted to copyright holders
iii. Describe the exceptions and limitations to copyright law
iv. Elaborate the way fair use/fair dealing apply to copyright?
v. Describe the public domain and its relationship with copyright
vi. Elaborate the penalties for copyright infringement?
vii. Explain copyright apply to digital content and the internet
viii. Explain the way copyright law address the use of copyrighted works in education

**Related to Creative Common Licenses – CO3**

i. Explain various Creative Commons licenses
ii. Describe, how can you apply a Creative Commons license to your existing work?
iii. Explain the benefits of using Creative Commons licenses?
iv. Elaborate, how you can modify a work licensed under Creative Commons?
v. Are Creative Commons licenses valid worldwide?
vi. Elaborate how Creative Commons license can be revoked, once it has been applied to your work?
vii. Explain, how anyone use a Creative Commons licensed work without giving attribution?
viii. Explain the limitations/restrictions while using works with Creative Commons licenses?

**b. Micro Projects:**

1. Collect information on the impact of OER on cost savings and student engagement.
2. Search at least four OER related to topic of your Engineering Discipline over Internet. Evaluate the material based on the relevance, accuracy and usability.
3. Explore the different types of resources under creative Commons licenses (e.g., CC BY, CC BY-SA, CC BY-NC, etc.) and their specific permissions and restrictions.

4. Create a comparative analysis chart or infographic that visually represents the key characteristics of each license.
5. Select minimum 5 real-world examples from different domains (such as music, art, literature, or education) where creators have used Creative Commons licenses.

**c. Other Activities:**

1. Seminar Topics:
   - OER Quality Assurance
   - OER Repositories and Platforms
   - Creative Commons and Digital Media
   - Creative Commons in the Visual Arts
   - Examine the legal implications of using Creative Commons licenses, including the obligations and responsibilities of both creators and users and present it.
2. Self-Learning Topics:
   - Open Licensing and Copyright: Understanding the Legal Framework for OER
   - Creative Commons and the future of Copyright
   - Copyright and Open Access Publishing
   - Copyright and Software

**K) 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, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, 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.

## L) List of Major Laboratory Equipment, Tools and Software: (If Any)

| S. No. | Name of Equipment, Tools and Software | Broad Specifications |
|---|---|---|
| 1. | Computers | Desktop computer with word processing and presentation facility |
| 2. | Internet | Internet Connectivity |

## M) Suggested Learning Resources:

**(a) Books**:

| S. No. | Titles | Author(s) | Publisher and Edition with ISBN |
|---|---|---|---|
| 1. | The OER Starter Kit. | Abbey Elder – 2019 | IA: Iowa State University Digital Press, available under a Creative Commons Attribution 4.0 International License. Retrieved from iastate.pressbooks.pub/oerstarterkit |
| 2. | A Brief History of Open Educational Resources | Bliss, T J and Smith, M. - 2017 | In: Jhangiani, R S and Biswas-Diener, R. (Eds.) Open: The Philosophy and Practices that are Revolutionizing Education and Science (pp. 9–27). London: Ubiquity Press. DOI: https://doi.org/10.5334/bbc.b. |

**Note:** Above listed books are available in soft form and can be downloaded as given respective link

**(b) Online Educational Resources:**

1. OER for Empowering Teachers Instructional Material by P. Malliga is licensed under a Creative Commons Attribution 4.0 International License.
2. William & Flore Hewlett Foundation. (n.d.). OER defined. Retrieved from https://hewlett.org/strategy/open-educational-resources/
3. Free Software Foundation. (2008). GNU Free Documentation License. Retrieved from https://www.gnu.org/licenses/fdl.html
4. Copyleft Attitude. (2007). Free Art License 1.3. Retrieved from http://artlibre.org/licence/lal/en/
5. Free Software Foundation. (n.d.). What is copyleft? Retrieved from https://www.gnu.org/copyleft/copyleft.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.

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