**GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**

**Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**
I/II – Semester

Course Title: **Basic Chemistry**
(Course Code: 4300011)

| Diploma programme in which this course is offered | Semester in which offered |
|---|---|
| Chemical Engineering, Textile Processing Technology | First |
| Printing Technology, Textile Manufacturing Technology, Textile Designing | Second |

## 1. RATIONALE

The branch of applied science that deals with chemistry is known as Basic chemistry. The study of concepts and principles of Basic chemistry will aid the technicians in comprehending and solving engineering problems. Thus, a strong foundation in applied science will help the students in their self-development to cope up with the constant influx of innovations. There are numerous materials used in fabricating and manufacturing devices for the comfort of life. The selection, characterization, and suitability assessment of natural raw materials essentially requires principles and concepts of Basic Chemistry for technicians. Successful completion of this course content will enable technicians to understand, ascertain and analyze properties of natural raw materials required for producing economical and eco-friendly finished products.

## 2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competencies through various teaching-learning experiences:

- **Use principles of basic chemistry to solve broadly-defined engineering problems.**

## 3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

- Apply the principles of chemical bonding and solutions to solve various engineering problems.
- Solve the engineering problems using the concepts of electrochemistry and corrosion.
- Use relevant water treatment methods to solve domestic and industrial problems.
- Classify organic compounds on the basis of their functional groups.
- Choose various types of engineering materials like lubricants, polymers, Elastomers and Adhesives for domestic and industrial applications.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P/2) | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | Total Marks |
| L | T | P | C | CA | ESE | CA | ESE | |
| 3 | - | 2 | 4 | 30* | 70 | 25 | 25 | 150 |

*(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate the integration of COs, and the remaining 20 marks are the average of 2 tests to be taken during the semester for assessing the attainment of the cognitive domain UOs required for the attainment of the COs.*

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

## 5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents of the COs. *These PrOs need to be attained to achieve the Cos.*

| S. No. | Practical Outcomes (PrOs) | Unit No. | | Approx. Hrs. required |
|---|---|---|---|---|
| 1 | Prepare a standard solution of oxalic acid or potassium permanganate. | I | | 02 |
| 2 | Determine the strength of the given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator. | I | | 02 |
| 3 | Standardize potassium permanganate solution by standard oxalic acid solution and estimate ferrous ions. | II | Any Three | 02 |
| 4 | Determine pH-Values of given samples of Solution by using Universal Indicator and pH-meter. | II | | 02 |
| 5 | Determine emf of an electrochemical cell (Daniel cell). | II | | 02 |
| 6 | Determine electrochemical equivalent of copper metal using Faraday's first law. | II | | 02 |
| 7 | Determine the rate of corrosion for different metals in the given solution. | III | | 02 |
| 8 | Determine the rate of corrosion for metal in the solution of different pH. | III | | 02 |
| 9 | Estimate total hardness of given water sample using standard EDTA solution. | IV | Any Three | 02 |
| 10 | Estimate alkalinity of given water sample using 0.01M sulphuric acid solution. | IV | | 02 |
| 11 | Determine Total Dissolved Solid (TDS) and Total | IV | | 02 |

| S. No. | Practical Outcomes (PrOs) | Unit No. | | Approx. Hrs. required |
|---|---|---|---|---|
| | Suspended Solid (TSS) in a given sample of water. | | | |
| 12 | Determine viscosity of lubricating oil using Redwood viscometer. | VI | | 02 |
| 13 | Determine the Acid value of the given lubricating oil | VI | | 02 |
| 14 | Determine the Saponification value of the given lubricating oil | VI | | 02 |
| 15 | Determine flash point and fire point of the given lubricating oil using Pensky Martens/Cleveland open cup apparatus/Able's flashpoint apparatus. | VI | | 02 |
| 16 | Prepare Polystyrene and Bakelite (Any one). | VII | | 02 |
| | **Total Hrs.** | | | **28** |

***Note***

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

i. *The f**ollowing are some sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) with approximate percentage weightage that occur in the above listed **Practical Exercises** of this **course** required which are embedded in the COs and ultimately the competency.*

| *S. No.* | *Sample Performance Indicators for the PrOs* | *Weightage in % (Approximate)* |
|---|---|---|
| *1* | *Prepare experimental setup accurately.* | *10* |
| *2* | *Use apparatus for precise measurement*s. | 20 |
| 3 | Practice and adapt good and safe measuring techniques. | 10 |
| 4 | Good Record keeping of the observations accurately. | 20 |
| 5 | Interpret the results and their conclusion. | 20 |
| 6 | Prepare Report in prescribed format | 10 |
| 7 | Viva-Voce | 10 |
| **Total** | | **100** |

## 6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure the conduction of practice in

all institutions across the state in a proper way so that the desired skills are developed in students.

| S. No. | Equipment Name with Broad Specifications | PrO. No. |
|---|---|---|
| 1. | **Digital pH Meter:**<br>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 | 4 |
| 2. | **Redwood Viscometer:**<br>Flow Range (Viscosity) in second: 20-2000, Redwood Viscometer Model No.: 01, Material: Stainless Steel, Bath Capacity (Approx.): 7 liters, Temperature Required: 95 ℃, Power supply: 220 Volt, 800 Watt, 50 Hz. | 12 |
| 3. | **Pensky Martens Flash Point Apparatus:**<br>Voltage: 220-240V, Phase: Single phase, Power Source: Electric, Timing Range: 999.9s<br>OR<br>**Cleveland Open Cup Apparatus:**<br>Temperature range: Ambient to 370℃, Temp. measurement PT100 temp. sensor, Temp. scale resolution 0.1℃, Ignition source gas or electric, cooling forced air cooling, heating coil, heating 888W, 220V, AC.<br>OR<br>**Abel's Flash Point Apparatus:**<br>Material: Stainless Steel, Power Source: Electric, Voltage: 115V/220-240V, 50-60 Hz, Dimensions: 230 mm x 470 mm x 470 mm (W x D x H) Temperature Range: 70 ℃, Resolution: 0.1 ℃ | 15 |
| 4. | **Hot Air Oven:**<br>Temperature is controlled by digital temperature indicator cum controller from ambient to 250°C with ± 0.1°C Accuracy. Power supply: 220/230V, 50Hz single phase, Capacity (Approx.): 50 – 100 liter, Type of Shelves: 03, Material of Inner Chambers: SS 304, Material of Outer Chamber: MS with powder coated paint, Material of Shelves: SS wire mesh. | 11 |
| 5. | **Laboratory Weighing Balance:**<br>Type of Laboratory Balance: Analytical, Sensitivity (mg): 1 mg, Maximum Capacity of weighing (grams): 200 g, Shape of PAN: Circular, Power Supply: Single Phase, Display: LED. | All |

| | | |
|---|---|---|
| 6 | **Hot Plate With Magnetic Stirrer:**<br>Number of stirring Positions:1, Calibration: Automatic Calibration,<br>Magnetic stirrer with a hot plate, Speed Control Accuracy of set speed (+/-) (RPM): 5, Maximum Stirring capacity per position: 3000 ml,Top plate Material: Stainless steel | 1,2,3,4,9,10, 11,13,14, |

## 7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices
c) Observe safety measures
d) Good house keeping
e) Time management
f) Practice environmentally friendly methods and processes. (Environment-related)

The ADOs are best developed through laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

## 8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

| Unit | Unit Outcomes (UOs) | Topics and Sub-topics |
|---|---|---|
| **Unit – I**<br><br>**Atomic Structure, Chemical Bonding and Solutions** | 1a. Apply the different atomic theories, models and principles for structural illustration.<br>1b. Explain Pauli's exclusion principle, Hund's rule and Aufbau rule with examples.<br>1c. Write the electronic configurations of different elements.<br>1d. Describe the different types of chemical bonds. | 1.1. Atomic Structure: Concepts of orbit and orbital, Pauli's exclusion principle.<br>1.2. Hund's rule of maximum multiplicity,<br>1.3. Aufbau rule, electronic configuration of atom (up to atomic number 30)<br>1.4. Chemical Bonding: Concept of chemical bonding, types of chemical bonds, Ionic bond, and its characteristics (example NaCl), Covalent bond and its |

| Unit | Unit Outcomes (UOs) | Topics and Sub-topics |
|---|---|---|
| | 1e. Differentiate among the ionic, covalent and coordinate compounds based on the type of chemical bonding.<br>1f. Explain various properties of materials depending upon bond formation.<br>1g. Prepare the solution of given concentrations (Normality, Molarity). | characteristics (example $H_2$, $O_2$, $N_2$, HF, $NH_3$, $H_2O$, $CH_4$), Coordinate covalent bond (example $NH_4^+$, $H_3O^+$), Metallic bond and its characteristics, Hydrogen bonding, its types, and Significance, Intermolecular force of attraction.<br>1.5. Molecular arrangement in solid, liquid and gases, Structure of solids - Molecular solid, Ionic solid, Network solid, and Metallic solid.<br>1.6. Solutions: The idea of solute, solvent, and solution, Methods to express the concentration of solution - Normality, Molarity (*M* = mole per liter), ppm, mass percentage, volume percentage, and mole fraction. |
| **Unit – II**<br><br>**Concepts of Electrochemistry** | 2a. Explain the theory of ionization and the factors affecting it.<br>2b. Describe pH value and its industrial application.<br>2c. Describe different types of buffer solutions and their application.<br>2d. Differentiate electrolyte and nonelectrolyte.<br>2e. Describe the construction and working of an electrochemical cell and standard hydrogen electrode (SHE)<br>2f. State the Nernst equation and Faraday's laws of electrolysis and its application.<br>2g. Use the different electrolysis processes such as electro metallurgy, electroplating, and electrorefining to solve wide variety of industrial | 2.1. Arrhenius theory of ionization.<br>2.2. Electronic concept of oxidation, reduction, and redox reactions.<br>2.3. Degree of ionization and factors affecting the degree of ionization.<br>2.4. Definition of pH, pH of acid, base and neutral solution, pH calculations for acid, base, and salt solutions at different concentrations, Importance of pH in various fields.<br>2.5. Definition of buffer solution, buffer action and types of buffer solution, Application of buffer solution.<br>2.6. Definition of terms: electrolytes, non-electrolytes with suitable examples, Types of electrolytes.<br>2.7. Construction and working of Electrochemical Cell.<br>2.8. Construction and working of Standard Hydrogen Electrodes (SHE).<br>2.9. Nernst theory of single electrode potential and Nernst equation.<br>2.10. Electrochemical series. |

| Unit | Unit Outcomes (UOs) | Topics and Sub-topics |
|---|---|---|
| | problems. | 2.11. Electrolysis, Faraday's laws of electrolysis.<br>2.12. Industrial application of electrolysis: Electro metallurgy, electroplating, electro refining. |
| **Unit– III**<br><br>**Corrosion of metals and its prevention** | 3a. Describe the various types of corrosion.<br>3b. Identify the different factors affecting the rate of corrosion.<br>3c. Explain the various type of protective measures to prevent corrosion.<br>3d. Select relevant method to prevent metal from corrosion | 3.1. Corrosion: Dry or Chemical corrosion: Oxidation corrosion-mechanism, Corrosion by other gases.<br>3.2. Wet or Electrochemical corrosion-$H_2$ liberation and $O_2$ absorption mechanism of electrochemical corrosion.<br>3.3. Galvanic corrosion mechanism.<br>3.4. Concentration cell corrosion.<br>3.5. Pitting corrosion, Waterline and Crevice corrosion.<br>3.6. Factors affecting the rate of corrosion: Nature of the metal, Nature of surface film, Relative areas of the anodic and cathodic parts, Purity of metal, Temperature, Humidity of air, Influence of pH.<br>3.7. Internal and External corrosion preventive measures: Modification of environment, Modification of the properties of metal, Use of protective coatings, Anodic and cathodic protection, Modification in design and choice of material. |
| **Unit– IV**<br><br>**Water** | 4a. Classify hard and soft water based on their properties .<br>4b. Determine the hardness of water by EDTA method.<br>4c. Softening the hard water by applying the different water softening methods.<br>4d. Apply the different treatment methods for purification of water.<br>4e. Use the Indian standard specification of drinking water. | 4.1 Introduction, Source of water, Hard water and soft water.<br>4.2 Salts cause water hardness, Unit of hardness, and simple numerical on water hardness.<br>4.3 Problems caused by the use of hard water in boilers and its prevention.<br>4.3.1 Scale and sludge, Foaming and Priming, Caustic embrittlement, Corrosion<br>4.4 Water softening techniques: Soda-lime process, Zeolite process, Ion exchange process, Reverse Osmosis process (R.O.)<br>4.5 Treatment of Municipal drinking |

| Unit | Unit Outcomes (UOs) | Topics and Sub-topics |
|---|---|---|
| | | water: Screening, Sedimentation, Coagulation, Filtration, Sterilization of water by chlorination, Break-point of Chlorination.<br>4.6 Enlist Indian standard specification of drinking water. |
| **Unit– V**<br><br>**Basic concepts of Organic Chemistry** | 5a. Differentiate Organic and Inorganic compounds.<br>5b. Explain the concept of hybridization.<br>5c. Describe the term of isomerism and homologous series, saturated and unsaturated hydrocarbon.<br>5d. Classify organic compounds based on functional groups<br>5e. Write the IUPAC name of simple hydrocarbons.<br>5f. Describe the preparation method, properties and application of ethane, ethylene and acetylene. | 5.1 Organic and Inorganic Compounds.<br>5.2 Tetravalency of carbon.<br>5.3 concept of hybridization- sp, sp2 and sp3 types of hybridization with examples of each.<br>5.4 Sigma and pi bonding.<br>5.5 Classification of Organic compounds and IUPAC nomenclature of simple hydrocarbons.<br>5.6 Functional group classification.<br>5.7 Isomerism and Homologous series, Saturated and unsaturated hydrocarbon,<br>5.8 Source of hydrocarbon:<br>5.8.1 Distillation of coal tar, Refining of petroleum.<br>5.9 Preparation, properties and applications of, Alkane – Ethane, Alkene – Ethylene, Alkyne - Acetylene. |
| **Unit– VI**<br><br>**Lubricants** | 6a. Explain terms lubricant and lubrication<br>6b. Describe the types of lubricants.<br>6c. Describe the physical and chemical properties of a lubricant.<br>6d. Selection of proper lubricants for engineering use.<br>6e. Select relevant lubricant based on their function and characteristic properties for use in different kind of machinery.<br>6f. State the biodegradable lubricants. | 6.1 lubricants and Lubrication, Functions of lubricants.<br>6.2 Mechanism of Lubrication: Fluid lubrication, Boundary lubrication. Classification of lubricant with examples: Solid, Semi-solid, liquid and synthetic lubricants.<br>6.3 Physical Properties of lubricants: Viscosity and viscosity index, Flash and fire point, Cloud and pour point, Oiliness.<br>6.4 Chemical properties of lubricants: Saponification number, Neutralization number, Emulsification number.<br>6.5 Selection of lubricants for different types of Machinery like: Gears, Cutting tools, Steam turbine, Transformers.<br>6.6 Biodegradable lubricants. |

| Unit | Unit Outcomes (UOs) | Topics and Sub-topics |
|---|---|---|
| **Unit– VII**<br><br>**Polymers, Elastomers, and Adhesives** | 7a. Classify Polymers based on molecular structures and monomers.<br>7b. Differentiate thermoplastic and thermosetting polymers with examples.<br>7c. Explain polymerization reactions with examples.<br>7d. Describe the applications of thermoplastic and thermosetting polymers.<br>7e. Describe the application of biodegradable polymers.<br>7f. Explain the properties and application of synthetic rubbers.<br>7g. Explain the process of vulcanization rubber.<br>7h. Explain the different types of adhesives and their application | 7.1 Definition of Monomer, Polymer and Polymerization.<br>7.2 Classification of Polymers based on molecular structure: Linear Polymers, Branched Polymers and Cross-linked Polymers.<br>7.3 Classification of polymers based on Monomer: Homopolymer, Copolymer.<br>7.4 Classification of polymers based on thermal behavior: Thermoplastics and Thermosetting polymers.<br>7.5 Types of polymerizations: Addition and condensation polymerization<br>7.6 Simple reactions involved in the preparation and their properties and application of thermoplastics and thermosetting polymers: Polyethylene, Polypropylene, Polyvinyl chloride, Polytetrafluoroethylene (Teflon), Polystyrene, Polyacrylonitrile, Bakelite, Epoxy resins<br>7.7 Biodegradable Polymers: Introduction, chemical composition, and application: Polyβ-hydroxybutyrate–co-β-hydroxy valerate (PHBV), Nylon-2–nylon-6.<br>7.8 Rubber: Natural rubber and its properties, Vulcanization of rubber, Synthetic rubber – simple reaction involved in the preparation and their properties and application: Buna-S rubber, Buna-N rubber, Neoprene rubber<br>7.9 Adhesives: Characteristics, Classification, and application of adhesives. |

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Atomic Structure, Chemical Bonding, and Solutions | 06 | 03 | 03 | 02 | 08 |

| | | | | | | |
|---|---|---|---|---|---|---|
| II | Concepts of Electrochemistry | 07 | 02 | 06 | 04 | 12 |
| III | Corrosion of Metals and its Prevention | 05 | 02 | 04 | 02 | 08 |
| IV | Water | 07 | 02 | 05 | 05 | 12 |
| V | Basic concepts of Organic Chemistry | 05 | 03 | 04 | 03 | 10 |
| VI | Lubricants | 05 | 02 | 04 | 02 | 08 |
| VII | Polymers, Elastomers, and Adhesives | 07 | 02 | 06 | 04 | 12 |
| **Total** | | **42** | **16** | **32** | **22** | **70** |

***Legends:*** *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

***Note****: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform the following activities in group and prepare small reports of about 5 pages for each activity. They should also collect/record physical evidence such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare a PowerPoint presentation or animation showing different types of chemical bonds and atomic structures.
b) Prepare a model of an atom with the help of a ball and stick or of any other items.
c) pH Calculations for acid, base, and salt solutions at different concentrations.
d) Preparation of a table showing the different methods used for prevention of corrosion.
e) Solve simple problems on hardness calculation.
f) Preparation of a table showing the difference between Organic and Inorganic Compounds.
g) Market survey of different lubricating oil and compare their physical and chemical properties.
h) Library survey regarding polymers, synthetic rubber, and adhesives used in different industries.
i) Collect different polymers and prepare the chart/ PowerPoint based on their type,properties, and uses.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (*MOOCs*) may be used to teach various topics/subtopics.

b) Guide student(s) in undertaking micro-projects/activities.
c) Different types of teaching methods i.e. video demonstration, activity based learning, case study, m-learning need to be employed by teachers to develop the outcomes.
d) Some *of the topics/sub-topics* which are relatively simpler or descriptive are to be given to the students for *self-learning* but to be assessed using different assessment methods.
e) Teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
f) Guide students to address issues on environment and sustainability with reference to using the knowledge of this course
g) OERs, Vlab, and Olabs may be used to teach for the teaching of different concepts.

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs which are the integration of PrOs, UOs, and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course.The students ought to submit micro-project by the end of the semester (so that they develop industry-oriented COs.

A suggestive list of micro-projects is given here. This should relate highly to the competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare common salt crystals from NaCl solution
b) 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.
c) Prepare a model to demonstrate the application of electrolysis cells.
d) Collect three metallic strips of Al, Cu, Fe, strips, Place them in a different acidic and alkaline solution of the same concentration. Observe and record the loss in weight of metals due to an acidic and alkaline environment. Discuss the findings with your teacher and colleagues.
e) 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 andcolleagues.
f) Collect water samples from different water sources and measure the hardness of the water.
g) 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).

h) Suppose you have been selected at the top diploma engineering college in the metro city. You have been living there for more than three months. Based on your critical observation and experience on the different kinds of activities/ performances, identify the type of water being used by you. Draw your inferences on the same.

i) Collect samples of petrol, kerosene oil, diesel, any edible oil, coconut oil. Find out the flash point and fire point, cloud and pour point, and viscosity of the same. Compare the properties and justify their use in relevant applications.

j) Depending on the type of machinery, the load applied, speed of the machine, heat generated, etc, select the appropriate lubricant which can be applied to the machinery. Discuss with your teachers and colleagues and present the same.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication with the place, year, and 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 |

## 14. SUGGESTED LEARNING WEBSITES

a) http://www.chemguide.co.uk/atommenu.html
b) https://www.visionlearning.com
c) http://www.chem1.com
d) https://www.wastewaterelearning.com/elearning/
e) https://www.wqa.org/
f) https://ncert.nic.in
g) http://www.olabs.edu.in/
h) http://chemcollective.org/activities/type_page/1
i) http://www.presentingscience.com/vac/corrosion/index.htm
j) https://vlab.amrita.edu/index.php?sub=2&brch=190

## 15. PO-COMPETENCY-CO MAPPING

| Semester I/II | Basic Chemistry (Course Code: 4300011) | | | | | | |
|---|---|---|---|---|---|---|---|
| | POs | | | | | | |
| **Competency & Course Outcomes** | **PO 1** Basic & Discipline-specific knowledge | **PO 2** Problem Analysis | **PO 3** Design/ development of solutions | **PO 4** Engineering Tools, Experimen-tation &Testing | **PO 5** Engineering practices for society, sustainability & environment | **PO 6** Project Management | **PO 7** Life-long learning |
| **Competency**<br>**Use principles of engineering chemistry to solve broadly defined engineering problems.** | 3 | 2 | 2 | 1 | 1 | 1 | 1 |
| **Course Outcomes**<br>CO1: Apply the principles of chemical bonding and solutions to solve various engineering problems. | 3 | 1 | - | 1 | - | - | 1 |
| CO2: Solve engineering problems using the concept of electrochemistry and corrosion. | 3 | 1 | - | 1 | 1 | - | 1 |
| CO3: Use relevant water treatment methods to solve domestic and industrial problems. | 3 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO4: Classify organic compounds based on their functional groups. | 3 | 1 | - | 1 | 1 | - | 1 |
| CO5: Choose various types of engineering materials like lubricants, polymers, Elastomers and Adhesives for domestic and industrial applications. | 3 | 1 | 1 | 1 | 1 | 1 | 1 |

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

## 16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

**GTU Resource Persons**

| S. No. | Name and Designation | Institute | Contact No. | Email |
|---|---|---|---|---|
| 1. | Dr. Narendra Makwana, Lecturer in Chemistry | Government Polytechnic, Chhotaudepur | 9909911391 | ngmakwana@yahoo.com |
| 2. | Rehana Baiju Mampilly, Lecturer in Chemistry | Government Polytechnic, Kheda | 8758267072 | rehanabaijum@gmail.com |
| 3. | Dr. Lopa KiranKumar Sanghavi | Govt. Polytechnic for Girls, Ahmedabad | 9429810823 | lopa4ever@gmail.com |

**NITTTR Resource Persons**

| S. No. | Name and Designation | Department | Contact No. | Email |
|---|---|---|---|---|
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