

APPLIED SCIENCE**Course Code : 312308****Programme Name/s**

: Automobile Engineering./ Agricultural Engineering/ Automation and Robotics/ Civil Engineering/
 Civil & Rural Engineering/ Construction Technology/ Electrical Engineering/ Electrical Power System/
 Instrumentation & Control/ Instrumentation/ Civil & Environmental Engineering/
 Mechanical Engineering/
 Mechatronics/ Manufacturing Technology/ Metallurgical Engineering/ Production Engineering/

Programme Code

: AE/ AL/ AO/ CE/ CR/ CS/ EE/ EP/ IC/ IS/ LE/ ME/ MK/ MRT/ MY/ PG

Semester

: Second

Course Title

: APPLIED SCIENCE

Course Code

: 312308

I. RATIONALE

Diploma engineers have to deal with various processes, materials and machines. The comprehension of concepts and principles of Science like Elasticity, motion, Oscillation, Photoelectricity, X rays ,LASER, Nanomaterials, metals, alloys, water treatment ,fuel and combustion, cells and batteries will help the students to use relevant materials ,processes and methods for various engineering applications .

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain following industry/ employer expected outcome through various teaching learning experiences. Apply the principles of physics and chemistry to solve broad-based engineering problems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select relevant material in industries by analyzing its physical properties .
- CO2 - Apply the concept of simple harmonic motion , resonance and ultrasonic sound for various engineering applications.
- CO3 - Apply the concept of modern Physics (X-rays, LASER, Photosensors and Nanotechnology) for various engineering applications.
- CO4 - Use the relevant metallurgical processes in different engineering applications.
- CO5 - Use relevant water treatment processes to solve industrial problems.
- CO6 - Use appropriate fuel and electrolyte for engineering applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

| Course Code | Course Title | Abbr | Course Category/s | Learning Scheme | | | Credits | Paper Duration | Assessment Scheme | | | | | | Total Marks | | | | | |
|-------------|-----------------|------|-------------------|--------------------------|-------|-------|---------|----------------|-------------------|-------|-------|------------------|-------|-----|-------------|-----|----------------|--|--|--|
| | | | | Actual Contact Hrs./Week | | | | | Theory | | | Based on LL & TL | | | Based on SL | | | | | |
| | | | | CL | | | | | NLH | | | Practical | | | | | | | | |
| | | | | FA-TH | SA-TH | Total | | | FA-TH | SA-TH | Total | FA-PR | SA-PR | SLA | | | | | | |
| | | | | Max | Max | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | 200 | | | | |
| 312308 | APPLIED SCIENCE | ASC | DSC | 4 | - | 4 | - | 8 | 4 | 1.5 | 30 | 70* | 100 | 40 | 50 | 20 | 50@ 20 - - 200 | | | |

Total IKS Hrs for Sem. : 4 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

♦ Candidate remaining absent in practical examination of any one part of Applied Science course i.e. Physics, Chemistry will be declare as Absent in Mark List and has to appear for examination. The marks of the part for which candidate was present will not be processed or carried forward.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|-------|---|--|---|
| 1 | TLO 1.1 Apply the concept of elasticity and plasticity to select the material for engineering applications. TLO 1.2 Establish relation between given types of moduli of elasticity. TLO 1.3 Predict the behavior of the given metallic wire. TLO 1.4 Explain the relevant Newton's laws of motion for the given moving object. TLO 1.5 Calculate the work, power, energy for the given situation. | Unit - I Properties of matter and kinematics 1.1 Deforming Force and Restoring Force, Elasticity, Plasticity, Rigidity. 1.2 Stress and Strain and their types, elastic limit and Hooke's law, types of moduli of elasticity. 1.3 Stress -Strain diagram, Poisson's ratio, factors affecting elasticity 1.4 Newton's laws of motion, and their applications. 1.5 Angular displacement, angular velocity, angular acceleration, three equations of angular motion, projectile motion, trajectory, range of projectile angle of projection ,time of flight 1.6 Work, power and energy: potential energy, kinetic energy, work -energy principle. | Improved lecture Video Demonstrations Model Demonstration |

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|-------|--|--|---|
| 2 | <p>TLO 2.1 Find the parameters required to analyze the given wave motion and simple harmonic motion.</p> <p>TLO 2.2 Explain the concept of resonance and its applications.</p> <p>TLO 2.3 Describe the properties of given ultrasonic waves.</p> <p>TLO 2.4 Explain the given method of production of ultrasonic waves .</p> | <p>Unit - II Waves and Oscillations</p> <p>2.1 Sound waves, amplitude, frequency, time - period, wave-length and velocity of wave, relation between velocity, frequency and time - period of wave.</p> <p>2.2 Simple Harmonic Motion , Uniform Circular Motion as Simple Harmonic Motion, Equation of simple harmonic motion , Phase of Simple Harmonic Motion.</p> <p>2.3 Resonance , Application of resonance.</p> <p>2.4 Resonance concept in prehistoric times, concept of different frequencies (Mantras) used to ignite different chakras in body (IKS).</p> <p>2.5 Ultrasonic waves, properties of ultrasonic waves.</p> <p>2.6 Piezoelectric and Magnetostriction method to produce ultrasonic waves .</p> <p>2.7 Applications of ultrasonic waves.</p> | Improved lecture Demonstration Video Demonstrations |
| 3 | <p>TLO 3.1 Explain properties of photon on basis Planck's hypothesis.</p> <p>TLO 3.2 Explain the construction and working of given photoelectric device.</p> <p>TLO 3.3 Explain the method to produce X-Rays with its properties and engineering applications.</p> <p>TLO 3.4 Differentiate between LASER and ordinary light.</p> <p>TLO 3.5 Explain the given terms related to LASER.</p> <p>TLO 3.6 Describe the properties of nanomaterials and its various applications.</p> | <p>Unit - III Modern Physics (Photoelectricity , X rays, LASER and nanotechnology)</p> <p>3.1 Planck's hypothesis, properties of photons.</p> <p>3.2 Photo electric effect: threshold frequency, threshold wavelength, stopping potential, Work function, characteristics of photoelectric effect, Einstein's photoelectric equation</p> <p>3.3 Photoelectric cell and LDR : principle ,Working and applications</p> <p>3.4 Production of X-rays by modern Coolidge tube, properties and engineering applications.</p> <p>3.5 Laser: properties, absorption, spontaneous and stimulated emission,</p> <p>3.6 Population inversion, active medium, optical pumping, three energy level system, He-Ne Laser.</p> <p>3.7 Engineering applications of Laser.</p> <p>3.8 Nanotechnology : Properties of nanomaterials (optical, magnetic and dielectric properties) , applications of nanomaterials, Metallic Bhasma (Ancient Ayurveda, IKS).</p> | Improved lecture Presentations Demonstration Video Demonstrations |

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|-------|--|--|---|
| 4 | TLO 4.1 Describe the extraction process of the ore. TLO 4.2 Explain Mechanical properties of metals. TLO 4.3 State purposes of making alloys. TLO 4.4 Describe methods of preparation of alloys. TLO 4.5 State Composition ,properties and applications of ferrous and nonferrous alloys. | Unit - IV Metals and Alloys 4.1 Ancient Indian Metallurgy (IKS) 4.2 Metals: Occurrence of metals in free and combined state. Basic concepts : Mineral, ore, gangue, flux and slag, metallurgy. 4.3 Metallurgy:Extraction processes of metal from ore Concentration : Gravity separation, electromagnetic separation, froth floatation, calcination and roasting, Reduction : Smelting, aluminothermic process, Refining,poling , electrorefining. 4.4 Mechanical properties of metals :Hardness, ductility, malleability, tensile strength, toughness, machinability, weldability, forging, soldering, brazing, castability. 4.5 Alloys: Purposes of making alloys with examples. 4.6 Preparation methods of alloys : Fusion, compression. 4.7 Classification of alloys :Ferrous and non-ferrous alloys Ferrous alloys: Composition ,properties and applications of low carbon, medium carbon, high carbon steels. Non-ferrous alloy:Composition ,properties and applications of Brass, Bronze, Duralumin, Tinman Solder, Woods metal. | Chalk-Board Demonstration Case Study Video Demonstrations |
| 5 | TLO 5.1 Explain types of hardness of water. TLO 5.2 List salts causing temporary and permanent hardness to water. TLO 5.3 Describe boiler corrosion and caustic embrittlement. TLO 5.4 Explain the given type of water softening process. TLO 5.5 Describe the Wastewater treatment and potable water treatment. TLO 5.6 Solve numerical based on pH and pOH. | Unit - V Water Treatment 5.1 Hard and soft water, causes of hardness, types of hardness 5.2 Hard water in boilers and prevention: Boiler corrosion, caustic embrittlement, priming and foaming, scales and sludges, and methods of prevention of boiler corrosion. 5.3 Methods of water softening: lime soda process (hot lime soda and cold lime soda process), zeolite process, ion exchange process. 5.4 Potable water treatment: Sedimentation, coagulation, filtration and sterilization . 5.5 Wastewater treatment: Sewage treatment, BOD and COD of sewage water. 5.6 pH and pOH: Concept of pH, pOH, pH Scale, Numerical. | Chalk-Board Demonstration Case Study Video Demonstrations |

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|-------|--|---|---|
| 6 | TLO 6.1 Describe the properties of the given type of fuel. TLO 6.2 Describe Proximate analysis and Ultimate analysis of coal samples. TLO 6.3 Calculate the calorific value of the given solid fuel using Bomb calorimeter. TLO 6.4 Describe fractional distillation of crude petroleum. TLO 6.5 Explain properties of liquid fuels. TLO 6.6 Describe composition, properties of given gaseous fuel with their applications. TLO 6.7 Describe production of green hydrogen by electrolysis. TLO 6.8 Describe construction and working of given cells and batteries. | Unit - VI Fuels and Combustion 6.1 Fuel: Calorific value and ignition temperature, classification. 6.2 Solid fuels: Coal, Classification and composition , Proximate analysis, Ultimate analysis, Calorific value of coal by Bomb calorimeter. 6.3 Liquid fuels: Fractional distillation of crude petroleum, boiling range, composition, propertie Knocking, cracking, octane number and cetane number. 6.4 Gaseous fuels: Biogas, LPG, and CNG. Combustion equation of gaseous fuels, mass and volume of air required for complete combustion. 6.5 Green hydrogen: Producing green hydrogen by electrolysis from renewable sources , Advantages and disadvantages of green hydrogen. 6.6 Electrical conductance in metals and electrolytes, specific conductance, equivalent conductance, cell constant 6.7 Cells and batteries :Construction ,working and applications of dry cell, lead acid storage cell H ₂ - O ₂ fuel cell, Ni-Cd battery and Lithium ion battery | Chalk-Board Demonstration Case Study Video Demonstrations |

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|-------|--|----------------|--------------|
| LLO 1.1 Use Searle's method to determine the Young's modulus of given wire | 1 | * Determination of Young's modulus of given wire. | 2 | CO1 |
| LLO 2.1 Compare young's modulii of different materials of wires . | 2 | Comparison of Young's modulii of given materials of wires. | 2 | CO1 |
| LLO 3.1 Use of inclined plane to find the downward force. | 3 | * Determination of relationship between angle of inclination and downward force using inclined plane. | 2 | CO1 |
| LLO 4.1 Use projectile motion to find the range from initial launch speed and angle | 4 | *Determination of range of projectile | 2 | CO1 |
| LLO 5.1 Use helical spring to find force constant . | 5 | * Determination of force constant using helical spring . | 2 | CO2 |
| LLO 6.1 Use resonance tube method to determine velocity of sound | 6 | * Determination of velocity of sound using resonance tube method. | 2 | CO2 |
| LLO 7.1 Use Simple pendulum to find acceleration due to gravity . | 7 | * Determination of acceleration due to gravity by using simple pendulum . | 2 | CO2 |
| LLO 8.1 Use ultrasonic distance – meter to measure distance of object . | 8 | Determination of distance of object using ultrasonometer. | 2 | CO2 |
| LLO 9.1 Use ultrasonic interferometer to determine velocity of sound | 9 | Determination of velocity of ultrasonic sound waves in different liquids using ultrasonic interferometer . | 2 | CO2 |

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| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|--|-------|---|----------------|--------------|
| LLO 10.1 Use photo electric cell to find dependence of the stopping potential on the frequency of given light source. | 10 | Determination of the dependence of the stopping potential on the frequency of given light source .(Virtual Lab) | 2 | CO3 |
| LLO 11.1 Determine I-V characteristics of the given photo electric cell. | 11 | * Determination of I-V characteristics of photoelectric cell. | 2 | CO3 |
| LLO 12.1 Determine I-V characteristics of given light dependent resistor. | 12 | * Determination of I-V characteristics of LDR. | 2 | CO3 |
| LLO 13.1 Find divergence of given laser . | 13 | Determination of the divergence of laser beam. | 2 | CO3 |
| LLO 14.1 Use LASER beam to find the refractive index of glass plate | 14 | Determination of refractive index of glass plate using laser beam. (Virtual Lab) | 2 | CO3 |
| LLO 15.1 Find the wavelength of given laser. | 15 | Determination of wavelength of helium neon laser (Virtual Lab) | 2 | CO3 |
| LLO 16.1 Prepare KMnO4 solution. LLO 16.2 Prepare standard oxalic acid. LLO 16.3 Standardize KMnO4 solution. | 16 | Standardization of KMnO4 solution using standard oxalic acid and preparation of Fe alloy sample. | 2 | CO4 |
| LLO 17.1 Set up titration Assembly. LLO 17.2 Record the observations. LLO 17.3 Calculate percentage of iron in haematite ore by titration method . | 17 | * Determination of the percentage of iron present in given Haematite ore by KMnO4 solution. | 2 | CO4 |
| LLO 18.1 Prepare Cu ore sample. LLO 18.2 Calculate percentage of Cu . | 18 | * Determination of percentage of copper in given copper ore . | 2 | CO4 |
| LLO 19.1 Prepare EDTA solution of known concentration. LLO 19.2 Determine total hardness of water by titration. | 19 | *Calculation of total hardness, temporary hardness and permanent hardness of water sample by EDTA method. | 2 | CO5 |
| LLO 20.1 Prepare acid solution of known concentration. LLO 20.2 Determine alkalinity of water sample. | 20 | * Determination of the alkalinity of a given water sample. | 2 | CO5 |
| LLO 21.1 Determine turbidity by using a Nephelometer or simulation. | 21 | Determination of turbidity of a given water sample by Nephelometric method by using Nephelometer or simulation. | 2 | CO5 |
| LLO 22.1 Set up titration Apparatus LLO 22.2 Record the observations. LLO 22.3 Calculate dissolved oxygen. | 22 | Determination of dissolved oxygen in the given water sample. | 2 | CO5 |
| LLO 23.1 Prepare AgNO3 Solution of known concentration. LLO 23.2 Calculate chloride content in water sample. | 23 | Determination of chloride content in the given water sample by Mohr's method. | 2 | CO5 |
| LLO 24.1 Use universal indicator for PH values. LLO 24.2 Calculate PH value by using PH meter. | 24 | * Determination of pH value of given solution using pH meter and universal indicator. | 2 | CO5 |

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| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|--|--------------|---|-----------------------|---------------------|
| LLO 25.1 Use of oven for appropriate temperature settings. LLO 25.2 Calculate moisture and ash content in coal samples. | 25 | * Determination of the moisture and ash content in a given coal sample using proximate analysis. | 2 | CO6 |
| LLO 26.1 Set up a Bomb Calorimeter. LLO 26.2 Calculate calorific value. | 26 | * Determination of calorific value of given solid fuel using Bomb calorimeter. | 2 | CO6 |
| LLO 27.1 Use gravimetric analysis method LLO 27.2 calculate the percentage of Sulphur. | 27 | Calculate the percentage of Sulphur in a given coal sample by ultimate analysis. (Gravimetric analysis) | 2 | CO6 |
| LLO 28.1 Standardize conductivity meter. LLO 28.2 Measure the conductance of given solutions. | 28 | Determination of conductance of given electrolyte by using a conductivity meter. | 2 | CO6 |
| LLO 29.1 Set up conductometric titration assembly. LLO 29.2 Record conductance. LLO 29.3 Determine specific conductance and equivalence conductance. | 29 | * Determination of specific conductance and equivalence conductance of given salt sample solution. | 2 | CO6 |
| LLO 30.1 Set up conductometric titration assembly. LLO 30.2 Record conductance. LLO 30.3 Determine equivalence point. | 30 | Determination of equivalence point of acetic acid and ammonium hydroxide using conductivity meter. | 2 | CO6 |

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

| Sr.No | Equipment Name with Broad Specifications | Relevant LLO Number |
|--------------|--|----------------------------|
| 1 | Searle's apparatus(with slotted mass of 0.5 kg each) | 1,2 |
| 2 | Experimental setup for characteristics of LDR, optical bench .Source of light ,LDR . | 11 |
| 3 | Laser Source (He Ne, diode laser), optical bench , graph paper, glass plate | 12,13,14 |
| 4 | Nephelometer ; Auto-ranging from 20-200 NTU, +/- 2% of reading plus 0.1 NTU, power 220 Volts +/- 10% AC 50 Hz | 21 |
| 5 | pH meter reading up to pH14; ambient temp. -40 to 700 C.; pH/mV resolution:13 bit | 24 |
| 6 | Electric oven inner size 18”x18”x18”; temperature range 100 to 2500 C with the capacity of 40 lt. | 25 |
| 7 | Bomb calorimeter Temperature Resolution:0.001°C Oxygen Filling Automatic /Manual | 26 |
| 8 | Conductivity meter; conductivity range – 0.01 uS /cm to 200 mS/cm, Cell constant – digital 0.1 to 2.00; Temp. range – 0 to 100°C | 28,29,30 |
| 9 | An inclined plane , a trolley or a roller , pan , weight box , spring balance spirit level, strong thread , meter scale . | 3 |
| 10 | Retort stand, helical spring , 6 slotted weight of 50 grams ., scale , stop watch. | 4 |
| 11 | Resonance tube , Tuning forks of different frequencies | 5 |
| 12 | Metallic bob , strong thread , stopwatch . | 6 |
| 13 | Ultrasonometer | 7 |

| Sr.No | Equipment Name with Broad Specifications | Relevant LLO Number |
|-------|---|---------------------|
| 14 | ultrasonic interferometer | 8 |
| 15 | Experimental setup for characteristics of photoelectric cell | 9,10 |
| 16 | Electronic balance, with the scale range of 0.001g to 500g. pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt. | All |

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

| Sr.No | Unit | Unit Title | Aligned COs | Learning Hours | R-Level | U-Level | A-Level | Total Marks |
|--------------------|------|--|-------------|----------------|-----------|-----------|-----------|-------------|
| 1 | I | Properties of matter and kinematics | CO1 | 9 | 3 | 4 | 4 | 11 |
| 2 | II | Waves and Oscillations | CO2 | 10 | 3 | 5 | 4 | 12 |
| 3 | III | Modern Physics (Photoelectricity , X rays, LASER and nanotechnology) | CO3 | 11 | 3 | 5 | 4 | 12 |
| 4 | IV | Metals and Alloys | CO4 | 10 | 2 | 3 | 5 | 10 |
| 5 | V | Water Treatment | CO5 | 8 | 3 | 4 | 4 | 11 |
| 6 | VI | Fuels and Combustion | CO6 | 12 | 3 | 5 | 6 | 14 |
| Grand Total | | | | 60 | 17 | 26 | 27 | 70 |

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks (Physics 15 marks, Chemistry-15 marks) and average of two unit tests.
- For laboratory learning 50 marks (Physics 25 marks, Chemistry-25 marks).

Summative Assessment (Assessment of Learning)

- End semester assessment of 50 marks for laboratory learning (Physics 25 marks, Chemistry-25 marks).
- End semester assessment of 70 marks through online MCQ examination.

XI. SUGGESTED COS - POS MATRIX FORM

| 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 | PSO-3 |
| CO1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | | | |
| CO2 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | | | |
| CO3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | | | |
| CO4 | 3 | 1 | - | 1 | 2 | 2 | 1 | | | |
| CO5 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | | | |
| CO6 | 3 | 1 | - | 1 | 2 | 2 | 1 | | | |

Legends :- High:03, Medium:02, Low:01, No Mapping: -

*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr.No | Author | Title | Publisher with ISBN Number |
|-------|--|--------------------------------------|--|
| 1 | Haliday, David; Resnik, Robert and Walker, Jearl | Fundamentals of Physics | John Wiley & sons, Hoboken, USA, 2014 ISBN : 812650823X. |
| 2 | Hussain Jeevakhan | Applied Physics II | Publisher: Khanna Book Publishing ISBN: 9789391505578. |
| 3 | Narlikar, J.V.;Joshi , A. W.; Ghatak A.K. et al | Physics Textbook Part I - Class XII | National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314 |
| 4 | Narlikar, J.V.;Joshi , A. W.; Ghatak A.K. et al | Physics Textbook Part II - Class XII | National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506713 |
| 5 | Aryabhatta | The Surya Siddhanta | Baptist mission press, Calcutta |
| 6 | Jain and Jain | Engineering Chemistry | National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083 |
| 7 | Dara, S. S. | Engineering Chemistry | National Council of Education Research and Training, New Delhi, 2015, ISBN : 8174505660 |
| 8 | Bagotsky V.S. | Fundamental of electrochemistry | National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314. |
| 9 | Agnihotri Rajesh | Chemistry for Engineers | Wiley India Pvt. Ltd. New Delhi, 2014, ISBN: 9788126550784. |
| 10 | Anju Rawlley, Devdatta V. Saraf | Applied Chemistry with Lab Manual | Khanna Book Publishing Co. (P) Ltd. New Delhi, 2021, ISBN- 978-93-91505-44-8 |
| 11 | Vairam S. | Engineering Chemistry | Wiley India Pvt. Ltd. New Delhi, 2013, ISBN: 9788126543342 |

XIII . LEARNING WEBSITES & PORTALS

| Sr.No | Link / Portal | Description |
|-------|---|---|
| 1 | https://www.iberdrola.com/sustainability/green-hydrogen | Green hydrogen |
| 2 | https://vedicheritage.gov.in/vedic-heritage-in-present-context/metallurgy | Ancient indian metallurgy (IKS) |
| 3 | https://vlab.amrita.edu/?sub=2&brch=193&sim=575&cnt=4 | Determine turbidity by using a simulation |
| 4 | https://www.britannica.com/science/metallurgy | Metals and alloy |
| 5 | https://phet.colorado.edu/en/simulations/ph-scale | PH and POH |
| 6 | https://archive.nptel.ac.in/courses/103/105/103105110/ | Solid fuel |
| 7 | www.physicsclassroom.com | Concepts of Physics |
| 8 | www.fearofphysics.com | Fundamental terms in Physics |
| 9 | https://iksindia.org | IKS |

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students