CHL102 Chemistry [3-1-0, **Credit:** 4]

Pre-requisites: NIL **Type of Course:** BS **Semester:** I , II Sem B Tech

Assessment: Mid Sem 30 % + TA 10%+ End Sem 60%

Course Objectives:

i. To present sound knowledge of chemistry fundamentals as a strong foundation for enriching students to understand the role of chemistry in the field of science and engineering.
ii. To develop ability to understand, plan and implement various processes like corrosion control, catalytic cracking, water softening, including modern approaches.
iii. To inculcate habit of scientific reasoning to do the task rationally.

Course Outcomes (CO):

1. Ability to explain the basic theories and principles of chemistry for engineering practices.
2. Exposure to chemical aspects of various kind of materials for industrial applications.
3. Ability to apply the chemical concepts to solve the industrial issues.
4. Ability to employ critical thinking and efficient numerical problem-solving skills.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	2	1	1	-	-	-	1
CO2	3	1	1	1	-	1	2	1	-	-	-	1
CO3	2	1	2	2	1	1	2	1	1	-	-	1
CO4	3	3	1	2	-	1	1	1	1	1	-	1
CO5	3	3	2	1	-	2	1	1	-	-	-	1

Course Content:

1. **Water Chemistry:**

Sources, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Chemistry involved in sedimentation, coagulation and sterilization. Softening of water, lime-soda, ion-exchange process and numerical problem. Boiler troubles, causes and effects, methods of prevention. (4 hours)

2. **Electrochemical Phenomenon, Corrosion and Battery Technology:**

Electrochemical and galvanic series, polarization, decomposition potential, over voltage. Theories of corrosion. Differential aeration theory. Factors influencing corrosion. Types of corrosion Control of corrosion: Design and material selection, anodic and cathodic protection, protective coatings, corrosion inhibitors.

Introduction types and properties of batteries: Primary cells, Secondary cells (Lithium-ion battery: Chemistry involved, Cathode materials, Anode materials, Electrolytes and Separators used. Reason why batteries explode) and Reserve cell (Water activated batteries, Electrolyte activated batteries, Gas activated batteries, Heat activated batteries), Fuel Cells, Solar cells

3. **Fuels and Lubricants:**

Fuels: Introduction and classification of fuels, solid fuels CV, proximate and ultimate analysis, carbonization. Liquid fuels, Knocking in I/C engine, Octane no, Cetane no., combustion problems.
Lubricants: Mechanism of friction, Classification: solid semisolid, liquid with examples.
Properties and applications of lubricants.

4. **Spectroscopy:**

Interaction of radiation with matter, Molecular/Atomic Spectroscopy: Principles and applications of optical (UV-Vis) spectroscopy, Atomic absorption spectroscopy, Flame photometry, vibrational (IR) spectroscopy and interpretation. Interaction of α-, β- and γ-radiation with matter.(6 hours)

5. **Industrially relevant processes**

Skraup synthesis, Beckman reaction, Friedel-craft acylation, Suzuki reaction, Heck reaction, Introduction to coordination chemistry, Chelate effect and applications.

Chemical methods of material synthesis: Chemistry in Sol-gel synthesis, co-precipitation technique, Pechini's method, emulsions, CVD, thin films, polymerization.

Topics in Chemistry of Metallurgical Analysis

6. Chemistry of Engineering Materials:

Cement: Introduction, manufacturing and properties, Fly ash utilization;

Polymers: Structure property relationship of polymers - Characterization. Synthesis, properties and applications of industrial grade polymers [polyester, poly(ethylene terephthalate) (PET), silicone, nylon, polyurethane, isoprene and Bakelite]. Conducting polymers; Glass and Ceramics: Introduction, properties and applications;

Explosives: Introduction, Introduction to Analytical techniques: trace and bulk level, requisites, oxygen balance, Classification, properties and applications. Rocket propellants

7. Adsorption and catalysis:

Physical adsorption, chemisorption, Freundlich's expression, Langmuir adsorption isotherm, BET isotherm, industrial applications of adsorption.

Heterogeneous catalysis: Materials' perspective in adsorption, ion conduction/exchange, gas separation, catalysts, sensors, pollution abatement, and sustainable energy applications.

Reference Books:

1. S.S. Dara; A Text Book of Engineering Chemistry, 10th Eds.; S. Chand,2003.
2. Jain and Jain, Engineering Chemistry, 17th Eds; Dhanpat Rai publishing.
3. Fundamentals of Ceramics – by Michel Barsoum, McgrawHill.
4. Fuels Combustion and Furnaces, John Griswold, Mc-Graw Hill Book Company Inc.
5. Lubrication-A practical guide to lubricant selection by A.R. Lansdown. Pergamonpress,1982.,
6. P. W. Atkins and J dePaula;Atkin'sPhysicalChemistry,8th,9thand10thEds.,OxfordUniversity Press .
7. Kuriacose,J.C.,Rajaram,J.;ChemistryinEngineeringandTechnology(Vol.1&2);McGrawHill, 1984.
8. Barrow,M.Gordon;PhysicalChemistry(Fifthedition);McGraw-Hill,1992.
9. Shashi Chawla; A Text Book of Engineering Chemistry, Dhanpat Rai and Co publishing.
10. S. Glasstone, An Introduction to Electrochemistry

CHP102 Chemistry Laboratory [0-0-2, **Credit:** 1]

Pre-requisites: NIL **Type of Course:** BS **Semester:** I , II Sem B Tech

Assessment: Mid-term Eval 40% + End Term Eval 60%

Course Objective:

i. To develop skills and capabilities of students in applying knowledge of chemistry for solving real life problems. Provide thorough understanding of the subject as many experiments are based on theory course.

Course Outcomes (CO):

1. Knows the proper procedures and regulations for safe handling and use of chemicals, and can follow the proper procedures and regulations for the safe handling when using chemicals.
2. Are able to design, carry out, record and analyze the results of chemical experiments. Are skilled in problem solving, critical thinking and analytical reasoning.
3. Ability to use modern instrumentation for chemical analysis and measurements.
4. Are able to communicate the results of their work to chemists and non-chemists.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	2	1	1	1	-	1
CO2	3	2	2	3	1	1	2	2	2	1	1	-
CO3	2	1	2	3	1	1	-	1	-	1	-	1
CO4	1	1	1	1	1	-	1	1	1	2	1	1

Course Content:

1. Water and waste water analysis: Determination of
   i. Hardness
   ii. Alkalinity
   iii. Dissolved oxygen and free chlorine,
   iv. Chloride, fluorides and COD,
   v. Trace metal in water using Ion –selective electrodes, arsenic, lead, mercury.
2. Determination of capacity of ion exchange resin.
3. Analysis of ores and alloys
   i. Determination of copper in brass
   ii. Calcium in limestone and dolomite.
4. Demonstration experiments on instrumental methods of analysis
   i. pH-metric and conductometric titration
   ii. Colorimetric determination
   iii. Turbidity by nephelometer
   iv. Flame photometry
   v. Flashpoint of lubricants
   vi. Viscosity of lubricants
   vii. Calorific value of solid fuels
   viii. Proximate analysis of coal.
5. Chemical kinetics / Adsorption
   i. Determination of rate constant
   ii. Verify Freundlich Adsorption isotherm (study adsorption of acetic acid on activated charcoal)
6. Synthesis of paracetamol and aspirin, and its characterization.
   Fabrication of reserve batteries.

CHL103 Chemistry [3-1-0, **Credit:** 4]

Pre-requisites: NIL **Type of Course:** BS **Semester:** I , II Sem B Tech

Assessment: Mid Sem 30 % + TA 10%+ End Sem 60%

Course Objective:

i. To present sound knowledge of chemistry fundamentals as a strong foundation for enriching students to understand the role of chemistry in the field of science and engineering.

ii. To develop ability to understand, plan and implement various processes for energy storage, synthesis and applications of nano-materials, opto-electronic materials, including modern approaches.

iii. To inculcate habit of scientific reasoning to do the task rationally.

Course Outcomes (CO):

1. Ability to explain the basic theories and principles of chemistry for engineering practices.
2. Exposure to chemical aspects of various kind of materials for industrial applications.
3. Ability to apply the chemical concepts to solve the technological issues.
4. Ability to employ critical thinking and efficient numerical problem-solving skills.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	2	1	1	-	-	-	1
CO2	3	1	1	1	-	1	2	1	-	-	-	1
CO3	2	1	2	2	1	1	2	1	1	-	-	1
CO4	3	3	1	2	-	1	1	1	1	1	-	1

Course Content:

1. **Electrochemical Phenomenon:**
   Electrochemistry fundamentals & terminologies, Electrochemical and galvanic series, polarization, decomposition potential, over voltage. Theories of corrosion, Differential aeration theory. Factors influencing corrosion. Types of corrosion. Control of corrosion: Design and material selection, anodic and cathodic protection, protective coating, corrosion inhibitors. Electrochemical Sensors.

2. **Battery Technology:**
   Introduction, Components of Cells and Batteries, Different Types of Batteries and their Classification: Primary cells, Secondary cells (Lithium-ion battery: Chemistry involved, Cathode materials, Anode materials, Electrolytes and Separators used. Reason why batteries explode) and Reserve cell (Water activated batteries, Electrolyte activated batteries, Gas activated batteries, Heat activated batteries), Fuel Cells.
   Parameters for Selecting a Battery System, Application of Batteries as: conventional battery, automobile battery, laptop battery, torpedo battery, Electric Vehicles (EV) battery and Hybrid Electric Vehicles (HEV) battery, Capacitors. Thermal stress of batteries.
   Solar Cells or Photovoltaic cells: Chemistry involved, Selection of materials, Construction, Working.

3. Spectroscopy:

Interaction of light radiation with matter; Types of transitions; Nuclear Resonance Spectroscopy: Basic Principle, Nuclear-spin and Resonance, Pulse-method, Relaxation processes – longitudinal and transverse, imaging method (MRI), diagnostic applications; Molecular spectroscopy: Absorption Spectroscopy, Fluorescence, Phosphorescence, Positron Emission Tomography (PET); Atomic Absorption Spectroscopy; Inductively Coupled Plasma (ICP): Advantages vs. disadvantages [comparison with other techniques], sensitivity, plasma generation from other sources.

4. Electrical/Magnetic Properties &Polymers:

Opto-ectronicMaterials:Diodematerials:LEDdisplays,quantumLEDdisplays.agneto-electronic Materials: Molecular Magnets, Theory Biopolymers
Silicones: Manufacture and applications

Conducting polymers; Liquid crystal polymers.

5. Environmental Chemistry:

Principles of sustainability and green chemistry, Standards for water and air quality. Environmental issues related to climate change, e-waste management.
Chemical elements in biological processes – Essential and non-essential elements in biological systems, Important biomolecules: carbohydrates, vitamins, proteins, nuclei acids – ribonucleic acid, transport across membranes in biological systems.

6. Nanomaterials and nanotechnology:

Introduction, properties and applications of nano materials, Physical and chemical methods of synthesis [Deposition & Growth such as Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD), epitaxy, Molecular Beam Epitaxy (MBE), Ion implantation], Introduction to Nanolithography. Emerging Nanostructure materials - Fullerenes, Bucky ball, carbon nanotubes.

Reference Books:

1. Dara, S.S. and S. S. Umare, A Text Book of Engineering Chemistry (Twelfth edition); S. Chand, 2014
2. Jain and Jain, Engineering Chemistry, 17th Eds; Dhanpat Rai publishing.
3. A.R. West, Solid-State Chemistry and its Applications, John Wiley & Sons,1989.
4. L. E. Smart and E. A. Moore, Solid State Chemistry-AnIntroduction, Chapman and Hall,1992.
5. K. Chakrabarty, Solid State Chemistry, New Age Publishers,1996
6. C. N. R. Raoand J.Gopalkrishanan, New directions in solid state chemistry Cambridge Univ. Press 1997.
7. Shashi Chawla; A Text Book of Engineering Chemistry (Third edition); Dhanpat Rai &Co., 2006.
8. Kuriacose,J.C.,Rajaram,J.; Chemistry in Engineering and Technology (Vol.1&2); McGraw Hill, 1985.
9. Barrow, M.Gordon; Physical Chemistry (Fifth edition); McGraw-Hill,1992.
10. C. N. BANWELL Fundamentals of. Molecular Spectroscopy. 3rd edition.

CHP103 Chemistry Laboratory [0-0-2, **Credit:** 1]

Pre-requisites: NIL **Type of Course:** BS **Semester:** I , II Sem B Tech

Assessment: Mid-term Eval 40% + End Term Eval 60%

Course Objective:

i. To develop skills and capabilities of students in applying knowledge of chemistry for solving real life problems.

Course Outcomes (CO):

1. Knows the proper procedures and regulations for safe handling and use of chemicals, and can follow the proper procedures and regulations for the safe handling when using chemicals.
2. Are able to design, carry out, record and analyze the results of chemical experiments. Are skilled in problem solving, critical thinking and analytical reasoning.
3. Ability to use modern instrumentation for chemical analysis and measurements.
4. Are able to communicate the results of their work to chemists and non-chemists.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	2	1	1	1	-	1
CO2	3	2	2	3	1	1	2	2	2	1	1	-
CO3	2	1	2	3	1	1	-	1	-	1	-	1
CO4	1	1	1	1	1	-	1	1	1	2	1	1

Course Content:

1. Water and waste water analysis: Determination of
   i. Hardness
   ii. Alkalinity
   iii. Dissolved oxygen and free chlorine,
   iv. Chloride, fluorides and COD,
   v. Trace metal in water using Ion –selective electrodes, arsenic, lead, mercury.
2. Determination of capacity of ion exchange resin.
3. Analysis of ores and alloys
   i. Determination of copper in brass
   ii. Calcium in limestone and dolomite.
4. Demonstration experiments on instrumental methods of analysis
   i. pH-metric and conductometric titration
   ii. Colorimetric determination
   iii. Turbidity by nephelometer
   iv. Flame photometry
   v. Flashpoint of lubricants
   vi. Viscosity of lubricants
   vii. Calorific value of solid fuels
   viii. Proximate analysis of coal.
5. Chemical kinetics / Adsorption
   i. Determination of rate constant
   ii. Verify Freundlich Adsorption isotherm (study adsorption of acetic acid on activated charcoal)
6. Synthesis of paracetamol and aspirin, and its characterization.
   Fabrication of reserve batteries.