*(Course structure B.Tech. Ist Year All branches: Approved by BOS dated 29.5.2017)*

# Department of Applied Chemistry

## B.TECH. IST YEAR

## (2017-18)

## (ALL BRANCHES)

## COURSE STRUCTURE

| Course Number | Course Title | Course category | Credits | Contact Periods | | | Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Course - work | Mid Sem. Exam | End Sem. Exam | Total |
| ACS 1110 | Applied Chemistry | BS | 4 | 3 | 1 | 0 | 15 | 25 | 60 | 100 |
| ACS 1910 | Applied Chemistry Lab | BS | 1.5 | 0 | 0 | 3 | 60 | | 40 | 100 |

*(ACS 1110: Approved by BOS dated 29.5.2017)*

# B.TECH. IST YEAR (ALL BRANCHES)

# COURSE

| | |
|---|---|
| **Course Title** | **Applied Chemistry** |
| **Course Number** | **ACS 1110** |
| **Credits** | **4** |
| **Course Category** | **BS** |
| **Pre-Requisite if any** | **Nil** |
| **Contact Hours (L-T-P)** | **3-1-0** |
| **Type of Course** | **Theory** |
| Course Objectives | To impart the knowledge of applications of chemical sciences in engineering and technology |
| Course outcome | After completion of the course the student shall be able to understand<br>1. Water treatment technology for municipal and industrial use<br>2. About solid, liquid and gaseous fuels. Types of lubrications their testing and applications.<br>3. About corrosion and techniques to control corrosion.<br>4. About polymers and their applications |
| Syllabus | **UNIT-I: Treatment of water for Municipal and Industrial use (12 L)**<br>Sources of water, Impurities in water, Requirements of water for municipal use, Municipal water treatment methods: Plain sedimentation, Sedimentation with coagulation (Role of alum, sodium aluminate and copperas), filtration (operation of sand filter), Disinfection, Requirements of a good disinfectant, Types of disinfecting agents (Bleaching powder, Liquid chlorine, Ozone, UV radiations and Chloramine and their disinfection action), Break point chlorination, Super chlorination and de-chlorination. Requirements of water for industrial use, Hardness of water, Units of hardness, Calculations on hardness, Determination of hardness by soap and EDTA methods. Boiler defects: Sludge and scale formation, Priming and foaming, Boiler corrosion and Caustic embrittlement, Boiler water treatment: External treatment (water softening methods) Lime-soda process, Zeolite process and Ion-exchange process, Internal treatment methods, Calculations based on lime - soda and zeolite process.<br>**UNIT-II: Fuels and Lubricants (12 L)**<br>Definition of fuels, Classification of fuels, Calorific value, Gross and net calorific value, Units of calorific value, Determination of calorific value by bomb calorimeter, Dulong's formula, Numerical problems, Coal, Classification of coal, Coal analysis (Proximate and ultimate analysis), Significance, Classification of petroleum, Fractions of petroleum and their uses, Cracking, Thermal and catalytic cracking (fixed bed only), Synthetic petrol, Synthesis of petrol by Fisher Tropsch process and Bergius process, Gaseous fuels (CNG, LPG), Advantages and disadvantages of solid, liquid and gaseous fuels, Combustion calculations based on solid fuels. Definition and classification of lubricants, Functions of lubricants, Mechanism of lubrication, Liquid lubricants: petroleum oils, purification of crude petroleum, blended oils, additives in the blended oils, Semi-solid lubricants or Greases: preparation and their types, Solid lubricants, Selection of lubricants. |

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| | **UNIT- III: Corrosion and its prevention (12 L)**<br>Definition, Significance of corrosion, Classification of corrosion, Dry corrosion, Mechanism of dry corrosion, Types of oxide films, Pilling Bedworth rule, Electrochemical corrosion, Electrode potential and its measurement, Electrode reactions, Electrochemical cell, Nernst equation, Calculations based on EMF of an electrochemical cell, Electrochemical and Galvanic series and their importance, Mechanism of electrochemical corrosion (Corrosion of Fe in HCl and rusting of Fe), Factors influencing corrosion rate, Corrosion control methods, Proper design (designing principles), Material selection, Cathodic protection (sacrificial and impressed current), Metallic coatings (methods of applications, hot dipping, galvanizing, tinning). Organic Coatings: Paints, Requirements of good paints, Constituents of paints and their functions, drying mechanism of oil, Varnishes (types, constituents), Characteristics of a good varnishes.<br>**UNIT-IV: High polymers (12 L)**<br>Introduction, Homopolymers and Copolymers, Tacticity, Functionality, classification of polymers (based on origin, sources, thermal behavior, structure, synthesis method, polymer chain growth), Types of polymerization, Mechanism of Polymerization (Free radical, anionic and cationic), Plastics, Advantages and disadvantages, Thermoplastic resins: Preparation, properties and uses of cellulose acetate, PVC, PS, PTFE, Nylons, Thermosetting resins: Preparation, properties and uses of Bakelite, Polyesters and epoxy resins, Difference between thermoplastics and thermosetting plastics, Molecular mass of a polymer, Types of molecular mass, Elastomers: natural rubber, Structure of natural rubber, Extraction and processing of natural rubber from rubber plant, Limitations of natural raw rubber, Vulcanization a advantages, Synthetic rubbers: Preparation, properties and uses of Buna-S, Buna-N, Neoprene and Thiocol rubbers, Compounding of rubbers. |
| Suggested Readings/ Text/References | 1.AText Book of Engineering Chemistry by SS. Dara, S. Chand & Co., New Delhi (India).<br>2.Engineering Chemistry by B.K. Sharma, Krishna Prakashan Media (P) Ltd., Meerut (India).<br>3.Engineering Chemistry by P.C. Jain, Dhanpat Rai Publishing Company, New Delhi |

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|---|---|---|---|
| Course Assessment | 1.Sessional/Mid sem Exam | a. Course work/Home Assignment | 15 Marks |
| | | b. Mid sem Examination (One Hour) | 25 Marks |
| | 2. End sem Exam | End sem Examination (Two hours) | 60 Marks |
| | | Total | 100 Marks |

*(ACS 1910: Approved by BOS dated 29.5.2017)*

# B.TECH. IST YEAR (ALL BRANCHES)

# COURSE

| | | | |
|---|---|---|---|
| **Course Title** | **Applied Chemistry Lab** | | |
| **Course Number** | **ACS 1910** | | |
| **Credits** | **1.5** | | |
| **Course Category** | **BS** | | |
| **Pre-Requisite if any** | **Nil** | | |
| **Contact Hours (L-T-P)** | **0-0-3** | | |
| **Type of Course** | **Practical** | | |
| Course Objectives | To train the students for the applications of the chemical sciences in the field of Engineering and technology. | | |
| Course outcome | After completion of the course the students shall be able to understand:<br>1. To estimate the hardness, dissolved oxygen in water and available chlorine in bleaching powder<br>2. To carry out analysis of coal and grading of coal<br>3. Testing of lubricants like flash point, aniline point, relative viscosity and drop point of grease and its applications.<br>4. To study and explore the nature of the electrochemical corrosion. | | |
| Syllabus | LIST OF EXPERIMENTS:<br>1. Determine total, permanent and temporary hardness of water in ppm by versenate method.<br>2. To determine the amount of dissolved oxygen in water in ppm units.<br>3. To determine the cloud point, pour point and setting point of an oil.<br>4. To determine the percentage of available chlorine in the given sample of bleaching powder.<br>5. To carry out proximate analysis of the given sample of coal.<br>6. To determine the saponification value and percentage of fatty oil in the given sample of compounded oil.<br>7. To determine the aniline point of a given sample of an oil.<br>8. To determine the relative viscosity of an oil by redwood viscometer and to study the variation of viscosity with change in temperature.<br>9. To demonstrate and explore the electrochemical nature of aqueous corrosion.<br>10. To determine the flash point of an oil by Abel's and Pensky Marten's apparatus. | | |
| Suggested Readings/ Text/References | Lab Manuals provided by the Department. | | |
| Course Assessment | 1.Sessional | a. Experimental work in the lab | 60 Marks |
| | | b. Viva-Voce | |
| | 2. End sem Exam | End semester Examination (Two hours) | 40 Marks |
| | | Total | 100 Marks |

*(AC 211: Approved in BOS dated 29.5.2017)*

# B.Tech. Second Year (IV Semester)

## Chemical Engineering

## COURSE

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|---|---|
| **CourseTitle** | **Engineering chemistry and Material science** |
| **Course Number** | **AC 211** |
| **Credits** | **4** |
| **Course Category** | **DC** |
| **Contact Hours (L-T-P)** | **3-1-0** |
| **Type of Course** | **Theory** |
| Course Objectives | To impart the knowledge of applications of material sciences in engineering and technology |
| Course outcome | After completion of the course the student shall be able to understand<br>1. Different types of crystalline solids, their structure and properties. Miller indices for determination of crystalline direction and planes.<br>2. Properties of engineering materials, classification of steels and techniques used to determine the microstructure of materials.<br>3. Phase equilibrium and different phases involved in the transformation of materials under varying conditions.<br>4. Adsorption and its classification. Role of adsorbent on the surface catalyzed reactions, Colloids and adhesives. |
| Syllabus | **Unit – I: Engineering Materials and their Structure:(12 Lectures)**<br>Crystalline and amorphous solids, crystal lattice, unit cell, crystal systems, different types of structures – SC, BCC, FCC and HCP, factors influencing the density of crystal, crystal direction and crystal planes, Miller indices, interplanar spacing, Bragg's Law of X-ray diifraction, Characterization of microstructure by XRD, crystal defects-types and impact on the properties of Engineering Materials.<br>**Unit – II: Engineering Materials and their Characterization:(12 Lectures)**<br>Introduction to engineering materials, classification, steels and cast irons, classification of steels, plain carbon steel, alloy steel, stainless steels, austenitic stainless steels, ferritic stainless steels, martensitic stainless steels, development of corrosion resistance in stainless steel, cast iron, gray cast iron, white cast iron, malleable cast iron, ductile cast iron, Characterization of microstructure by TGA, DSC, SEM and TEM<br>**Unit – III: Phase Equilibria and Heat Treatment:(12 Lectures)**<br>Phase rule, phase diagrams, phase changes in pure iron, different types of reactions involved in the binary system such as eutectic, eutectoid, peritectic and peritectoid, Binary phase diagrams of Pb-Sn, Cu-Zn and Fe-C, General principles and Types of heat treatment, annealing, Normalizing, tempering, hardening, case hardening, austempering, martempering, TTT Curves. |

<table>
<tr><td></td><td colspan="3">Unit – IV: Surface Phenomenon and Miscellaneous Materials: (12 Lectures)<br>Adsorption, Types of Adsorption, Adsorption Isotherms (Langmuir, Freundlich and BET), Catalysis at Solid Surfaces, Colloids, Properties of Colloids, Preparation of Sols, Adhesives and Adhesion, Classification of Adhesives, Factors Controlling the Properties of Adhesives, Definition of Composites, Classification of Composites, Applications of Composites.</td></tr>
<tr><td>Suggested Readings/ Text/References</td><td colspan="3">1. Materials Science and Engineering by V. Raghavan.<br>2. A Textbook of Materials Science and Metallurgy by O.P. Khanna<br>3. Physical Chemistry by P W Atkins</td></tr>
<tr><td rowspan="4">Course Assessment</td><td rowspan="2">1.Sessional/Mid sem Exam</td><td>1. Course work/Home Assignment</td><td>15 Marks</td></tr>
<tr><td>2. Mid-Sem Examination (One Hour)</td><td>25 Marks</td></tr>
<tr><td rowspan="2">2. End semExam</td><td>End-Sem Examination (Two hours)</td><td>60 Marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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*(AC 311: Approved by BOS dated 29.5.2017)*

# B.Tch. Third Year (Vth Semester)

## (Petrochemical Engineering)

## COURSE

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|---|---|
| **CourseTitle** | **Engineering Materials** |
| **Course Number** | **AC 311** |
| **Credits** | **4** |
| **Course Category** | **DC** |
| **Contact Hours (L-T-P)** | **3-1-0** |
| **Type of Course** | **Theory** |
| Course Objectives | To impart the knowledge of applications of material sciences in engineering and technology |
| Course outcome | After completion of the course the student shall be able to understand<br>1. Different types of crystalline solids, their structure and properties. Miller indices for determination of crystalline direction and planes.<br>2. Properties of engineering materials, classification of steels and techniques used to determine the microstructure of materials.<br>3. Phase equilibrium and different phases involved in the transformation of materials under varying conditions.<br>4. Adsorption and its classification. Role of adsorbent on the surface catalyzed reactions, Colloids and adhesives. |
| Syllabus | **Unit – I: Engineering Materials and their Structure:(12 Lectures)**<br>Crystalline and amorphous solids, crystal lattice, unit cell, crystal systems, different types of structures – SC, BCC, FCC and HCP, factors influencing the density of crystal, crystal direction and crystal planes, Miller indices, interplanar spacing, Bragg's Law of X-ray diifraction, Characterization of microstructure by XRD, crystal defects-types and impact on the properties of Engineering Materials.<br>**Unit – II: Engineering Materials and their Characterization:(12 Lectures)**<br>Introduction to engineering materials, classification, steels and cast irons, classification of steels, plain carbon steel, alloy steel, stainless steels, austenitic stainless steels, ferritic stainless steels, martensitic stainless steels, development of corrosion resistance in stainless steel, cast iron, gray cast iron, white cast iron, malleable cast iron, ductile cast iron, Characterization of microstructure by TGA, DSC, SEM and TEM<br>**Unit – III: Phase Equilibria and Heat Treatment:(12 Lectures)**<br>Phase rule, phase diagrams, phase changes in pure iron, different types of reactions involved in the binary system such as eutectic, eutectoid, peritectic and peritectoid, Binary phase diagrams of Pb-Sn, Cu-Zn and Fe-C, General principles and Types of heat treatment, annealing, Normalizing, tempering, hardening, case hardening, austempering, martempering, TTT Curves. |

<table>
<tr><td></td><td colspan="3">Unit – IV: Surface Phenomenon and Miscellaneous Materials: (12 Lectures)<br>Adsorption, Types of Adsorption, Adsorption Isotherms (Langmuir, Freundlich and BET), Catalysis at Solid Surfaces, Colloids, Properties of Colloids, Preparation of Sols, Adhesives and Adhesion, Classification of Adhesives, Factors Controlling the Properties of Adhesives, Definition of Composites, Classification of Composites, Applications of Composites.</td></tr>
<tr><td>Suggested Readings/ Text/References</td><td colspan="3">1. Materials Science and Engineering by V. Raghavan.<br>2. A Textbook of Materials Science and Metallurgy by O.P. Khanna<br>3. Physical Chemistry by P W Atkins</td></tr>
<tr><td rowspan="4">Course Assessment</td><td rowspan="2">1.Sessional/Mid sem Exam</td><td>1. Course work/Home Assignment</td><td>15 Marks</td></tr>
<tr><td>2. Mid-Sem Examination (One Hour)</td><td>25 Marks</td></tr>
<tr><td rowspan="2">2. End semExam</td><td>End-Sem Examination (Two hours)</td><td>60 Marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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*(AC 308: Approved by BOS dated 29.5.2017)*

## B.Tech. V/VI/VII/VIII semester (Electrical/Mechanical/ Civil/Chemical/ Electronics/Computer/Architecture/Petro-Chemical Engineering)

## COURSE

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|---|---|
| **Course Title** | **Atmospheric Chemistry** |
| **Course Number** | **AC 308** |
| **Credits** | **4** |
| **Course Category** | **OE** |
| **Contact Hours (L-T-P)** | **3-1-0** |
| **Type of Course** | **Theory** |
| Course Objectives | To impart the knowledge of atmospheric chemistry in engineering and technology |
| Course outcome | After completion of the course the student shall be able to understand<br>1. Structure of the atmosphere, classification of the air pollutants and clean air act.<br>2. Criteria Pollutants, particulate matter and control devices for particulate pollutants.<br>3. Sampling, monitoring and quantitative analysis of gaseous pollutants.<br>4. Natural cycles, photochemical reactions, alternative fuels, indoor air quality and global atmospheric change. |
| Syllabus | **UNIT–I: Atmospheric Structure (12 L)**<br>Composition of the atmosphere. Atmospheric regions (Troposphere, stratosphere, mesosphere and ionosphere). Temperature profile and major chemical species present in various atmospheric regions. Classification of air pollutants on the basis of origin, chemical composition and state of matter. Clean Air Act. National ambient air quality standards (NAAQS) and emission standards.<br>**UNIT-II: Air Pollutants (12 L)**<br>Criteria pollutants existing under NAAQS: Ground level ozone, carbon monoxide, oxides of nitrogen, oxides of Sulphur and volatile organic compounds (VOC). Particulate matter: physical, chemical and biological characteristics of particulates. Significance of $PM_{10}$ and $PM_{2.5}$. Control devices for particulate pollutants: Gravitational settling chamber, cyclone separators, fabric filters. General Principle of wet collectors (scrubbers): spray tower and venturi scrubber.<br>**UNIT-III: Monitoring and analysis of Air Pollutants (12 L)**<br>Sampling and monitoring of gaseous pollutants: Grab sampling, condensation, adsorption and absorption techniques. Methods of air pollution analysis. Gravimetric and volumetric analysis. Instrumental methods of analysis: Principle of UV-Visible spectrophotometry, Infra-red and atomic absorption spectrometry. Quantitative estimation of CO, $CO_2$, $SO_2$, $H_2S$, $O_3$ and $NH_3$.<br>**UNIT-IV: Natural Cycles photochemical reactions and global atmospheric change: (12 L)**<br>Hydrologic cycle, nitrogen cycle and Carbon cycle. Photochemical oxidants and formation of photochemical smog. Alternative fuels. Indoor air quality. Greenhouse effect, regional impacts of temperature change. Changes in stratospheric region, catalytic destruction of Ozone, impacts of increased exposure to UV radiations. |
| Suggested Readings/ Text/References | 1 Gilbert M, Masters. Introduction to Environmental Engineering and Science. Prentice Hall of India, New Delhi. |

<table>
<tr><td></td><td colspan="3">2. S.S.Dara, A text Book of Environmental Chemistry and Pollution control. S. Chand and Company Ltd.<br>3. S.M Khopkar, Environmental Pollution Analysis. Wiley Eastern Ltd.<br>4. Gary D. Christian, Analytical Chemistry. John Wiley and Sons, Inc. New York.<br>5. G.W. Ewing, Instrumental methods of Chemical Analysis, McGraw Hill International, New York.<br>6. A.K. De, Environmental Chemistry, New Age International Publishers, New Delhi</td></tr>
<tr><td rowspan="4">Course Assessment</td><td rowspan="2">1.Sessional/Mid sem Exam</td><td>1. Course work/Home Assignment</td><td>15 Marks</td></tr>
<tr><td>2. Mid sem Examination (One Hour)</td><td>25 Marks</td></tr>
<tr><td rowspan="2">2. End sem Exam</td><td>End sem Examination (Two hours)</td><td>60 Marks</td></tr>
<tr><td>Total</td><td>100 Marks</td></tr>
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