COURSE DESCRIPTION OF B.Sc. (HONS.) CHEMISTRY

SEMESTER I

Atomic Structure and Chemical Bonding

Title: Atomic Structure & Chemical Bonding **Code: BS1CH101**

L-T-P Scheme: 2-1-0 **Credit: 03**

Prerequisite: The students must be aware of basic Chemistry up to the I.Sc. Level. This knowledge helps them to correlate and adopt at Graduate level.

Objective:

The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of chemical bonding in compounds. It provides basic knowledge about ionic, covalent and metallic bonding and explains that chemical bonding is best regarded as a continuum between the three cases. It discusses the periodicity in properties with reference to the s and p block, which is necessary in understanding their group chemistry.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning of Atomic Structure and Chemical Bonding. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to atomic structure; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Chemistry.
CO2	Describe the real-world problems, challenges with the application. Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Chemistry. Draw the plausible structures and geometries of molecules using Radius Ratio Rules, VSEPR

theory and MO diagrams (homo- & hetero-nuclear diatomic molecules)

CO4 Identify and use various analytical techniques in Chemistry based project management. Understand the concept of lattice energy using Born-Landé and Kapustinskii expression.

CO5 Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures. Rationalize the conductivity of metals, semiconductors and insulators based on the Band theory.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1:

Atomic Structure: Recapitulation of Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance. Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum mechanical treatment of H- atom, Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, and d orbitals, Relative energies of orbitals. Pauli's Exclusion Principle, Hund's rule of maximum spin multiplicity, Aufbau principle and its limitations.

Unit 2:

Chemical Bonding: **Ionic bond:** General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Unit 3:

Covalent bond: Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference. Molecular orbital theory.

Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, C2, B2, F2, CO, NO, and their ions; HCl (idea of s-p mixing and orbital interaction to be given).

Unit 4:

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment). Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process.

Unit 5:

VSEPR Theory: Lewis structure, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_3, PCl_5, SF_6, ClF_3, I_3^- , BrF_2^+, PCl_6^- , $ICl2^-$, ICl_4^-, and SO_4^{2-} .

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Atomic structure and Chemical bonding basic concept in details. The entire syllabus has divided into five units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Lee, J.D.; (2010),Concise Inorganic Chemistry, Wiley India.

[2] Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009),Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Education.

[3] Douglas, B.E.; McDaniel, D.H.; Alexander, J.J.(1994),Concepts and Models of Inorganic Chemistry, John Wiley & Sons.

[4] Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010),Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.

Reference Book:

[1] Wulfsberg, G (2002),Inorganic Chemistry, Viva Books Private Limited.

[2] Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014),Inorganic Chemistry, 5th Edition, Pearson.

Organic Chemistry I

Title: Organic Chemistry I **Code: BS1CH102**

L-T-P Scheme: 2-1-0 **Credit: 03**

Prerequisite: The students must be aware of basic Organic Chemistry up to the I.Sc. Level. This knowledge helps them to correlate and adopt at Graduate level.

Objective:

The core course Organic Chemistry I is designed in a manner that it forms a cardinal part of the learning of organic chemistry for the subsequent semesters. The course is infused with the recapitulation of fundamentals of organic chemistry and the introduction of a new concept of visualizing the organic molecules in a three-dimensional space. To establish the applications of these concepts, the functional groups-alkanes, alkenes, alkynes and aromatic hydrocarbons are introduced. The constitution of the course strongly aids in the paramount learning of the concepts and their applications.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning of different nature and behavior of organic compounds based on fundamental concepts learnt.. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Organic Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Organic Chemistry.
CO2	Describe the real-world problems, challenges with the application of the concept. Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems. Learn and identify many organic reaction mechanisms including Free Radical Substitution, Electrophilic Addition and Electrophilic Aromatic Substitution.
CO4	Identify and use various analytical techniques in Organic Chemistry based project

management.

CO5 Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures. Understand the fundamental concepts of stereochemistry.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1:

General Organic Chemistry: Hybridisation: Shapes of molecules Electronic displacements and their applications: Inductive, electromeric, resonance and mesomeric effects and hyperconjugation. Concept of dipole moment, acidity and basicity and pKa values. Homolytic and heterolytic fissions with suitable examples. Types, shape and relative stability of carbocations, carbanions, carbenes and free radicals. Weaker forces like van der Waals forces and hydrogen bonding Electrophiles and nucleophiles, and introduction to types of organic reactions: addition, elimination and substitution reactions.

Unit 2:

Stereochemistry: Stereoisomerism: Optical activity and optical isomerism, asymmetry, chirality, enantiomers, diastereomers. specific rotation; Configuration and projection formulae: Newmann, Sawhorse, Fischer and their interconversion. Chirality in molecules with one and two stereocentres; meso configuration. Racemic mixture and their resolution. Relative and absolute configuration: D/L and R/S designations. Geometrical isomerism: cis-trans, syn-anti and E/Z notations using CIP rules.

Unit 3:

General methods of preparation- Wurtz and Wurtz Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Free radical substitutions; Halogenation, concept of relative reactivity v/s selectivity. Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane and butane).General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram, Axial and equatorial positions. Conformations of monosubstituted cyclohexanes.

Unit 4:

Structure and isomerism.General methods of preparation, physical and chemical properties. Mechanism, of E1, E2, E1cb reactions, Saytzeff and Hoffmann eliminations, Electrophilic Additions, mechanism with suitable examples, (Markownikoff/Antimarkownikoff addition), syn and anti-addition; addition of H2, X2, oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, hydroxylation, Diels Alder reaction, 1,2-and 1,4-addition reactions in conjugated dienes. Mechanism of allylic and benzylic bromination in propene, 1-butene, toluene,ethyl benzene. Reactions of alkynes; acidity, electrophilic and nucleophilic additions, hydration to form carbonylcompounds, Alkylation of terminal alkynes.

Unit 5:

Aromatic Hydrocarbons: Concept of Aromaticity, Huckel's rule, aromatic character of arenes, cyclic carbocations and carbanions with suitable examplesand heterocyclic compoundswith suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation, Friedel Crafts alkylation/ acylation with their mechanism. Directing effects of groups in electrophilic substitution.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Organic Chemistry basic concept in details. The entire syllabus has divided into five units. Each section includes multiple topics to help a student gain a deeper understanding of Organic Chemistry. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	

Total	100 Marks

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

[2] Finar, I. L. Organic Chemistry (Volume 1& 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Page 26 of 167 B.Sc. Hons Chemistry University of Delhi.

[3] Chandra, R. ; Singh, S.; Singh, A. (2019), Basic Organic Chemistry, Arcler Press.

[4] Eliel, E. L.; Wilen, S. H.(1994),Stereochemistry of Organic Compounds; Wiley: London.

[5] Singh, S.P.; Prakash, O.,(2017), Reaction Mechanism in organic chemistry, Laxmi Publications.

Reference Book:

[1] Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016),Organic Chemistry, 12th Edition, Wiley.

[2] Bruice, P. Y. (2017),Organic Chemistry, 8th Edition, Pearson.

[3] Clayden, J.; Greeves, N.; Warren, S. (2012), Organic Chemistry, Oxford.

[4] Nasipuri, D.(2018), Stereochemistry of Organic Compounds: Principles and Applications, 3 rd Edition, New Age International.

[5] Gunstone, F. D. (1975), Guidebook to Stereochemistry, Prentice Hall Press.

Quantitative & Qualitative Analysis Lab

Course Name: Quantitative & Qualitative Analysis Lab **Code:** BS1CH171

L-T-P Scheme: 0-0-02 **Credit:** 01

Prerequisite: The students must be aware of basic Inorganic Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Graduate level.

Objective: The students will aware about various chemical synthesis and analysis at laboratory

[1] Titrimetric Analysis: (i) Calibration and use of apparatus (ii) Preparation of solutions of titrants of different Molarity/Normality.

[2] Acid-Base Titrations: Principles of acid-base titrations to be discussed.

(i) Estimation of sodium carbonate using standardized HCl.

(ii) Estimation of carbonate and hydroxide present together in a mixture.

(iii) Estimation of carbonate and bicarbonate present together in a mixture.

(iv) Estimation of free alkali present in different soaps/detergents

[3] Oxidation-Reduction Titrimetry: Principles of oxidation-reduction titrations (electrode potentials) to be discussed.

(v) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution

(vi) Estimation of oxalic acid and sodium oxalate in a given mixture.

(vii) Estimation of Fe(II) with K2Cr2O7 using internal indicator (diphenylamine, N-phenylanthranilic acid) and discussion of external indicator

Teaching Methodology: This course is introduced to help students understand various experiments useful at various levels in chemical industry as well as higher study. The entire course is broken down into following separate units. Each section includes multiple topics to help a student gain deeper understanding of the subject. This lab course is well complemented by a theory course in the same semester that helps a student learn and discuss the technical details of the underlying technologies.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Exp 1-4
P-2	15 Marks	Exp 5-8

Attendance & Discipline	15 Marks	
Practical Records	15 Marks	
Day to day activity	40 Marks	
Total	**100 Marks**	

Learning Resources: Study material of Environmental Engineering Lab (will be added time to time): Digital copy will be available on the JUET server.

Reference Book:

[1] Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),**Vogel's Textbook of Quantitative Chemical Analysis,** John Wiley and Sons.

Algebra

Title: Algebra Code: BS1MA101

L-T-P scheme:3-1-0 C**redit: 4**

Prerequisite: Students must have basic knowledge of systems of linear equations, matrices.

Objective:

This course aims to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study certain structures called groups and some related structures and Application of matrices. Algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill.

Learning Outcomes:

Course Outcome	**Description**
CO1	Familiarize with relations, equivalence relations and partitions
CO2	Work within various algebraic structures
CO3	Understand the importance of algebraic properties with regard to working within various number systems.
CO4	Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
CO5	Compute rank of matrix, solution of system of LE. and find kernel of homomorphism. Find eigenvalues and corresponding eigenvectors for a square matrix
CO6	Think critically by interpreting theorems and apply relating results to problems in other mathematical disciplines

Course Contents:

Unit-I : Introduction of matrices, Elementary operations of matrices. Inverse of a matrix. Rank of amatrix.

Unit-2 : Application of matrices to the system of linear equations, Consistency of the system.

Unit-3: Divisionalgorithm, Divisibility and Euclidean algorithm, Congruence relation betweenintegers, Fundamental Theorem of Arithmetic.

Unit-4: Definition of a group with examples and simple properties, Abelian group, Subgroups,Generation of groups, Cyclic groups.

Unit-5 : Coset decomposition, Lagrange's theorem and its consequences, Normal subgroups.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Algebra (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1]. I. N. Herstein , Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975.
[2]. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.
[3]. K.B. Datta, Matrix and Linear Algebra, PHI Pvt. Ltd. New Delhi, 2000.
[4]. P.B. Bhattacharya, S.K.Jain , S.R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd. New Delhi, 1983.
[5]. S. Singh, Modern Algebra, Vikas Publ. House, India.

Calculus

Title: **Calculus** Code: **BS1MA102**
L-T-P scheme:3-1-0 C**redit: 4**

Objective:

The objective of this course is to be able to write rigorous mathematical proofs for basic theorems in single -variable calculus involving the fundamental tools such as continuity and differentiability. This course is essential for any student majoring in mathematics.

Learning Outcomes:

Course Outcome	**Description**
CO1	Define Limit, Continuity, Discontinuity, properties of Continuous functions.
CO2	Calculate the Differentiability, Chain rule ofdifferentiation,
CO3	Understand the Mean value theorems, Taylor's and Maclaurin theorems.
CO4	Application ofdifferential calculus in curve sketching.
CO5	Ilaborate Integral Calculus: Integration of ational and Irrational fractions,
CO6	Discuss Integration of Transcendental functions, Definite Integrals, Areas of curves, lengths of curves, Volumes and Surfaces of solids of revolution.

Course Contents:

Unit1. Differential Calculus: Successive differentiation and Leibnitz theorem. Limit, Continuity, Discontinuity, properties of Continuous functions.

Unit2. Differentiability, Chain rule ofdifferentiation, Mean value theorems, Taylor's and Maclaurin theorems.

Unit3. Application ofdifferential calculus in curve sketching.

Unit4. Integral Calculus: Integration of ational and Irrational fractions, Integration of Transcendental functions.

Unit5. Definite Integrals, Areas of curves. lengths of curves, Volumes and Surfaces of solids of revolution.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Calculus (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1]. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
[2]. Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
[3]. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar Inc. New York 1975.
[4.] Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi

Course Description

Title of Course: Mechanics and Relativity	Course Code: BS1PH101

L-T Scheme: 3-1-0 **Course Credit: 4**

Objective:
Capable of demonstrating good knowledge and understanding of major concepts of theoretical principles and experimental results as well. The course is aimed at enhance the ability to employ the critical thinking, and efficient problem solving skills in all the areas of physics. Student should be capable of demonstrating ability to think and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism,

Learning Outcomes: At the end of the course a student will be able to analyze a problem using their mathematical skills to classical mechanics problems. It will also enable them to use Newton's Laws of Motion and conservation laws in the solution of physical problems.

Course Contents: Preliminary Concepts: Vector Algebra, dimensional analysis, unit systems, concept of frame of references etc. Laws of Motion: Newton's first law of motion and concept of inertia, Second law of Motion concept of force. Newton's third law. Gravity, Weight, and the Gravitational Field, Contact Forces, Force of a String, The Normal Force, Friction, the Linear Restoring Force, Simple Harmonic Motion etc. **(Lectures: 12)**

Conservation Principles : Introduction to Momentum, Angular Momentum, Work and Energy, Conservation laws. Inverse square law of force, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, motion of CM of system of particles subject to external forces, elastic, and inelastic collisions in one and two dimensions. **(Lectures: 10)**
Scattering Problem in Classical Mechanics: Scattering angle in, the laboratory frame of reference, Impact parameter, Scattering cross section. **(Lectures: 6)**
Rigid Bodies: Elementary dynamics of rigid bodies. **(Lectures: 6)**
Special Relativity: Frames of reference, Inertial and non-inertial frames of reference Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. **(Lectures: 8)**

Course Outcome

Course Outcome	Description
CO1	Introduction to concept of motion and Newton's law of motions, frame of references
CO2	Motion in 1D and 2D Cartesian and plane polar coordinate system. Application of Newton law of motion to various physical problem. Understanding of the principle of conservation of energy, momentum, angular momentum etc.

CO3	Advance concept of calculus to understand the rigid body motion, and fluid flow.
CO4	Applying the knowledge to scattering problem and several other physical problem
CO5	Understanding the limitation of Newton law of motion and extend the concept of special theory of relativity to problem where relative velocity between two observer exist. Extending the understanding of special theory of relativity to describe the motion a body that has very high velocity

Text Books:

1. An Introduction to Mechanics, D. Kleppner and R.J. Kolenkow
2. Mechanics (Berkeley Physics Course, Vol. 1), C. Kittle et.al.
3. Introduction to Special Relativity, R. Resnick

Reference Books:

1. Fundamentals of Physics, R. Resnick, D. Halliday
2. Concept in Physics Vol.: I, H.C.Verma

Title of Course: Waves and Sound	Course Code: BS1PH102

L-T Scheme: 3-1-0 **Course Credit: 4**

Course Objectives: Simple harmonic motion is one of the fundamental types of motion that exists in nature. The objective of this course is to cover the fundamental physical concepts of Simple harmonic motion, waves and sound.

Course Outcomes : After successful completion of this course, students will be able to
CO1 : Set up an equation of motion for simple harmonic motion and obtain its solution.
CO2 : Explain how superposition of waves leads to different Lissajous figures.
CO3 : Set and solve the equation of motion for damped and driven damped harmonic oscillators and analyse the nature of oscillations.
CO4: Understand the dependence of velocity of sound waves on various factors like temperature, pressure, density, humidity.
CO5: Solve problems for different cases of Doppler Effect.

UNIT – I: Undamped free oscillation, Undamped free oscillation, Different type of equilibria (Stable, unstable and neutral equilibrium). Periodic oscillations and potential well. Differential equation for simple harmonic oscillator and its solutions. Energy of the harmonic oscillator. Examples of simple harmonic oscillations: spring and mass system, simple and compound pendulum, torsional pendulum, bifilar oscillations, Helmholtz resonator. Superposition of two simple harmonic motions of the same frequency along the same line. Superposition of two mutually perpendicular simple harmonic vibrations of the same frequency. Superposition of two mutually perpendicular simple harmonic vibrations and having time periods in the ratio 1:2. Uses of Lissajous' figures.

UNIT – II: Damped Oscillations and Driven Damped Oscillations Damped Oscillations, Introduction. Differential equation of damped harmonic oscillator and its solution, discussion of different cases (Strong, weak and Critical damping).Logarithmic decrement. Energy equation of damped oscillations. Power dissipation. Quality factor. Driven Damped Oscillations Introduction, Differential equation of forced oscillation and its solution (transient and steady state). Resonance. Width of the resonance; the Q factor. The phase at resonance. Velocity resonance. . Coupled Oscillations Coupled oscillations. Normal Coordinates. Energy of coupled oscillations.

UNIT – III: Waves and Sound, Transverse vibrations in strings. Velocity of longitudinal waves in gases. Newton's formula for velocity of sound. Velocity in a homogeneous medium. Laplace's correction. Kundt's tubedetermination of velocity of sound in a gas and in solids. Intensity level and Bel and Decibel. Production and detection of Ultrasonic waves.

Unit IV: Doppler Effect: Explanation of Doppler effect in sound. Observer in rest and source in motion. Source at rest and observer in motion. When both source and observer are in motion. Effect of wind velocity. Doppler effect in light. Applications of Doppler effect.

References:

1. Khanna, D. and Bedi, R. 1992, A Textbook of Sound, Atma Ram and sons, Delhi.
2. Mathur, D. 2012, Mechanics, S. Chand, New Delhi.
3. Taylor, J. 2005, Classical Mechanics, University Science Books, USA
4. Subrahmanyam, N. and Lal, B. 1994, Waves and Oscillation, Vikas Publishing House, Noida
5. French, AP 2003, Vibration and Waves, CBS Publisher, India.
6. Halliday, D., Resnick, R. and Walker, J. 2003, Fundamentals of Physics, 6th edition, John Wiley and Sons, USA. 3. Pain, J. 2005,
7. The Physics of Vibration and Waves, 6th Edition, Wiley.

Title of Course: Physics Lab I	Course Code: BS1PH171

L-T Scheme: 0-0-2 **Course Credit: 1**

Objective: To learn the use of different instruments for understanding the principles of Physics.

List of Experiments:

1. Using Vernier Callipers
   (i) Measure the diameter of a small spherical/cylindrical body.
   (ii) Measure the dimensions of a given regular body of known mass and hence find its density.
   (iii) Measure the internal diameter and depth of a given beaker and hence find its volume
2. Using Screw-gauge
   (i) Measure diameter of a given wire.
   (ii) Measure thickness of a given sheet.
3. To find the weight of a given body using parallelogram law.
4. To determine the force constant K and mass of the flat spiral spring by statistical and dynamical method..
5. Using simple pendulum determine the acceleration due to gravity.
6. To determine the value of Young's modulus of the material from the flexure of a beam supported on two knife-edges and loaded at its middle point.
7. To determine the modulus of rigidity of the material of wire with the help of a torsional pendulum.
8. To determine the radius of curvature of a convex lens by spherometer

Course Outcome	Description
CO1	Develop the ability to collect experimental data and understanding the working procedures within the precautionary limits
CO2	Acquired the ability to analyze the experimental data and related errors in a reflective, iterative and responsive way
CO3	Demonstrate understanding of the basic concepts related to classical mechanics
CO4	Acquired an enhanced understanding of the theory course "Mechanics and relativity" offered in parallel

CO5	Appreciate the importance of the laboratory work culture and ethics that is intended to impart features like regularity, continuity of self evaluation and honesty of reporting the data

SEMESTER II

Inorganic Chemistry

Title: Inorganic Chemistry I **Code: BS1CH201**

L-T-P Scheme: 2-1-0 **Credit: 03**

Prerequisite: The students must be aware of basic Inorganic Chemistry up to the I.Sc. Level. This knowledge helps them to correlate and adopt at Graduate level.

Objective:

The course reviews the general principles of metallurgy and s-, p-block elements. It reviews the terms minerals, ores, concentration, benefaction, calcination, roasting, refining, etc. and explains the principles of oxidation and reduction as applied to the extraction procedures. Methods of purification of metals, such as electrolytic, oxidative refining, Van Arkel-De Boer process and Mond's process are discussed and applications of thermodynamic concepts like that of Gibbs energy and entropy to the extraction of metals are reviewed. It further discusses the patterns and trends exhibited by s and p block elements and their compounds with emphasis on synthesis, structure, bonding and uses.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning of different nature and behavior of inorganic compounds based on fundamental concepts learnt. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Inorganic Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Inorganic Chemistry. Learn the fundamental principles of metallurgy and understand the importance of recovery of byproducts during extraction.
CO2	Describe the real-world problems, challenges with the application of the concept. Formulate the mechanism of inorganic reactions by recalling and correlating the fundamental properties of the reactants involved. Understand the basic and practical applications in various fields of metals and alloy behavior and their manufacturing

processes.

CO3 Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems. Apply the thermodynamic concepts like that of Gibbs energy and entropy to the principles of extraction of metals.

CO4 Identify and use various analytical techniques in Inorganic Chemistry based project management. Understand the periodicity in atomic and ionic radii, electronegativity, ionization energy, electron affinity of elements of the periodic table

CO5 Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures. Understand oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1:

General Principles of Metallurgy: Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, Van Arkel-De Boer process, Zone refining.

Unit 2:

Chemistry of s-Block Elements General characteristics: melting point, flame colour, reducing nature, diagonal relationships and anomalous behavior of first member of each group. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water. Common features such as ease of formation, thermal stability and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates. Complex formation tendency of s-block elements; structure of the following complexes: crown ethers and cryptates of Group I; basic beryllium acetate, beryllium nitrate, EDTA complexes of calcium and magnesium. Solutions of alkali metals in liquid ammonia and their properties.

Unit 3:

Chemistry of p- Block Elements: Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, Catenation, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group.

Unit 4:

Structure, bonding and properties: acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat of the following:

• **Hydrides**: hydrides of Group 13 (only diborane), Group 14, Group 15 (EH3 where E = N, P, As, Sb, Bi), Group 16 and Group 17. • **Oxides**: oxides of phosphorus, sulphur and chlorine • **Oxoacids:** oxoacids of phosphorus and chlorine; peroxoacids of sulphur • Halides: halides of silicon and phosphorus

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Inorganic Chemistry basic concept in details. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Inorganic Chemistry. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Lee, J.D.; (2010),Concise Inorganic Chemistry, Wiley India.

[2] Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009),Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Education.

[3] Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994),Concepts and Models of Inorganic Chemistry,John Wiley & Sons.

[4] Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010),Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.

[5] Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014),Inorganic Chemistry, 5th Edition, Pearson.

Physical Chemistry I

Title: Physical Chemistry I **Code: BS1CH202**

L-T-P Scheme: 3-1-0 **Credit: 04**

Prerequisite: The students must be aware of basic Physical Chemistry up to the I.Sc. Level. This knowledge helps them to correlate and adopt at Graduate level.

Objective:

To develop basic and advance concepts regarding the three states of matter. To derive the expressions for determining the physical properties of gases, liquids and solids.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning of different nature and behavior of Physical Chemistry based on fundamental concepts learnt. Derive mathematical expressions for different properties of gas, liquid and solids and understand their physical significance.
CO2	Describe the real-world problems, challenges with the application of the concept. Explain the crystal structure and calculate related properties of cubic systems.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems.
CO4	Identify and use various analytical techniques in Physical Chemistry based project management. Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures. Apply the concepts of gas equations, pH and electrolytes while studying other chemistry courses and everyday life.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1:

Gaseous state: Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. Equation of states for real gases; van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial coefficients, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Unit 2:

Liquid state: Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

Unit 3:

Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.

Unit 4:

Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility

product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Physical Chemistry basic concept in details. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is dividing into 42 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Atkins, P.W.; Paula, J.de. (2014),**Atkin's Physical Chemistry Ed**., 10th Edition, Oxford University Press.

[2] Ball, D. W. (2017),**Physical Chemistry,** 2nd Edition,Cengage Learning, India.

[3] Castellan, G. W. (2004),**Physical Chemistry**, 4th Edition, Narosa.

[4] Kapoor, K.L. (2015),**A Textbook of Physical Chemistry**, Vol 1, 6th Edition, McGraw Hill Education

Reference Book:

[1] Moore, W.J. (1972),**Physical Chemistry**, 5th Edition,Longmans Green & Co. Ltd.

[2] 2. Glasstone, S. (1948),**Textbook of Physical Chemistry**, D. Van Nostrand company, New York.

Physical Chemistry Lab

Course Name: Physical Chemistry Lab **Code:** BS1CH271
L-T-P Scheme: 0-0-02 **Credit:** 01

Prerequisite: The students must be aware of basic Physical Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Graduate level.

[1] Objective: The students will aware about various chemical synthesis and analysis at laboratory To analyze different group radicals.

[2] Indentify different functional group of unknown organic compound.

[3] Determine the surface tension of aqueous solutions by (i) drop number (ii) drop weight method.

[4] Study the variation of surface tension with different concentration of detergent solutions. Determine CMC.

[5] Viscosity measurement using Ostwald's viscometer. i. Determination of co-efficient of viscosity of an unknown aqueous solution. ii. Study the variation of co-efficient of viscosity with different concentration of Poly Vinyl Alcohol (PVA) and determine molar mass of PVA. iii. Study the variation of viscosity with different concentration of sugar solutions.

[6] Determination of molecular weight of a volatile compound using Victor Meyer's method.

[7] Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.

[8] Preparation of buffer solutions of different pH values

(a) Sodium acetate-acetic acid

(b) Ammonium chloride-ammonium hydroxide

Teaching Methodology: This course is introduced to help students understand various experiments useful at various levels in chemical industry as well as higher study. The entire course is broken down into following separate units. Each section includes multiple topics to help a student gain deeper understanding of the subject. This lab course is well complemented by a theory course in the same semester that helps a student learn and discuss the technical details of the underlying technologies.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Exp 1-4
P-2	15 Marks	Exp 5-8
Attendance & Discipline	15 Marks	
Practical Records	15 Marks	
Day to Day Activity	40 Marks	
Total	**100 Marks**	

Learning Resources: Study material of Environmental Engineering Lab (will be added time to time): Digital copy will be available on the JUET server.

Reference Book:

[1] Khosla, B.D.; Garg, V.C.; Gulati, A. (2015),Senior Practical Physical Chemistry, R. Chand & Co, New Delhi.

[2] Kapoor, K.L. (2019),A Textbook of Physical Chemistry, Vol.7, 1st Edition, McGraw Hill Education.

[3] Garland, C. W.; Nibler, J. W.; Shoemaker, D. P.(2003),Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York.

Linear Algebra

Title of Course: Linear Algebra **Course code: BS1MA201**
L-T-P Scheme: 3 -1 - 0 **Course Credit: 4**

Prerequisite: Students should have basic knowledge of group and field theory.

Objectives: The course is intended to prepare the students for mathematical theory and methods of linear algebra, in particular vector spaces over the real or complex numbers, linear transformation, diagonalization and orthogonality .

Learning Outcomes:

Course Outcome	At the end of the course, the student is able to:
CO1	Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.
CO2	Determine linear independence for vectors in R^n, rank and nullity of linear transformation.
CO3	Derive the matrix representing a linear under a given basis, and determine how the matrix changes if the basis is changed.
CO4	Use characteristic polynomials to compute eigenvalues and eigenvectors,
CO5	Recognize definite integral as an inner product,orthogonality of vectors and its use in projecting vectors into subspaces and decomposing vectors into components.
CO6	Apply the theory, methods and techniques of the course to solve mathematical problems.

Course Contents:

Unit 1: Vector spaces, subspaces and linear spans, linear dependence and independence. Finite dimensional vector spaces.

Unit 2: Linear transformations and their matrix representations. Algebra of linear transformations, the rank and nullity theorem. Change of basis. Dual spaces, bi dual space and natural isomorphism.

Unit 3: Eigen values and Eigen vectors of LT, Diagonalization, Cayley Hamilton theorem.

Unit 4: Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel's inequality, Gram-Schmidt orthogonalization process.

Methodology

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	

Learning Resources:

Tutorials and lecture slides on linear algebra (will be added from time to time): Digital copy will be available on the JUET server.

Books:

1. N. Herstain, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. K. Hoffman and R. Kunze, Linear Algebra, Prentice-Hall of India, New Delhi, 1971.
3. N. Jacobson, Basic Algebra, Vols I & II, W.H. Freeman, 1980
4. K.B. Dutta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New Delhi, 2000.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups, Narosa Publishing House, Vol. I 1996.

Discrete Mathematics

Course Title: Discrete Mathematics **Course Code: BS1MA202**

L-T-P Scheme: 3 -1 - 0 **Course Credit: 4**

Objectives:

The aim of the course is to cover the basic principles sets relations functions partially ordered set, lattice, Boolean algebra and its applications. The main objective of the course is to develop in student, an intuitive understanding of graphs by emphasizing on the real world problems.

Learning Outcomes:

CO1	Employ De Moivre's theorem in a number of applications to solve numerical problems.
CO2	Appreciate the definition and basics of graphs along with types and their examples.
CO3	Visualize the applications of graph theory to network flows. Understand the notion of planarity and coloring of a graph. Relate the graph theory to the real-world problems.
CO4	Understand the definition of a tree and learn its applications to fundamental circuits.
CO5	Solve real-life problems using finite-state and Turing machines
CO6	Learn about partially ordered sets, lattices and their types,Boolean algebra and Boolean functions, logic gates, switching circuitsand their applications.

Course Contents:

Unit 1: Basics of set theory, Mathematical induction. Relations, Equivalence relation, partial-ordered relation algorithms and functions.

Unit 2: Big O notation,Proposition, Basic logical operators, Propositional functions and Quantifiers.

Unit 3: Graphs and related definitions, Eulerian and Hamiltonian graphs, Graph colorings. Trees, Algebraic expressions and Polish notation, shortest path.

Unit 4: Algebraic Systems. Latticeand Boolean Algebra.

Unit5: Language, Finite State Automata and Machines. Grammars.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

References:

1. B. A, Davey & H. A. Priestley (2002). "Introduction to Lattices and Order" (2nd edition)Cambridge University, Press.
2. Edgar, G. Goodaire & Michael M. Parmenter (2018). "Discrete Mathematics with Graph Theory" (3rd edition). Pearson Education.
3. Rudolf Lidl & Günter Pilz (1998). "Applied Abstract Algebra" (2nd edition). Springer.
4. Kenneth H. Rosen (2012). "Discrete Mathematics and its Applications: With Combinatorics and Graph Theory" (7th edition), McGraw-Hill.
5. C. L. Liu (1985). "Elements of Discrete Mathematics" (2nd edition). McGraw-Hill.

Evaluation plan:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2& Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Title of Course: Electricity and Magnetism	Course Code: BS1PH201

L-T Scheme: 3-1-0 **Course Credit: 4**

Course Objectives:

The course intends to introduce fundamental aspects of theory of electromagnetism starting from electrostatics, magnetostatics and concluding with Maxwell's equations

Course Outline

Introduction to Vector Calculus

Basic concepts of Vector calculus: Cartesian, Spherical polar and Cylindrical Co-ordinate systems, concept of Gradient, divergence, curl and fundamental theorems **[08 Lectures]**

Electrostatics

Electric charge, conservation of charge, quantization of charge, Coloumb's force law, Electric field, charge distributions, flux, Gauss's law and its applications, energy associated with electric field. Electric potential, potential due to various charge distribution, Method of images, Laplace's and Poisson's equations, Energy of system of charges, Electric field inside matter, linear dielectric materials, polarization, capacitance, energy stored in a capacitor, Electric displacement, Electric currents. **[18 Lectures]**

Magnetostatics

Electric currents, Magnetic field as effects of electric current, Biot-Savart law, Ampere's law, magnetic field inside matter, forces and torques in magnetic field, electromagnetic induction, Faraday's law, lenz law, Inductance and magnetic circuits **[08 Lectures]**

Electromagnetism

Maxwell's equations in free space and matter, Maxwell correction to Ampere's law, electromagnetic waves in free space, Transverse nature of electromagnetic waves and polarization, propagation of electromagnetic field in free space **[08 Lectures]**

Text Books & References:

1. Physics: Resnick and Halliday
2. Electricity and Magnetism: Berkeley Physics Course vol. 2
3. Electromagnetics, Schaum's Outline Series.
4. Introduction to electrodynamics, D. J. Griffiths , Prentice Hall of India Ltd.

Course Outcomes	Description
CO1	Develop basic working knowledge of co-ordinate systems in a generalized way and vector differential operators
CO2	Understand the fundamentals of electric fields produced by charges, forces among charges and charge conservation, Able to apply Gauss's law in evaluation of electric fields produced by various charge distributions, Understand the formulation and evaluation of electric potential using special techniques
CO3	Acquired relevant identification of electric fields inside matter, handling the problem of

	evaluation of electric field at the interface of two media
CO4	Become familiar with the magnetic field as an effect of moving charges, Understand the effects of magnetic fields on charges and currents and be able to evaluate magnetic field due to current distributions using Biot Savart's law and Ampere's law
CO5	Understanding and developing an appreciation for the utility and important role of Maxwell's equation as far as propagation of electromagnetic waves in free space is concerned

Title of Course: Physics Lab II	Course Code: BS1PH271

L-T Scheme: 0-0-2 **Course Credit: 1**

Objective: To learn the use of different instruments for understanding the principles of Physics.

List of Experiments:

1. To determine the coefficient of thermal conductivity of mica sheet (bad conductor) by Lee's disc method
2. To convert a Weston galvanometer into an ammeter of a given range
3. To study the variation of magnetic field along the axis of Helmholtz Galvanometer and to determine its reduction factor
4. To verify the Ohm's law
5. To observe Newton's rings and to determine the wavelength of sodium light
6. To study the presence of energy levels in an atom by Franck-Hertz Experiment
7. To determine the specific rotation of cane sugar solution using Biquartz polarimeter
8. To determine the surface tension of a liquid by capillary rise method

Course Outcome	Description
CO1	Develop the ability to collect experimental data and understanding the working procedures within the precautionary limits
CO2	Acquired the ability to analyze the experimental data and related errors in a reflective, iterative and responsive way
CO3	Demonstrate understanding of the basic concepts related to general properties of matter, optics and modern physics

CO4	Acquired an enhanced understanding of the theory course “Electricity and Mgnetism” offered in parallel
CO5	Appreciate the importance of the laboratory work culture and ethics that is intended to impart features like regularity, continuity of self evaluation and honesty of reporting the data

SEMESTER III

Organic Chemistry II

Title: Organic Chemistry II **Code: BS1CH301**

L-T-P Scheme: 2-1-0 **Credit: 03**

Prerequisite: The students must be aware of basic Organic Chemistry I up to the graduate level. This knowledge helps them to correlate and adopt at Graduate level.

Objective:

The core course Organic Chemistry II is designed in a manner that gives a better understanding of the organic functional groups, which include halogenated hydrocarbons and oxygen containing functional groups and their reactivity patterns. The detailed reactions mechanistic pathways for each functional group will be discussed to unravel the spectrum of organic chemistry and the extent of organic transformations.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning of different nature and behavior of organic compounds based on fundamental concepts learnt. Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups
CO2	Describe the real-world problems, challenges with the application of the concept. Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems. Use the synthetic chemistry learnt in this course to do functional group transformations.
CO4	Identify and use various analytical techniques in Organic Chemistry based project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures. To propose plausible mechanisms for any relevant reaction.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1:

Chemistry of Halogenated Hydrocarbons: Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent; nucleophilic substitution vs. elimination. Aryl halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg (Grignard reagent) – Use in synthesis of organic compounds.

Unit 2:

Alcohol, Phenol, Ether and Epoxides: Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouveault–Blanc Reduction;Oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement. Phenols: Preparation and properties; Acidity and affecting factors, Ring substitutionreactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements and their mechanism. Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia and $LiAlH_4$.

Unit 3:

Carbonyl Compounds

Structure, reactivity, preparation and properties; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism. Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC Addition reactions of α, β- unsaturated carbonyl compounds: Michael addition.Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Unit 4:

Carboxylic acids and their derivatives

General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hoffmann-bromamide degradation and Curtius rearrangement.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Organic Chemistry basic concept in details. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Organic Chemistry. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Morrison, R. N.; Boyd, R. N. **Organic Chemistry**, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

[2] Finar, I. L. **Organic Chemistry** (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

[3] Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), **Intermediate for Organic Synthesis,** I.K.International.

[4] Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016),**Organic Chemistry**, 12th Edition, Wiley.

[5] Chandra, R. ; Singh, S.; Singh, A. (2019), **Organic reactions and their nomenclature**, Arcler Press.

Physical Chemistry II

Title: Physical Chemistry II **Code: BS1CH302**

L-T-P Scheme: 3-1-0 **Credit: 04**

Prerequisite: The students must be aware of basic Physical Chemistry up to the graduation level. This knowledge helps them to correlate and adopt at Graduate level.

Objective:

The aim of this course is to make students understand thermodynamic concepts, terminology, properties of thermodynamic systems, laws of thermodynamics and their correlation with other branches of physical chemistry and make them able to apply thermodynamic concepts to the system of variable compositions, equilibrium and colligative properties.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning of different nature and behavior of compounds based on fundamental concepts learnt. Understand the three laws of thermodynamics, concept of State and Path functions, extensive and intensive properties.
CO2	Describe the real-world problems, challenges with the application of the concept. Derive the expressions of ΔU, ΔH, ΔS, ΔG, ΔA for ideal gases under different conditions.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems. Explain the concept of partial molar properties.
CO4	Identify and use various analytical techniques in Chemistry based project management. Explain the thermodynamic basis of colligative properties and applications in surroundings.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1:

Chemical Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems. Mathematical treatment - Exact and inexact differential, Partial derivatives, Euler's reciprocity rule, cyclic rule.

Unit 2:

First law: Concept of heat, Q, work, W, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, Joule Thompson Porous Plug experiment, Nature of Joule Thompson coefficient, calculations of Q, W, ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Enthalpy of reactions: standard states; enthalpy of neutralization, enthalpy of hydration, enthalpy of formation and enthalpy of combustion and its applications, bond dissociation energy and bond enthalpy; effect of temperature (Kirchhoff's equations) on enthalpy of reactions.

Unit 3:

Second Law: Concept of entropy; statement of the second law of thermodynamics, Carnot cycle. Calculation of entropy change for reversible and irreversible processes (for ideal gases). Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity (for ideal gases). Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Third Law: Statement of third law, unattainability of absolute zero, calculation of absolute entropy of molecules, concept of residual entropy, calculation of absolute entropy of solid, liquid and gases.

Unit 4:

Systems of Variable Composition: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, Change in thermodynamic functions on mixing of ideal gases.

Chemical Equilibrium: Criteria of thermodynamic equilibrium, degree of advancement of reaction, Chemical equilibria in ideal gases, Thermodynamic derivation of relation between Gibbs free energy of a reaction and reaction quotient, Equilibrium constants and their

dependence on temperature, pressure and concentration, Le Chatelier's Principle (Quantitative treatment), Free energy of mixing and spontaneity, Equilibrium between ideal gases and a pure condensed phase.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Physical Chemistry basic concept in details. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is dividing into 42 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Peter, A.; Paula, J. de. (2011), **Physical Chemistry**, 9th Edition, Oxford University Press.

[2] Castellan, G. W. (2004),**Physical Chemistry**, 4th Edition, Narosa.

[3] Kapoor, K.L.(2015),**A Textbook of Physical Chemistry**,Vol 2, 6th Edition, McGraw Hill Education.

[4] Kapoor, K.L.(2013),**A Textbook of Physical Chemistry**,Vol 3, 3rd Edition, McGraw Hill Education.

[5] 5. McQuarrie, D. A.; Simon, J. D. (2004),**Molecular Thermodynamics**, Viva Books Pvt. Ltd.

Chemistry Lab

Course Name: Chemistry Lab **Code:** BS1CH371
L-T-P Scheme: 0-0-02 **Credit:** 01

Prerequisite: The students must be aware of basic Organic Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Graduate level.

Objective: The students will aware about various chemical synthesis and analysis at laboratory.

Experiment Details

[1] Calibration of a thermometer.

[2] Organic Preparation (any one of the following):

a. Bromination of acetanilide/aniline/phenol
b. Nitration of nitrobenzene/toluene

[3] Purification of organic compounds by crystallization using the following solvents:

a. Water
b. Alcohol
c. Alcohol-Water

[4] Determination of the melting points of prepared organic compounds (Kjeldahl method and electrically heated melting point apparatus)

[5] Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.

[6] Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)

[7] Chromatography

a. Separation of a mixture of two amino acids by ascending and radial paper chromatography
b. Separation of a mixture of two sugars by ascending paper chromatography.

[8] Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

Teaching Methodology: This course is introduced to help students understand various experiments useful at various levels in chemical industry as well as higher study. The entire course is broken down into following separate units. Each section includes multiple topics to

help a student gain deeper understanding of the subject. This lab course is well complemented by a theory course in the same semester that helps a student learn and discuss the technical details of the underlying technologies.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Exp 1-4
P-2	15 Marks	Exp 5-8
Attendance & Discipline	15 Marks	
Practical Records	15 Marks	
Day to Day Activity	40 Marks	
Total	**100 Marks**	

Learning Resources: Study material of Environmental Engineering Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Mann, F. G.; Saunders, B. C. (2009), **Practical Organic Chemistry**, Pearson Education.

[2] Ahluwalia, V.K.; Dhingra, S. (2004),**Comprehensive Practical Organic Chemistry: Qualitative Analysis**, University Press.

[3] Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012),**Vogel's Textbook Of Practical Organic Chemistry**, Pearson.

[4] Leonard, J.; Lygo, B.; Procter, G. **Advanced Practical Organic Chemistry**, CRC Press.

Advanced Calculus

Title: Advanced Calculus Code: BS1MA301

L-T-P scheme:3-1-0 C**redit: 4**

Prerequisite: Students must have already studied course, “Calculus”.

Objective:

The objective of this course is to be able to write rigorous mathematical proofs for basic theorems in multi-variable calculus involving the fundamental tools such as continuity and differentiability. This course is essential for any student majoring in mathematics.

Learning Outcomes:

Course Outcome	**Description**
CO1	Assimilate the notions of limit of a sequence and convergence of a series of real numbers.
CO2	Calculate the limit and examine the continuity of a function at a point.
CO3	Understand the consequences of various mean value theorems for differentiable functions.
CO4	Sketch curves in Cartesian and polar coordinate systems
CO5	Find points of discontinuity for functions and classify them.
CO6	Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of otherdisciplines.

Course Contents:

Unit-1: Limit, Continuity, Partial derivatives, Directional derivatives, differentiability of functions of several variables.

Unit-2: Sufficient conditions for continuity and differentiability in terms of partial derivatives,algebra of differentiable functions, differentiability of composite functions.

Unit-3: Chain rule of differentiation, total differentiations and mean value theorem for real valued functions.

Unit-4: Homogeneous functions and Euler's theorem, Equality of mixed derivatives, Higher Differentials.

Unit-5: Change of Variable of integration, Double integral in polar form, area of region by double integral, Triple integral.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Advanced Calculus (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1] Mathematical analysis, S.C.malik,
[2] Advanced calculus, D.Widder
[3] Function of several variables, Pramila Srivastava, Allahabad Mathematical Society,1990.
[4] Gorakh Prasad, Differential Calculus(19th edition). Pothishala Pvt. Ltd, 2016.

Optics & Laser Physics

Title: Optics & Laser Physics **Course Code:** BS1PH301

L-T Scheme: 3-0 **Credit: 3**

Course Objectives:

This course aims at a detailed introduction of basic principles of superposition of waves and consequences. Various theoretical and experimental aspects related to Interference, diffraction and polarization is to be presented. Also included are the basic principles and working of Laser systems.

Course Outline:

Introduction to Superposition of Waves

Simple harmonic motion, Fermat's principle, forced vibrations and origin of refractive index, wave propagation, wave equation, Huygen's principle, rectilinear propagation, Superposition of waves, Coherence, Spatial Coherence, Temporal coherence **[08 Lectures]**

Interference

Two beam interference by division of wave front, intensity distribution, Fresnel's two mirror arrangement, Fresnel's biprism, Interference with white light, displacement of fringes, Lloyd's mirror arrangement, Phase change on reflection, Interference by division of amplitude, Interference by a plane parallel film illuminated by plane wave, Cosine law, Non-reflecting films, high reflectivity by thin film deposition, reflection by periodic structure, Interference by a film with two non parallel reflecting surfaces, Colors of thin films, Newton's rings, The Michelson interferometer, Multiple beam interferometry, Multiple reflections from a plane parallel film, Fabry-Perot interferometer **[14 Lectures]**

Diffraction

Fraunhofer diffraction, Single slit diffraction, Diffraction by a circular aperture, Double slit diffraction, N-slit diffraction, Diffraction Grating, Missing orders, Fresnel diffraction and half period zones **[08 Lectures]**

Polarization

Light as transverse electromagnetic wave, Polarization, Polarized light, Malus's law, anisotropic media, Double refraction, analysis of polarized light, Optical activity **[06 Lectures]**

Basic Principle of Laser system

Lasers as a source of coherent light, Einstein coefficients, Population inversion, Optical resonator, Basic properties and applications of Laser, Ruby laser, He-Ne laser **[06 Lectures]**

Books Recommended:

1. Optics by Ajoy Ghatak
2. Optics by Eugene Hecht
3. Fundamentals of Optics by Jenkins and White
4. Lasers-Principles and Applications by Ghatak and Thyagrajan

Course Outcomes	**Description**
CO1	Understand the rectilinear propagation of light, difference between a ray and a wave Explain the principle of superposition and redistribution of intensity of light in a given region of space
CO2	Acquired knowledge of the phenomenon of interference by division of wave front and division of amplitude through important standard experiments & their results
CO3	Understand and interpret the basic aspect related to diffraction of light through various apertures and practical implications
CO4	Acquired the knowledge of polarization on the basis of transverse nature of light and related applications
CO5	Developed a basic comprehension of basic properties and working of Laser systems and applications

Title of Course: General Properties of Matter	Course Code: BS1PH302

L-T Scheme: 3-1-0 Course Credit: 4

Objectives: This course provides an introduction to general properties of matter and is aimed at studying basic aspect which is important from view points of applications. The primary objective is to study theoretical and experimental aspects of various moduli and coefficients quantifying various properties of matter.

Unit I

Elasticity, Effect of temperature and impurities on elasticity of a substance, Small deformations Stress and Strain, Hooke's law, Elastic constants for an isotropic material, Young's Modulus, Bulk Modulus, Modulus of Rigidity, Relation between various elastic modulii, Poisson ratio and its experimental determination, Torsion of a cylinder, Strain energy of a twisted cylinder, Comparison between the torsional rigidities of a solid and a hollow cylinder of same mass, length and material, Determination of modulus of rigidity of a thin rod by Barton's apparatus, Torsional pendulum, Determination of modulus of rigidity of the material of a wire

(Lectures: 12)

Unit II

Expression for work done per unit volume in three type of strain, Bending of beams and bending moment, Cantilever, Transverse oscillations of a cantilever, beam supported at its ends and loaded in the middle, determination of Young's modulus of material of a beam by bending method, Determination of Young's modulus, modulus of rigidity and Poisson's ratio of material of a wire by Searle's apparatus, Internal energy of a strained body,

(Lectures: 10)

Unit III

Ideal and Viscous fluids, Streamline and Turbulent flow, Reynolds' number, Rotational and irrational flow, Equation of continuity, Energy of a flowing fluid, Euler's equation of motion for a non-viscous fluid and its integration, Bernoulli's theorem and its applications e.g. Venturimeter, Torrcelli's theorem, Magnus effect, Atomizer etc. Viscous flow of fluids, Effect of temperature and pressure on the coefficient of viscosity,

(Lectures: 10)

Unit IV

Flow of liquid through a capillary tube, Poiseuille's formula, Experimental determination of coefficient of viscosity of a liquid using constant pressure difference method, Cohesive and adhesive forces, Surface tension, Angle of contact and surface energy, Effect of temperature and impurity on surface tension,

(Lectures: 8)

Unit V

Pressure difference between two sides of a curved liquid surface, Excess pressure on a curved liquid surface, Excess pressure inside a spherical drop, Excess pressure inside an air bubble present in a liquid, Excess pressure inside a soap bubble, A liquid between two glass plates, Equilibrium of liquid drop and wetting of a solid surface, Methods for experimental determination of surface tension of a liquid- capillary rise method, Jaeger's method, Quinck's method

(Lectures: 8)

Learning Outcomes/Course Outcome

Course Outcome	Description
CO1	Introduction of elasticity and nature of deformation, To understand stress, strain and relationship between various elastic constants
CO2	Understanding the cantilever and its transverse oscillations, knowing the experimental methods to determine various moduli of elasticity
CO3	To understand the viscous and non viscous fluid flow, solving Euler equation for a non viscous fluid and studying Effect of temperature and pressure on the coefficient of viscosity
CO4	To derive Poiseuille's formula, comprehending experimental determination of coefficient of viscosity of a liquid using constant pressure difference method, Effect of temperature and impurity on surface tension
CO5	To derive expression for Pressure difference between two sides of a curved liquid surface, experimental methods to determine surface tension

Suggested Readings:

1. F. H. Newman, V. H. L. Searle, The General Properties of Matter
2. J. C. Upadhyay, General Properties of Matter

Physics Lab III

Title of Course: Physics Lab III	Course Code: BS1PH371

L-T Scheme: 0-0-2 **Course Credit: 1**

Objective: To learn the use of different instruments for understanding the principles of Physics.

List of Experiments:

1. To study the Photo-Electric effect and to determine the value of the Planck's constant.
2. To study the variation of resistivity of a semiconductor with temperature and to determine the band gap using Four-Probe method
3. To study the dielectric constant and Curie temperature of Ferroelectric ceramics.
4. To determine value of specific charge e/m for an electron by Thomson method
5. To determine the resistance per unit length of a Carey Foster's bridge and to obtain the specific resistance of a given wire
6. To determine the Planck's constant using Wien's displacement law
7. To study the CRO and function generator by producing the following waveforms.
    a. 10kHz, $8V_{p-p}$(sine wave, square wave, triangular wave)
    b. 4kHz, $6V_{p-p}$(sine wave, square wave, triangular wave)
    c. 10kHz, $8V_{peak}$(sine wave, square wave, triangular wave)
    d. 4kHz, $6V_{peak}$(sine wave, square wave, triangular wave)
8. To determine the wavelength of Laser light by diffraction grating

Course Outcome	Description
CO1	Develop the ability to collect experimental data and understanding the working procedures within the precautionary limits
CO2	Acquired the ability to analyze the experimental data and related errors in a reflective,

	iterative and responsive way
CO3	Demonstrate understanding of the basic concepts related to Modern physics, working of CRO , basic properties of semi conductors
CO4	Acquired an enhanced understanding of the theory course “Quantum Mechanics” offered in parallel
CO5	Appreciate the importance of the laboratory work culture and ethics that is intended to impart features like regularity, continuity of self evaluation and honesty of reporting the data

SEMESTER IV

Environmental Science

Title: Environmental Science **Code: BS1CH401**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: The students must be aware of basic Environmental Science upto class 12th. Basic knowledge of Environmental Science helps them to correlate in various division of Engineering during this course.

Objective:

The purpose behind this course is to make the students familiar with Environment (surrounding) and to understand the significance/importance of natural resource, biodiversity, environment pollution and impact of intervention of human being in the Ecosystem. This course is mandatory for all branches of the Engineering and Sciences.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in learning the significance and importance of environment in their life.
CO2	Describe the real world problems, challenges with the suitable case study based on conservation (natural resource and biodiversity), ecosystem, socio-economic development and remedial measure of the various pollutions (air, water, soil, noise and radiation).
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in their surrounding (the Environment).
CO4	Identify and use of various techniques for solving the Environmental Problems.
CO5	Apply filed visit and justification by using various analytical techniques.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in the Environmental Science and related multidisciplinary areas that involve Environmental Science and help to develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Modules	Description
Unit 1:	**Introduction to Environmental Science:** Multidisciplinary nature of environmental science; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.
Unit 2:	**Ecosystems:** What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
Unit 3:	**Natural Resources:** Renewable and Non-renewable Resources • Land Resources and land use change; Land degradation, soil erosion and desertification. • Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. • Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). • Heating of earth and circulation of air; air mass formation and precipitation. • Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.
Unit 4:	**Biodiversity and its conservation:** Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. • India as a mega-biodiversity nation; Endangered and endemic species of India. • Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ Conservation of biodiversity. • Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.
Unit 5:	**Environmental Pollution:** Environmental pollution: types, causes, effects and controls; Air, water, soil, chemical and noise pollution. • Nuclear hazards and human health risks. •

Solid waste management: Control measures of urban and industrial waste. • Pollution case studies.

Unit 6: **Environmental Policies & Practices:** Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.• Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC).

• Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.

Unit 7: **Human Communities and the Environment** Human population and growth: Impacts on environment, human health and welfares.

• Carbon foot-print.

• Resettlement and rehabilitation of project affected persons; case studies.

• Disaster management: floods, earthquakes, cyclones and landslides.

• Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan.

• Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.

• Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8: **Field Work:** Visit to a local area to document assets-river / forest / grassland /hill / mountain. polluted sites(Urban, rural ,industrial, agriculture), plants, insects, bird, Ecosystem (pond, river, hill slopes etc)

Teaching Methodology:

The core module Syllabus for Environment Science includes class room teaching and Field Work. The syllabus is divided into eight units covering lectures. The first seven units will cover 42 lectures, which are class room based to enhance knowledge skills and attitude to environment. Unit eight is based on field activities which will be covered in 4 lecture hours and would provide student firsthand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves out of the scope of the

text book mode of teaching into the realm of real learning in the field, where the teacher merely acts as a catalyst to interpret what the student observes or discovers in his/her own environment. Field studies are as essential as class work and form an irreplaceable synergistic tool in the entire learning process. Course material provided by UGC for class room teaching and field activities is utilized.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 Unit 2 and Unit-3
Test-2	25 Marks	Based on Unit-4 & Unit-5 (70 %) and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 to Unit-7 and around 30% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book

[1] Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, Ahmadabad – 380013, India.
[2] De Anil Kumar, Environmental Chemistry, Wiley Eastern Ltd, 2007.
[3] Agarwal KC, 2001. Environmental Biology, Nidhi Publishers Ltd. Bikaner.

Reference Book

[1] Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
[2] Clark R B, Marine Pollution, Clanderson Press, Oxford (TB).2001.
[3] Cunningham WP, Cooper TH, Gorhani E & Hepworth MT, 2001. Environmental Encyclopedia, Jaico Publishing House, Mumbai, 1196 pgs.
[4] Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
[5] Heywood VH, and Watson RT, 1995. Global Biodiversity Assessment. Cambridge University Press 1140pgs.
[6] Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws. Himalaya Publishing House, Delhi 284pgs.
[7] Mckinney ML and Schoch RM, 1996. Environmental Science Systems and Solutions. Web enhanced edition, 639 pgs.

Industrial Chemistry I

Title: Industrial Chemistry I **Code: BS1CH402**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of the basic organic and inorganic chemistry and various applied synthesis methods. Basic knowledge of synthesis of organic and inorganic compound helps them to correlate in various industrial activities and understanding of their chemistry.

Objective:

The course introduces learners to the diverse roles of inorganic materials in the industry. It gives an insight into how these raw materials are converted into products used in day to day life. Students learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction as well as the emerging area of nano-sized materials. The course helps develop the interest of students in the frontier areas of inorganic and material chemistry.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in Learn the composition and applications of the different kinds of glass.
CO2	Describe the real world problems, challenges to understand glazing of ceramics and the factors affecting their porosity. Give the composition of cement and discuss the mechanism of setting of cement. Explain the suitability of fertilizers for different kinds of crops and soil. Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in chemical industry.
CO4	Identify and use of various techniques for solving chemical industry. This course focused on few selected chemical industry like glass, cement, fertilizer etc.
CO5	Apply filed visit and justification by using various analytical techniques.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies and help to develop a range of generic skills that are relevant to

wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Unit 1:

Silicate Industries:

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armored glass, different types of safety glass, borosilicate glass, fluorosilicate glass, colored glass, photosensitive glass, photo-chromic glass, glass wool and optical fiber.

Ceramics: Brief introduction to types of ceramics. glazing of ceramics.

Cement: Manufacture of Portland cement and the setting process, Different types of cements: quick setting cements, eco-friendly cement (slag cement), pozzolana cement.

Unit 2:

Fertilizers: Different types of fertilizers (N, P and K). Importance of fertilizers, chemistry involved in the manufacture of the following fertilizers: urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime, potassium chloride and potassium nitrate.

Unit 3:

Surface Coatings: Brief introduction to and classification of surface coatings, paints and pigments: formulation, composition and related properties, pigment volume concentration (PVC)and critical pigment volume concentration (CPVC), fillers, thinners, enamels and emulsifying agents. Special paints: heat retardant, fire retardant, eco-friendly paints, plastic paints, water and oil paints. Preliminary methods for surface preparation, metallic coatings (electrolytic and electroless with reference to chrome plating and nickel plating), metal spraying and anodizing. Contemporary surface coating methods like physical vapor deposition, chemical vapor deposition, galvanising, carburizing, sherardising, boriding, nitriding and cementation.

Unit 4:

Batteries: Primary and secondary batteries, characteristics of an Ideal Battery, principle, working, applications and comparison of the following batteries: Pb- acid battery, Li-metal batteries, Li-ion batteries, Li-polymer batteries, solid state electrolyte batteries, fuel cells, solar cells and polymer cells.

Unit 5:

Nano dimensional materials: Introduction to zero, one and two-dimensional nanomaterial: Synthesis, properties and applications of fullerenes, carbon nanotubes, carbon fibres, semiconducting and superconducting oxides.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Industrial Chemistry basic concept in details. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Industrial Chemistry. This course is dividing into 42 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] West, A. R. (2014),**Solid State Chemistry and Its Application**, Wiley.

[2] Smart, L. E.; Moore, E. A. (2012),**Solid State Chemistry An Introduction**, CRC Press Taylor & Francis.

[3]Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A.(2010),**Shriver and Atkins Inorganic Chemistry**, W. H. Freeman and Company.

[4] Kent, J. A. (ed**)** (1997),**Riegel's Handbook of Industrial Chemistry**, CBS Publishers, New Delhi.

[5] Poole Jr.; Charles P.; Owens, Frank J.(2003), **Introduction to Nanotechnology**, John Wiley and Sons.

Reference Book:

[1] Kingery, W. D.; Bowen H. K.; Uhlmann, D. R. (1976),**Introduction to Ceramics**, Wiley Publishers, New Delhi.

[2] Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004),**Engineering Chemistry**, Vikas Publications.

Environmental Science Lab

Title: Environmental Science Lab **Code**: BS1CH471

L-T-P scheme: 0-0-2 **Credit**: 1

Prerequisite: NIL

Objective:

The objective of this course is to give the students a basic idea of the different types of pollution in the environment. This course also gives them the idea about how to handle environmental pollution problems.

Course Learning Outcomes:

Course Outcome	Description
CO1	Outline different types of pollutants
CO2	Understand the causes of pollution and their harmful effects.
CO3	Describe various equipments related to air pollution and water pollution control
CO4	Implement expressions for the estimating the efficiency of various air pollution control equipments.
CO5	Apply appropriate equations for the design of water pollution control equipments.
CO6	Demonstrate the working of various equipments related to pollution control.

CONTENT:

[1] pH, Turbidity, Electrical Conductivity

[2] Acidity and Alkalinity

[3] Total Hardness, Calcium and Magnesium

[4] Solids (total, suspended and dissolved)

[5] Dissolved oxygen

[6] Biochemical oxygen demand

[7] Chemical oxygen demand (COD)

[8] Gas liquid mass transfer characteristics (aeration apparatus)

[9] Softening or demineralization of water (ion exchange column)

Teaching Methodology: This course is introduced to help students understand basic principles of air and water pollution along with the design of air pollution and water pollution control

equipment. The entire course is broken down into following separate units: Introduction, Air pollution, Water pollution and Noise pollution. Each section includes multiple topics to help a student gain deeper understanding of the subject. This lab course is well complemented by a theory course under the name Environmental Engineering in the same semester that helps a student learn and discuss the technical details of the underlying technologies.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Exp 1-6
P-2	15 Marks	Exp 7-12
Attendance & Discipline	15 Marks	
Practical Records	15 Marks	
Day to Day Activity	40 Marks	
Total	**100 Marks**	

Learning Resources: Study material of Environmental Engineering Lab (will be added time to time): Digital copy will be available on the JUET server.

TEXT BOOKS

[1] .Laboratory Manual available in Lab

[2] Study material available in related folder of Server

[3] Rao C.S., "Environmental Pollution Control Engineering", Wiley Eastern.

[4] Davis M.L., Cornwell D.A., "Introduction to Environmental Engineering", 2/e McGraw Hill1991.

[5] Mahajan S.P., "Pollution Control in Process Industries", Tata McGraw Hill Publishing Company Ltd.

[6] Peavy, H.S., Rowe, D.R., Tchobanoglous G., "Environmental Engineering", McGraw Hill 1985.

[7] Master, G.M., "Introduction to Environmental Engineering & Science", Prentice Hall of India. REFERENCE BOOKS / Material: 1. Metcalf et. al., "Waste Water Treatment, Disposal & Teuse", 3/e, Tata McGraw Hill.

[8] Chandalia S.B., Rajgopal D., “Environmental Perspectives of Chemical Industries”

Partial Differential Equations

Course name: Partial Differential Equations Course Code: BS1MA401

L-T-P scheme:3-1-0 C**redit: 4**

Prerequisite: Students must have already studied course, "Calculus".

Objective:

In this course we have studied the Partial Differential techniques which consist of applying your mathematical skills to obtain useful answers to real problems. Equations are used in a very wide range of applications, some of which do not appear initially to be mathematical in nature. Learning to apply mathematical skills is very different from learningmathematics itself.

Learning Outcomes:

Course Outcome	**Description**
CO1	Introduce and derive of partial differential equation, Linear partial differential equations of first order
CO2	Discuss Lagrange's linear equation, Lagrange's solution of the linear equation, Geometrical interpretation of Lagrange's linear equation
CO3	Understand the linear equations with n independent variables, special types of equations, Non linear PDE of first order, solve using Charpit's method, .
CO4	Illaborate Linear partial differential equation of second and higher order of homogeneous and non-homogeneous forms with constant coefficients
CO5	Solve using Variable seperable method
CO6	Apply in finding the solution of heat and wave equations in one dimension

Course Contents:

Unit-1: Introduction and derivation of partial differential equation, Linear partial differential equations of first order

Unit-2: Lagrange's linear equation, Lagrange's solution of the linear equation, Geometrical interpretation of Lagrange's linear equation

Unit-3: linear equations with n independent variables, special types of equations, Non linear PDE of

first order, Charpit's method.

Unit-4: Linear partial differential equation of second and higher order of homogeneous and non-homogeneous forms with constant coefficients, Solution of heat and wave equations in one dimension by method of separation of variables.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Partial Differential Equations (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1]. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Son Inc., NewYork, 1999.
[2]. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill BookCompany, 1988.
[3]. S.B. Rao and H.R. Anuradha, Differential Equations, University Press, 1996.
[4]. W.T.H. Piaggio, Elementary Treatise on Differential Equations and their applications,CBS Publishers N.Delhi, 1985.

Atomic and molecular Physics

Title of Course: Atomic and molecular Physics	Course Code:

L-T Scheme: 3-1-0 **Course Credit: 4**

Objectives: The course introduces students to the basic physics of atoms, molecules, their spectra and the interaction of light with matter. Theoretical understanding of diffrent spectroscopic techniques.

Unit I

Atomic Spectroscopy: General discussion in Hydrogen spectra, Relativistic correction to spectra of Hydrogen atom, Spectra of monovalent atoms, quantum defect, Introduction to electron spin, Spin-orbit interaction and fine structure, Spectra of divalent atoms: Singlet and triplet states of divalent atoms, LS and j-j coupling, Branching rule, Hyperfine structure in spectra of monovalent atoms. **(Lectures: 10)**

Unit II

Microwave Spectroscopy: Pure rotational spectra of diatomic molecules, Isotopic effect, Non-rigid rotator, Poly-atomic molecules, Study of linear molecules and symmetric top molecules, Stark effect, Quadrupole hyperfine interaction, Microwave spectrometer, Information from rotational spectra. **(Lectures: 10)**

Unit III

Infrared Spectroscopy: Vibrational spectroscopy of diatomic and simple polyatomic molecules, Harmonic Oscillator, Anharmonic Oscillator, Rotational vibrators, Normal modes of vibration of polyatomic molecules, IR spectrometer: FTIR Spectrometer, Applications of infrared spectroscopy: H_2O and CO_2 molecules. **(Lectures: 10)**

Unit IV

Raman Spectroscopy: Raman effect, Classical and Quantum theory of Raman effect, Vibrational Raman spectra, Rotational Raman spectra, Vibrational-Rotational fine structure, Raman Spectrometer, Structure determinations from Raman and Infra-red spectroscopy. Electronic Spectra: Electronic structure of diatomic molecules, Intensity of spectral lines, Frank- Condon principle, Dissociation energy and dissociation products, Rotational fine structure of electronic-vibration transitions. **(Lectures: 10)**

Unit V

NMR and ESR Techniques: Theory of NMR, Relaxation effect, Theory of dipolar interaction and chemical shifts, Indirect spin-spin interactions, Experimental set up of NMR, Applications of NMR to quantitative measurements (Idea only). ESR: Quantum mechanical treatment of ESR, Nuclear interaction and hyperfine structure, Relaxation effects, ESR spectrometer, Applications of ESR method. **(Lectures: 10)**

Suggested Reading:

1. Willard, Merritt, Dean, Settle: *Instrumental Methods of Analysis*, CBS Publishers & Distributors, Delhi, 6th Ed. 1986.
2. Colin N. Banwell and Elaine M. McCash*: Molecular Spectroscopy,* Mc-Graw Hill College; 4th Sub. Ed., 1994.
3. B. H. Bransden and Joachain: *Physics of Atoms and Molecules*, Longman, 1983.
4. V. Rajendran and A. Marikani: *Applied Physics*, TMH publication, 4th Ed., 2002.

Learning Outcomes/Course Outcome

Course Outcome	Description
CO1	On completion of the course the student will learn about the origin of different fine spectra for hydrogen , helium atom etc.
CO2	Explain the change in behavior of atoms in external applied electric and magnetic field. To understand microwave spectroscopy.
CO3	Explain rotational, vibrational, electronic and Raman spectra of molecules.
CO4	Leaarn aspects of Raman spectroscopic techniques and their applications in research field.
CO5	It describe electron spin and nuclear magnetic resonance spectroscopy and their applications

Physics Lab IV

Title of Course: Physics Lab IV	Course Code: BS1PH471

L-T Scheme: 0-0-2 **Course Credit: 1**

Objective: To learn the use of different instruments for understanding the principles of Physics.

List of Experiments:

1. To determine the refractive index of the material of a convex lens
2. To determine the wavelengths of spectral lines Red, Green and Violet of mercury using plane transmission grating
3. To study Hall effect in a P type semiconductor. To determine
   (i) Hall voltage and Hall coefficient
   (ii) Number of charge carriers per unit volume
   (iii) Hall angle and mobility
4. Using solar cell Trainer (a) study voltage and current of a solar cell

(b) Voltage and current in series and parallel combinations. (c) Draw power curve to find maximum power point (MPP) and to obtain efficiency of a solar cell

5. To determine the magnetic susceptibility of a paramagnetic, $FeCl_3$ solution by Quinck's tube method
6. To determine dispersive power of a prism using spectrometer
7. To determine, using Fiber Optic kit
   (i) Numerical Aperture of the fiber
   (ii) Losses in given fiber
8. To study the magnetostriction in metallic rod using Michelson- Interferometer

Course Outcome	Description
CO1	Develop the ability to collect experimental data and understanding the working procedures within the precautionary limits
CO2	Acquired the ability to analyze the experimental data and related errors in a reflective, iterative and responsive way

CO3	Demonstrate understanding of the basic concepts related to optics, working of solar cells and optical fiber
CO4	Acquired an enhanced understanding of the theory course “Waves & Optics” offered in parallel
CO5	Appreciate the importance of the laboratory work culture and ethics that is intended to impart features like regularity, continuity of self evaluation and honesty of reporting the data

SEMESTER V

Industrial Chemistry II

Title: Industrial Chemistry II **Code: BS1CH501**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of the basic organic chemistry. Basic knowledge of synthesis of organic compound helps them to correlate in various industrial activities and understanding of their chemistry.

Objective:

Cosmetic plays an important role in our everyday lives as they make an individual's appearance more attractive and boost one's self-esteem and confidence. Keeping in view the tremendous potential which the cosmetic industry has today around the globe, this course will be useful for introducing students of Chemistry honours to the world of cosmetic chemistry. This has been designed to impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in learning basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products.
CO2	Describe the real world problems, challenges to understand cosmetics industry. Learn the use of safe, economic and body-friendly cosmetics
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in chemical industry.
CO4	Identify and use of various techniques for solving chemical industry. Prepare new innovative formulations.
CO5	Apply filed visit and justification by using various analytical techniques.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies and help to develop a range of generic skills that are relevant to

wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Unit 1:

Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, Regulations.

Unit 2:

Face Preparation: Structure of skin, Face powder, Compact powder, Talcum powder.

Unit 3:

Skin Preparation: Face cream, vanishing cream, cold cream, suntan cream, lather shaving cream.

Unit 4:

Hair preparation: Structure of hair, classification of hair, Hair dye- classification – temporary, semi-permanent, demi-permanent, permanent, formulation, hair sprays, shampoo- types of shampoo, conditioners.

Unit 5:

Colored preparation: Nail preparation Structure of nail, Nail lacquers, Nail polish remover Lipsticks.

Unit 6:

Personal hygiene products: Antiperspirants and deodorants, oral hygiene products, flavours and essential Oils.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Cosmetic Industry Chemistry basic concept in details. The entire syllabus has divided into six units. Each section includes multiple topics to help a student gain a deeper understanding of Industrial Chemistry. This course is dividing into 42 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2

Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Barel, A.O.; Paye, M.; Maibach, H.I.(2014),**Handbook of Cosmetic Science and Technology,** CRC Press.

[2] Garud, A.; Sharma, P.K.; Garud, N. (2012),**Text Book of Cosmetics**, Pragati Prakashan.

[3] Gupta, P.K.; Gupta, S.K.(2011),**Pharmaceutics and Cosmetics**, Pragati Prakashan

[4] Butler, H. (2000),**Poucher's Perfumes, Cosmetic and Soap**, Springer

[5] Kumari, R.(2018),**Chemistry of Cosmetics**, Prestige Publisher.

Reference Book:

[1] Flick,E.W.(1990),**Cosmetic and toiletry formulations,** Noyes Publications / William Andrew Publishing.

[2] Natural Ingredients for Cosmetics; EU Survey 2005

[3] Formulation Guide for cosmetics; The Nisshin OilliO Group, Ltd.

[4] Functional Ingredients & Formulated Products for Cosmetics & Pharmaceuticals; NOF Corporation

Medicinal Chemistry I

Title: Medicinal Chemistry I **Code: BS1CH502**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of the basic organic chemistry. Basic knowledge of synthesis of organic compound helps them to correlate in pharmaceutical industry.

Objective:

The objective of this paper is to develop basic understanding of drugs discovery, design, development and their side effects. The course will cover synthesis of major drug classes including-analgesics, antipyretics, anti- inflammatory agents, antibacterial and antifungal agents, antiviral agents, central nervous system agents and drugs for HIV--AIDS. An overview of fermentation process and production of certain dietary supplements and certain common antibiotics will be discussed.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in gain insight into retro-synthesis approach in relation to drug design and drug discovery.
CO2	Describe the real world problems, challenges to understand cosmetics industry. Learn synthetic pathways of major drug classes.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in chemical industry. Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins.
CO4	Identify and use of various techniques for solving chemical industry. Prepare new innovative formulations.
CO5	Apply filed visit and justification by using various analytical techniques.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies and help to develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Unit 1:

Introduction: Drug discovery, design and development: Sources of drugs: biological, marine, minerals and plant tissue culture, physio-chemical aspects (optical, geometric and bioisosterism) of drug molecules and biological action, drug receptor interaction, basic retro-synthetic approach for development of drug. Cause of side effect of drugs like ibuprofen, cetirizine, thalidomide. Difference between drug and poison.

Unit 2:

Drugs and Pharmaceuticals: Study of pharmaceutical aids like talc, diatomite, kaolin, bentomite, gelatin and natural colours. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), central nervous system agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Unit 3:

Fermentation: Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Medicinal Chemistry basic concept in details. The entire syllabus has divided into three units. Each section includes multiple topics to help a student gain a deeper understanding of Medicinal Chemistry. This course is dividing into 42 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2

Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Patrick, G. (2017), **Introduction to Medicinal Chemistry**, Oxford University Press.

[2] Singh H.; Kapoor V.K. (1996), **Medicinal and Pharmaceutical Chemistry**, Vallabh Prakashan.

[3] Foye, W.O.; Lemke, T. L.; William, D.A. (1995),**Principles of Medicinal Chemistry**, B.I. Waverly Pvt. Ltd.

Spectroscopy

Title: Spectroscopy **Code: BS1CH503**

L-T-P Scheme: 2-1-0 **Credit: 3**

Prerequisite: The students must be aware of the basic physical chemistry. Basic knowledge of rotation, motion and radiation of molecules helps them to correlate in spectroscopy.

Objective:

The students will learn various types of Spectroscopy and efficiently utilize them for analysis of chemical compound.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in gain insight into Understand basic components of IR, FTIR, and UV-Visible and Mass spectrometer.
CO2	Describe the real world problems, challenges to understand cosmetics industry. Interpret of IR, FTIR, UV-visible spectra and their applications
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in chemical industry. Understand the use of single and double beam instruments.
CO4	Identify and use of various techniques for solving chemical industry.
CO5	Apply filed visit and justification by using various analytical techniques.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies and help to develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Unit 1:

Molecular Spectroscopy: Interaction of electromagnetic radiation with molecules and various types of spectra; Born Oppenheimer approximation.

Unit 2:

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Unit 3:

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Unit 4:

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Unit 5:

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Unit 6:

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales (δ and T), spin-spin coupling and high resolution spectra, interpretation of PMR spectra of simple organic molecules like methanol, ethanol, acetaldehyde, acetic acid and aromatic proton

Teaching Methodology:

This syllabus has been implemented for helping the students to understand spectroscopy basic concept in details. The entire syllabus has divided into six units. Each section includes multiple topics to help a student gain a deeper understanding of spectroscopy. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2

Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Banwell, C.N.; McCash, E.M.(2006), **Fundamentals of Molecular Spectroscopy**, Tata McGraw-Hill.

[2] Kapoor, K.L.(2015),**A Textbook of Physical Chemistry**, McGraw Hill Education, ,Vol 4, 5th Edition, McGraw Hill Education.

[3] Kakkar, R. (2015),**Atomic & Molecular Spectroscopy**, Cambridge University Press.

Medicinal Chemistry Lab

Title: Medicinal Chemistry Lab **Code**: BS1CH571

L-T-P scheme: 0-0-2 **Credit**: 1

Prerequisite: Understanding of the Organic Chemistry basic synthesis and characterization.

Objective:

The objective of this course is to give the students a basic idea of the different types drug synthesis. This course also gives them the idea about how to synthesis medicine in laboratory.

Course Learning Outcomes:

Course Outcome	Description
CO1	Outline different types of medicine
CO2	Understand the application and impact of medicine.
CO3	Describe various equipments related to synthesis and characterization of medicine.
CO4	Implement expressions for the estimating the efficiency of various equipments.
CO5	Apply appropriate equations for the design equipments.
CO6	Demonstrate the working of various equipments related synthesis of medicine.

CONTENT:

[1] Preparation of aspirin and its analysis.

[2] Preparation of paracetamol and its analysis.

[3] Preparation of sulphacetamide of sulphonamide and its analysis.

[4] Determination of alcohol contents in liquid drugs/galenical.

[5] Determination of ascorbic acid in vitamin C tablets by iodometric or coulometric titrations.

[6] Synthesis of ibuprofen.

[7] Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry

Teaching Methodology: This course is introduced to help students understand basic principles of medicinal chemistry. The entire course is broken down into following separate units:. Each section includes multiple topics to help a student gain deeper understanding of the subject. This lab course is well complemented by a theory course under the name medicinal chemistry in the

same semester that helps a student learn and discuss the technical details of the underlying technologies.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Exp 1-6
P-2	15 Marks	Exp 7-12
Attendance & Discipline	15 Marks	
Practical Records	15 Marks	
Day to Day Activity	40 Marks	
Total	**100 Marks**	

Learning Resources: Study material of Environmental Engineering Lab (will be added time to time): Digital copy will be available on the JUET server.

TEXT BOOKS

[1] Kjonaas, R.A.; Williams, P.E.; Counce, D.A.; Crawley, L.R. **Synthesis of Ibuprofen**. J. Chem. Educ., 2011, 88 (6), pp 825–828 DOI: 10.1021/ed100892p.

[2] Marsh, D.G.; Jacobs, D.L.; Veening, H. **Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry**. J. Chem. Educ., 1973, 50 (9), p 626. DOI: 10.1021/ed050p626

Industrial Chemistry Lab

Title: Industrial Chemistry Lab **Code**: BS1CH572

L-T-P scheme: 0-0-2 **Credit**: 1

Prerequisite: NIL

Objective:

The objective of this course is to give the students a basic idea of the different types of industrial pollution in the environment. This course also gives them the idea about how to handle industrial pollution problems.

Course Learning Outcomes:

Course Outcome	Description
CO1	Outline different types of pollutants
CO2	Understand the causes of pollution and their harmful effects.
CO3	Describe various equipments related to air pollution and water pollution control
CO4	Implement expressions for the estimating the efficiency of various air pollution control equipments.
CO5	Apply appropriate equations for the design of water pollution control equipments.
CO6	Demonstrate the working of various equipments related to pollution control.

CONTENT:

[1] Determination of dissolved oxygen in water.

[2] Determination of Chemical Oxygen Demand (COD).

[3] Determination of Biological Oxygen Demand (BOD).

[4] Percentage of available chlorine in bleaching powder.

[5] Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).

[6] Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.

[7] Measurement of dissolved CO_2

[8] Determination of hexavalent Chromium Cr(VI) concentration in tannery wastes/waste water sample using UV-Vis spectrophotometry technique.

[9] Preparation of borax/ boric acid

Teaching Methodology: This course is introduced to help students understand basic principles of air and water pollution along with the design of air pollution and water pollution control equipment. The entire course is broken down into following separate units: Introduction, Air pollution, Water pollution and Noise pollution. Each section includes multiple topics to help a student gain deeper understanding of the subject. This lab course is well complemented by a theory course under the name Environmental Engineering in the same semester that helps a student learn and discuss the technical details of the underlying technologies.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Exp 1-6
P-2	15 Marks	Exp 7-12
Attendance & Discipline	15 Marks	
Practical Records	15 Marks	
Day to Day Activity	40 Marks	
Total	**100 Marks**	

Learning Resources: Study material of Environmental Engineering Lab (will be added time to time): Digital copy will be available on the JUET server.

TEXT BOOKS

[1] Vowles, P.D.; Connell, D.W. (1980),**Experiments in Environmental Chemistry: A Laboratory Manual**, Vol.4, Pergamon Series in Environmental Science.

[2] Gopalan, R.; Anand, A.; Sugumar R.W. (2008),**A Laboratory Manual for Environmental Chemistry**, I. K. International.

SEMESTER VI

Analytical Chemistry

Title: Analytical Chemistry **Code: BS1CH601**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of basic Inorganic, Physical and Organic Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Graduate LEVEL.

Objective:

Fundamental understanding on the principle of operation, sources of error and correct interpretation of results using appropriate analytical techniques will be aimed.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning. Students will be learns the various Analytical Technique for application in advance chemistry.
CO2	Describe the real-world problems, challenges with the application of the Analytical Chemistry. Advanced analytical techniques along with the instrumentation part will enable students to perform optimal use of these techniques efficiently to their advantage and will be useful for getting in chemical industries.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Chemistry.
CO4	Identify and use various analytical techniques in characterization and application.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1

Analytical techniques (Instrumentation and Applications)

(i) **Electroanalytical methods:-** Polarography (DC, AC and pulse), cyclic voltammetry, coulometry and anode stripping voltammetry.

(ii) **Optical methods:-** UV/Visible, X-ray photoelectron spectroscopy (XPS), Auger Electron Spectroscopy (AES), ESCA, Atomic absorption and emission spectroscopy.

(iii) Infrared Spectroscopy, Dispersive and Fourier Transformed Raman, Resonance Raman and Surface Enhanced Raman Spectroscopy- Dispersive and Fourier Transformed.

(iv) **Hifanated Techniques:** GC-IR, TG-IR Spectroscopy, GC-Mass Spectroscopy (v) Imaging Techniques: Electron microscopy (SEM, TEM)

Unit 2:

Diffraction, Separation and Thermal Methods

(i) Diffraction Methods: Single crystal and Powder X–Ray Diffraction and their applications for Inorganic Compounds, Neutron Diffraction and Electron Diffraction.

(ii) Separation Methods: Theory and applications of separation methods in analytical chemistry: solvent extraction, ion exchangers including liquid ion exchangers and chromatographic methods for identification and estimation of multicomponent systems (such as TLC, GC, HPLC, etc.).

(iii)Thermal Methods: TG, DTA, DSC and thermometric titrations.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand the various Analytical Technique for analysis of chemical compound. The entire syllabus has divided into two units. Each section includes multiple topics to help a student gain a deeper understanding. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2

Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] West, A.R. Solid State Chemistry & its Applications, John Wiley & Sons (1987).

[2] West, A.R. Basic Solid State Chemistry, 2nd Edition, John Wiley & Sons (2000).

[3] Smart, L.E. & Moore, E.A. Solid State Chemistry - An Introduction, 3rd Edition, CRC Press (2005).

[4] Rodgers, G.E. Descriptive Inorganic, Coordination & Solid-State Chemistry, 3rd Edition, Brooks/Cole, Cengage learning (2002).

[5] Tilley, R.J.D. Understanding Solids: The science of materials. , 2nd Edition, John Wiley & Sons (2004).

[6] Christian, G. D., Analytical Chemistry, 6th Ed., John Wiley & Sons, Inc. (2004).

[7] Skoog, D. A., West, D. M., Holler, R. J & Nieman, T. A. Principles of Instrumental Analysis Saunders Golden Sunburst Series (1997).

[8] Willard, H. H., Merritt, L. L., Dean, J. A. & Settle, F. A. (Eds.) Instrumental Methods of Analysis - 7th Ed., Wadsworth Publishing (1988) ISBN 0534081428

[9] Cullity, B.D. & Stock, S.R. Powder X-Ray Diffraction, 3rd edition, Kindle Publisher 2001.

[10] Stout, G.H. & Jensen, L. H. X- Ray structure Determination A Practical Guide IIed (John Wiley & Sons), 1989.

Medicinal Chemistry II

Title: Médicinal Chemistry II **Code: BS1CH602**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of the basic organic chemistry. Basic knowledge of synthesis of organic compound helps them to correlate in pharmaceutical industry.

Objective:

Cosmetic plays an important role in our everyday lives as they make an individual's appearance more attractive and boost one's self-esteem and confidence. Keeping in view the tremendous potential which the cosmetic industry has today around the globe, this course will be useful for introducing students of Chemistry honours to the world of cosmetic chemistry. This has been designed to impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products..

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with Learn basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products..
CO2	Describe the real world problems, challenges to understand cosmetics industry. Learn the use of safe, economic and body-friendly cosmetics
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in chemical industry. Prepare new innovative formulations.
CO4	Identify and use of various techniques for solving chemical industry. Prepare new innovative formulations.
CO5	Apply filed visit and justification by using various analytical techniques.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies and help to develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

COURSE CONTENT

Unit 1:

Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, Regulations.

Unit 2:

Face Preparation: Structure of skin, Face powder, Compact powder, Talcum powder.

Unit 3:

Skin Preparation: Face cream, vanishing cream, cold cream, suntan cream, lather shaving cream.

Unit 4:

Hair preparation: Structure of hair, classification of hair, Hair dye- classification – temporary, semipermanent, demi permanent, permanent, formulation, hair sprays, shampoo- types of shampoo, conditioners.

Unit 5:

Colored preparation: Nail preparation Structure of nail, Nail lacquers, Nail polish remover Lipsticks.

Unit 6:

Personal hygiene products: Antiperspirants and deodorants, oral hygiene products, flavours and essential Oils.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand the various Analytical Technique for analysis of chemical compound. The entire syllabus has divided into two units. Each section includes multiple topics to help a student gain a deeper understanding. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around

		20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Barel, A.O.; Paye, M.; Maibach, H.I.(2014),**Handbook of Cosmetic Science and Technology,** CRC Press.

[2] Garud, A.; Sharma, P.K.; Garud, N. (2012),**Text Book of Cosmetics**, Pragati Prakashan.

[3] Gupta, P.K.; Gupta, S.K.(2011),**Pharmaceutics and Cosmetics**, Pragati Prakashan

[4] Butler, H. (2000),**Poucher's Perfumes, Cosmetic and Soap**, Springer

[5] Kumari, R.(2018),**Chemistry of Cosmetics**, Prestige Publisher.

Additional Resources:

[1] Flick,E.W.(1990),**Cosmetic and toiletry formulations,** Noyes Publications / William Andrew Publishing.

[2] Natural Ingredients for Cosmetics; EU Survey 2005

[3] Formulation Guide for cosmetics; The Nisshin OilliO Group, Ltd.

[4] Functional Ingredients & Formulated Products for Cosmetics & Pharmaceuticals; NOF Corporation